BASCOM AVR

Help Reference

Version 1.11.8.3 build 8

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Dear reader.

Thank you for your interest in BASCOM.

BASCOM was "invented" in 1995. It was intended for personal usage only. I decided to make it public as I found no other tool that was so simple to use. Since that time, a lot of options and extensions were added. Without the help and patience of the many users, BASCOM would not be what it is today : "the best and most affordable tool for fast proto typing".

We hope that BASCOM will contribute in making your work with microprocessors Easy and enjoyable.

While there is not enough space to mention all contributors, there is one that must be mentioned : Josef Franz Vögel. He wrote the Trig libraries, the AVR-DOS file system and the DOUBLE library.

The MCS Electronics Team

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Keyword Reference

1WIRE
1Wire routines allow you to communicate with Dallas 1wire chips.
1WRESET , 1WREAD , 1WWRITE , 1WSEARCHFIRST , 1WSEARCHNEXT ,1WVERIFY , 1WIRECOUNT

Conditions
Conditions execute a part of the program depending on a condition being True or False
IF-THEN-ELSE-END IF , WHILE-WEND , ELSE , DO-LOOP , SELECT CASE - END SELECT , FOR-NEXT

Configuration
Configuration commands initialize the hardware to the desired state.
CONFIG , CONFIG ACI , CONFIG ADC , CONFIG BCCARD , CONFIG CLOCK , CONFIG COM1 , CONFIG COM2 , CONFIG DATE , CONFIG PS2EMU , CONFIG ATEMU , CONFIG I2CSLAVE , CONFIG GRAPHLCD , CONFIG KEYBOARD , CONFIG TIMER0 , CONFIG TIMER1 , CONFIG LCDBUS , CONFIG LCDMODE , CONFIG 1WIRE , CONFIG LCD , CONFIG SERIALOUT , CONFIG SERIALOUT1 , CONFIG SERIALIN , CONFIG SERIALIN1 , CONFIG SPI , CONFIG LCDPIN , CONFIG SDA , CONFIG SCL , CONFIG DEBOUNCE , CONFIG WATCHDOG , CONFIG PORT , COUNTER0 AND COUNTER1 , CONFIG TCPIP , CONFIG TWISLAVE , CONFIG SINGLE

Conversion
A conversion routine is a function that converts a number or string from one form to another.
BCD , GRAY2BIN , BIN2GRAY , BIN , MAKEBCD , MAKEDEC , MAKEINT , FORMAT , FUSING , BINVAL , CRC8 , CRC16 , CRC32 , HIGH , HIGHW , LOW

DateTime
Date Time routines can be used to calculate with date and/or times.
DATE , TIME , DATE$, TIME$, DAYOFWEEK , DAYOFYEAR , SECOFDAY , SECELAPSED , SYSDAY , SYSSEC , SYSSECELAPSED

Delay
Delay routines delay the program for the specified time.
WAIT , WAITMS , WAITUS , DELAY

Directives
Directives are special instructions for the compiler. They can override a setting from the IDE.
$ASM , $BAUD , $BAUD1 , $BGF , $BOOT , $CRYSTAL , $DATA , $DBG , $DEFAULT , $EEPLEAVE , $EEPROM , $EEPROMHEX , $EXTERNAL , $HWSTACK , $INC , $INCLUDE , $INITMICRO , $LCD , $LCDRS , $LCDPUTCTRL , $LCDPUTDATA , $LCDVFO , $LIB , $LOADER , $LOADERSIZE , $MAP , $NOINIT , $NORAMCLEAR , $PROG , $PROGRAMMER , $REGFILE , $ROMSTART $SERIALINPUT, $SERIALINPUT1 , $SERIALINPUT2LCD , $SERIALOUTPUT , $SERIALOUTPUT1 , $SIM , $SWSTACK , $TIMEOUT , $TINY , $WAITSTATE , $XRAMSIZE , $XRAMSTART , $XA

File
File commands can be used with AVR-DOS, the Disk Operating System for AVR.
BSAVE , BLOAD , GET , VER , DISKFREE , DIR , DriveReset , DriveInit , LINE INPUT , INITFILESYSTEM , EOF , WRITE , FLUSH , FREEFILE , FILEATTR , FILEDATE , FILETIME , FILEDATETIME , FILELEN , SEEK , KILL , DriveGetIdentity , DriveWriteSector ,

DriveReadSector , LOC , LOF , PUT , OPEN , CLOSE

Graphical LCD
Graphical LCD commands extend the normal text LCD commands.
GLCDCMD , GLCDDATA , SETFONT , LINE , PSET , SHOWPIC , SHOWPICE , CIRCLE , BOX

I2C
I2C commands allow you to communicate with I2C chips with the TWI hardware or with emulated I2C hardware.
I2CINIT , I2CRECEIVE , I2CSEND , I2CSTART,I2CSTOP,I2CRBYTE,I2CWBYTE

IO
I/O commands are related to the I/O pins and ports of the processor chip.
ALIAS , BITWAIT , TOGGLE , RESET , SET , SHIFTIN , SHIFTOUT , DEBOUNCE , PULSEIN , PULSEOUT

Micro
Micro statements are specific to the micro processor chip.
IDLE , POWERDOWN , POWERSAVE , ON INTERRUPT , ENABLE , DISABLE , START , END , VERSION , CLOCKDIVISION , CRYSTAL , STOP

Memory
Memory functions set or read RAM , EEPROM or flash memory.
WRITEEEPROM , CPEEK , CPEEKH , PEEK , POKE , OUT , READEEPROM , DATA , INP , READ , RESTORE , LOOKDOWN , LOOKUP , LOOKUPSTR , CPEEKH , LOAD , LOADADR , LOADLABEL , LOADWORDADR , MEMCOPY

Remote Control
Remote control statements send or receive IR commands for remote control.
RC5SEND , RC6SEND , GETRC5 , SONYSEND

RS-232
RS-232 are serial routines that use the UART or emulate a UART.
BAUD , BAUD1, BUFSPACE , CLEAR, ECHO , WAITKEY , ISCHARWAITING , INKEY , INPUTBIN , INPUTHEX , INPUT , PRINT , PRINTBIN , SERIN , SEROUT , SPC

SPI
SPI routines communicate according to the SPI protocol with either hardware SPI or software emulated SPI.
SPIIN , SPIINIT , SPIMOVE , SPIOUT

String
String routines are used to manipulate strings.
ASC , UCASE , LCASE , TRIM , SPLIT , LTRIM , INSTR , SPACE , STRING , RTRIM , LEFT , LEN , MID , RIGHT , VAL , STR , CHR , CHECKSUM , HEX , HEXVAL

TCP/IP

TCP/IP routines can be used with the W3100/IIM7000/IIM7010 modules.
BASE64DEC , BASE64ENC , IP2STR , UDPREAD , UDPWRITE , UDPWRITESTR , TCPWRITE , TCPWRITESTR , TCPREAD , GETDSTIP , GETDSTPORT , SOCKETSTAT , SOCKETCONNECT , SOCKETLISTEN , GETSOCKET , CLOSESOCKET , SETTCP , GETTCPREGS , SETTCPREGS , SETIPPROTOCOL

Text LCD

Text LCD routines work with normal text based LCD displays.
HOME , CURSOR , UPPERLINE , THIRDLINE , INITLCD , LOWERLINE , LCD , LCDAT , FOURTHLINE , DISPLAY , LCDCONTRAST , LOCATE , SHIFTCURSOR , DEFLCDCHAR , SHIFTLCD , CLS

Trig & Math

Trig and Math routines work with numeric variables.
ACOS , ASIN , ATN , ATN2 , EXP , RAD2DEG , FRAC , TAN , TANH , COS , COSH , LOG , LOG10 , ROUND , ABS , INT , MAX , MIN , SQR , SGN , POWER , SIN , SINH , FIX , INCR , DECR , DEG2RAD

Various

This section contains all statements that were hard to put into another group
CONST , DBG , DECLARE FUNCTION , DEBUG, DECLARE SUB , DEFXXX , DIM , DTMFOUT , EXIT , ENCODER , GETADC , GETKBD , GETATKBD , GETRC , GOSUB , GOTO , LOCAL ,ON VALUE , POPALL , PS2MOUSEXY , PUSHALL , RETURN , RND , ROTATE , SENDSCAN , SENDSCANKBD , SHIFT , SOUND , STCHECK , SUB , SWAP , VARPTR , X10DETECT , X10SEND , READMAGCARD , REM , BITS , BYVAL , CALL , #IF , #ELSE , #ENDIF

Installation

Installation of BASCOM

After you have downloaded the ZIP file you need to UNZIP the file.
On Windows XP, for the DEMO version, run the setupdemo.exe file from within the Zipped file.

The commercial version comes with a license file in the form of a dll. This file is always on the disk where the file SETUP.EXE is located. When explorer does not show this file, you must set the option in explorer to view system files(because a DLL is a system file).
For the commercial version the setup file is named SETUP.EXE

Some resellers might distribute the DLL file in a zipped file. Or the file might have the extension of a number like "123". In this case you must rename the extension to DLL.

Make sure the DLL is in the same directory as the SETUP.EXE file.

When you are using the DEMO version you don't need to worry about the license file.

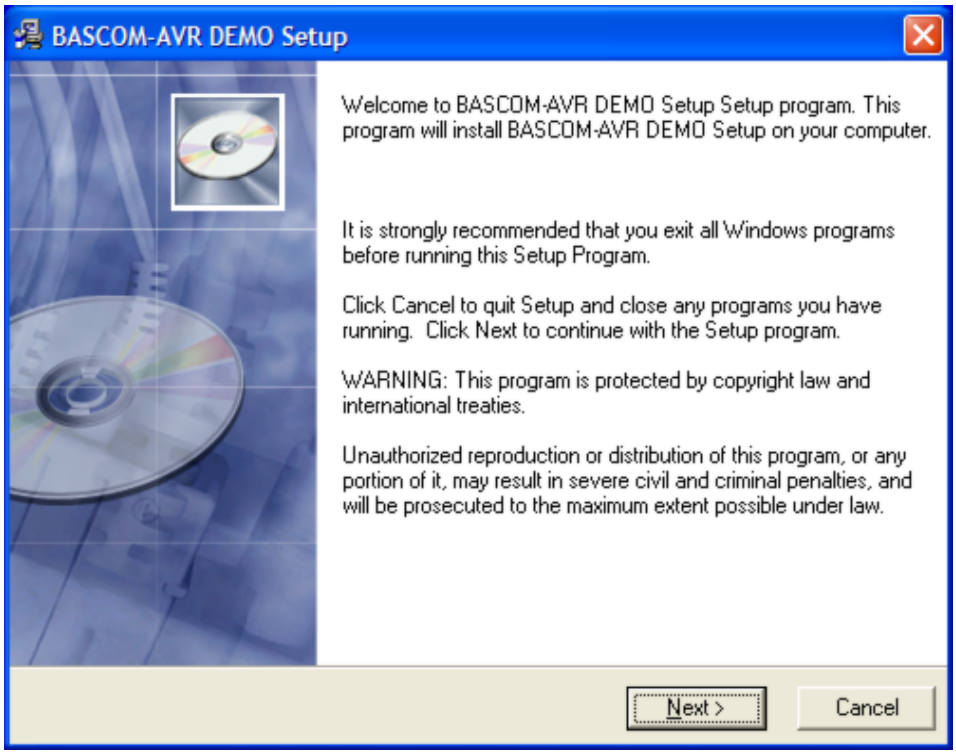
When you are installing on a NT machine like NT4 , W2000 or XP, you need to have Administrator rights.

After installing BASCOM you must run BASCOM once as an administrator.After that you may run BASCOM as restricted user.

The installation example will describe how the DEMO version installs. This is almost identical to the installation of the commercial version.
Now run the SETUPDEMO.EXE (or SETUP.EXE) by double clicking on it in explorer.

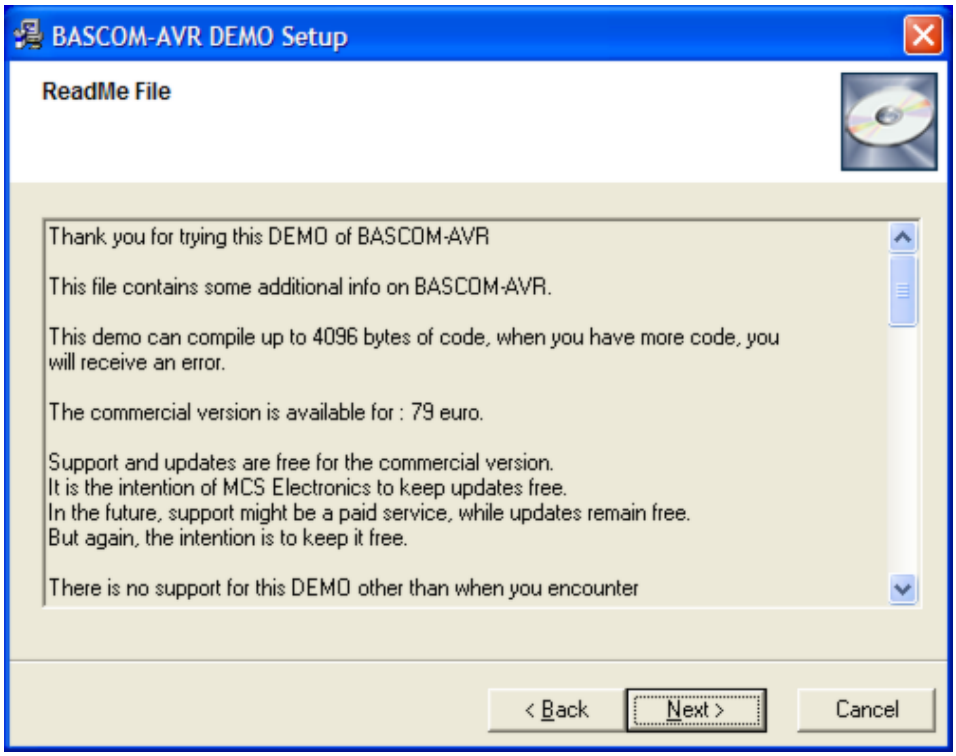
The following window will appear:

(screen shots may differ a bit)



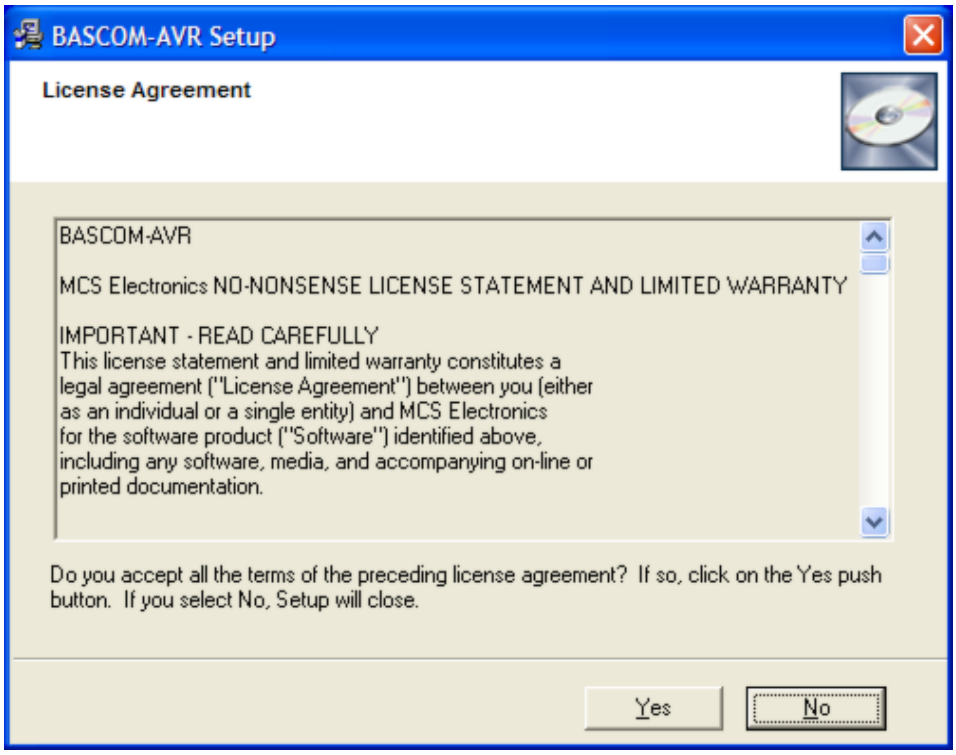
Click on the **Next button** to continue installation.

The following license info window will appear:



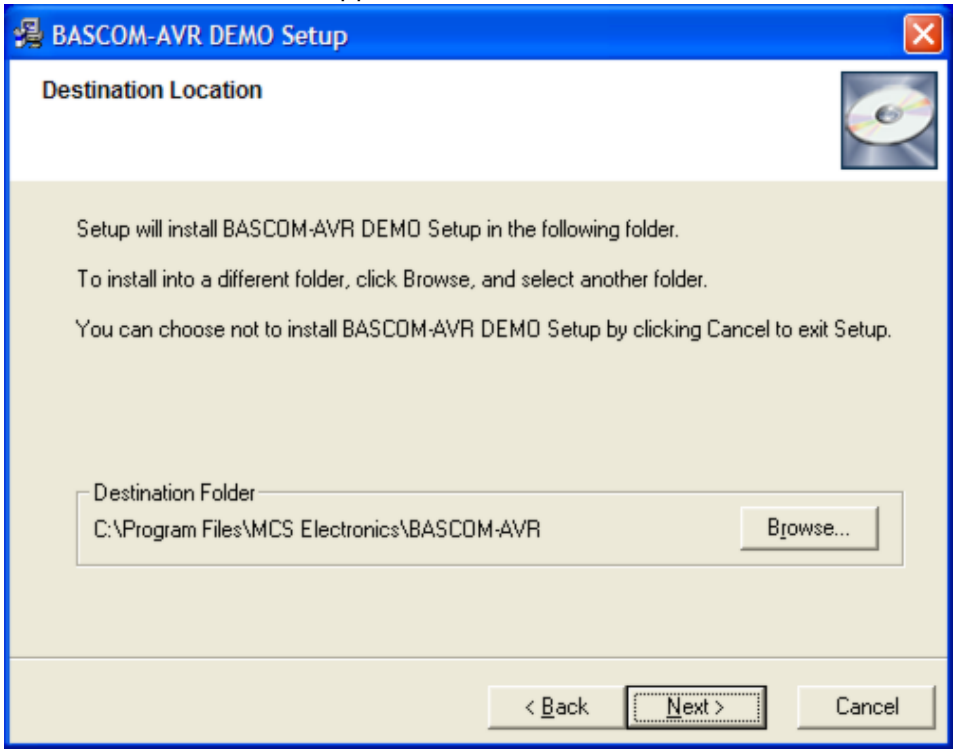
Read the instructions and press the **Next button**.

The following window will be shown :



Read the license agreement and click the **Yes button** when you agree.

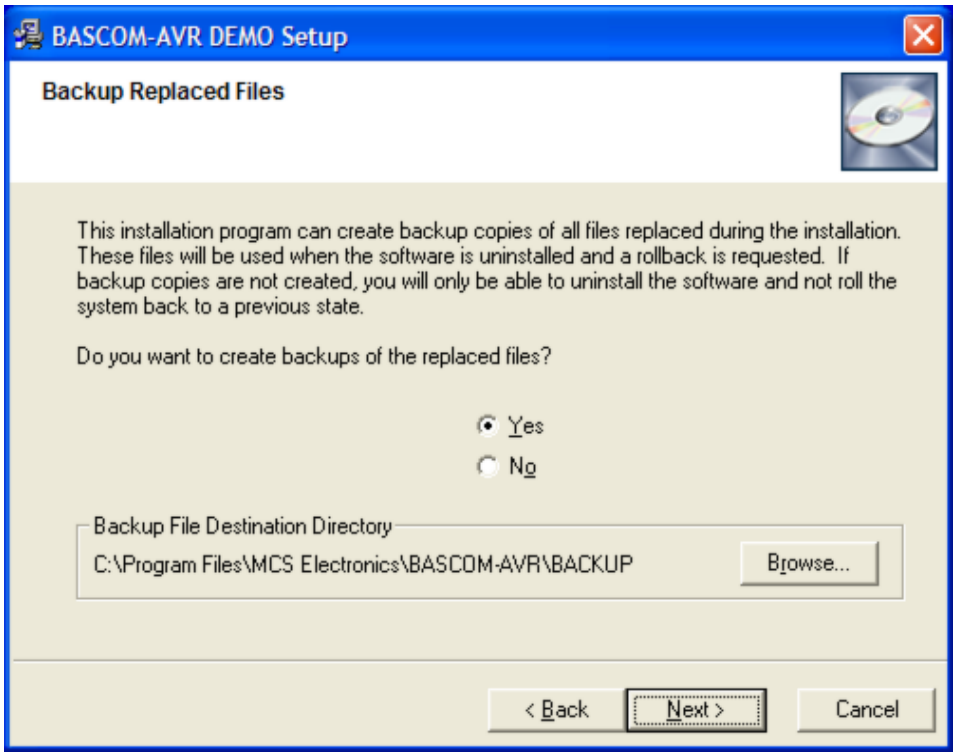
Now the next screen will appear:



You can select the drive and path where you like BASCOM to be installed. You can also accept the default value which is :
C:\Program Files\MCS Electronics\BASCOM-AVR

When you are finished click the **Next Button** to continue.

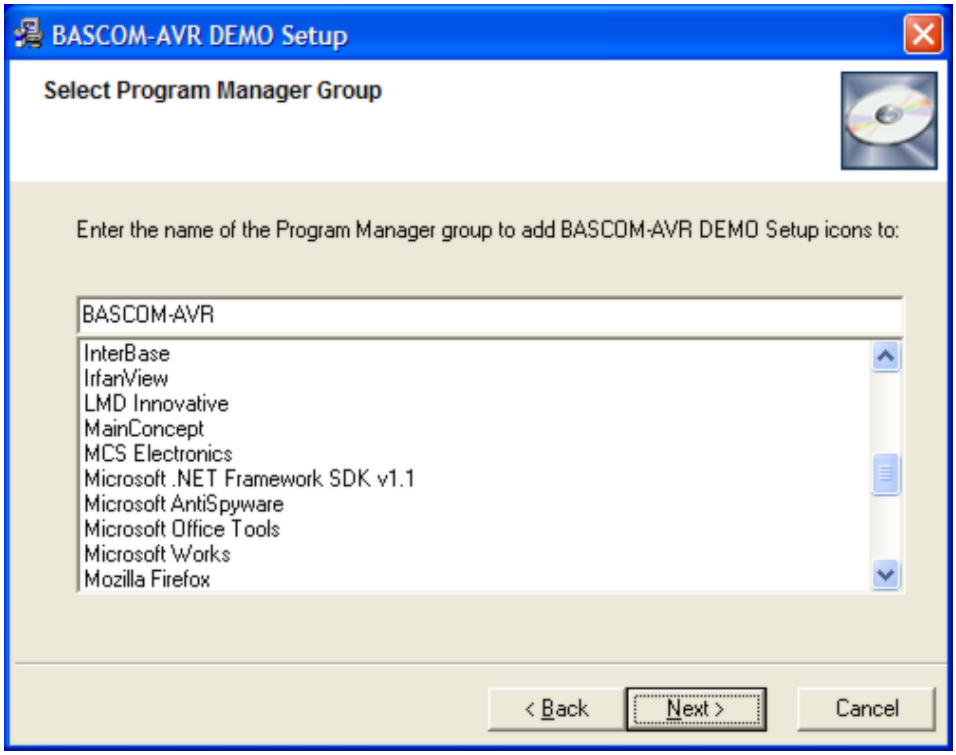
You will now see the following window:



You can choose if the setup program must make a backup of the files it will replace.
By default, all files are installed into the BASCOM application directory or it's subdirectories.
It is advised to backup replaced files.

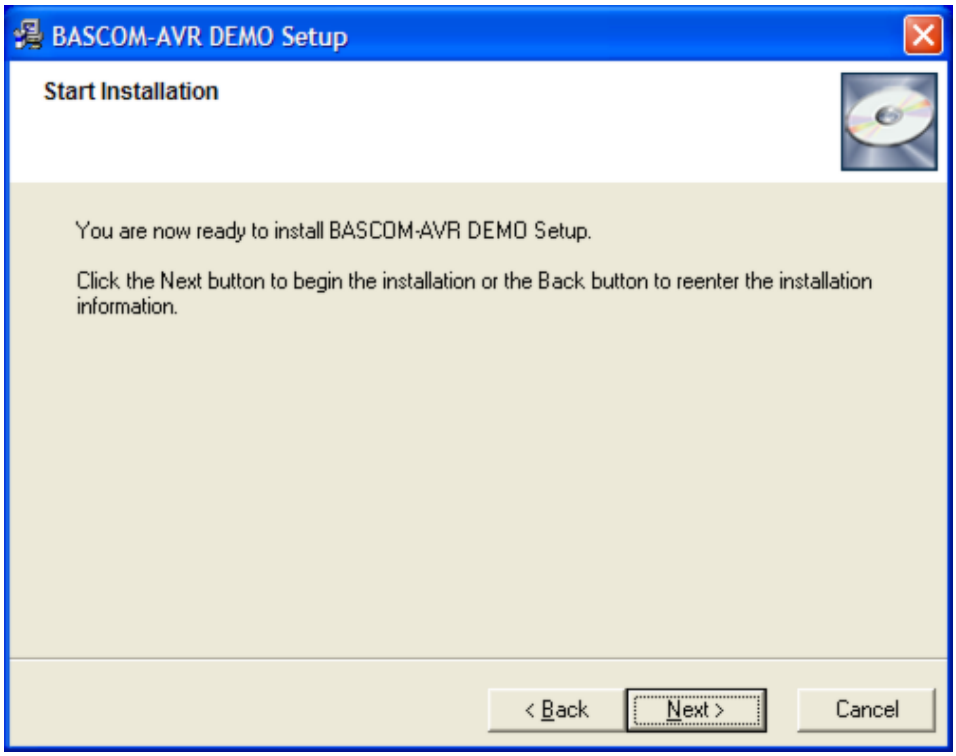
Click the **Next-button** after you have made your choice.

Now you get the next screen where you can select the Program Group:



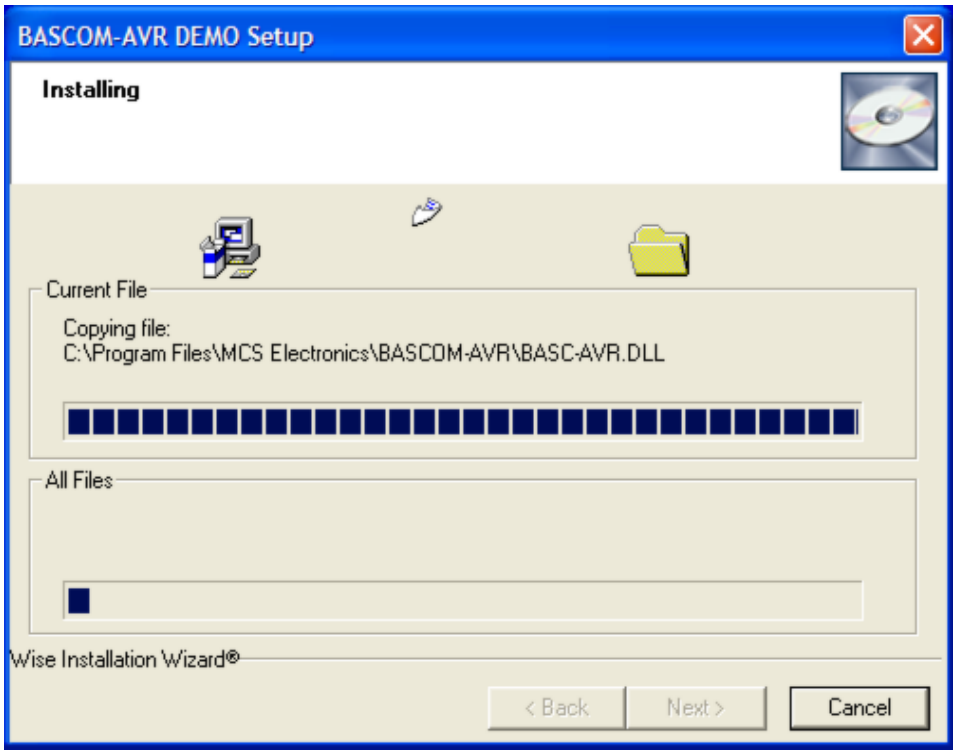
You can choose to create into a new Program Group named 'BASCOM-AVR' , or you can modify the name, or install into an existing Program Group. Press the **Next-button** after you have made your choice.

Now the following window appears:

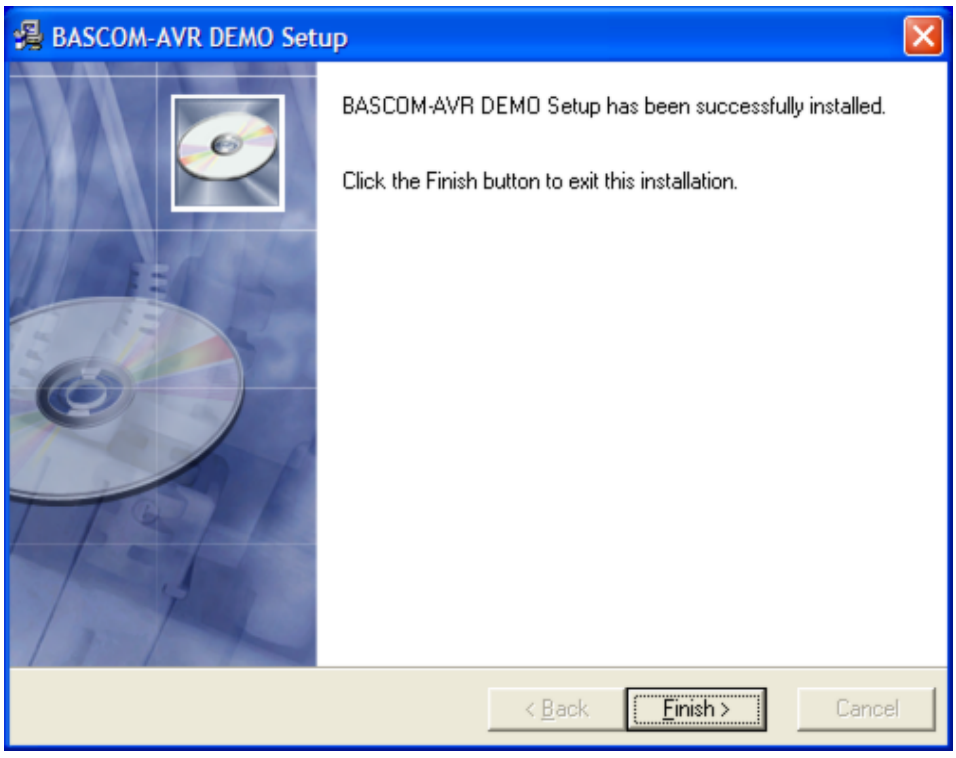


This window will inform you that setup knows all details to perform the installation.
You need to click the Next-button once more to actual perform the installation.

During the installation you will see a progress window :

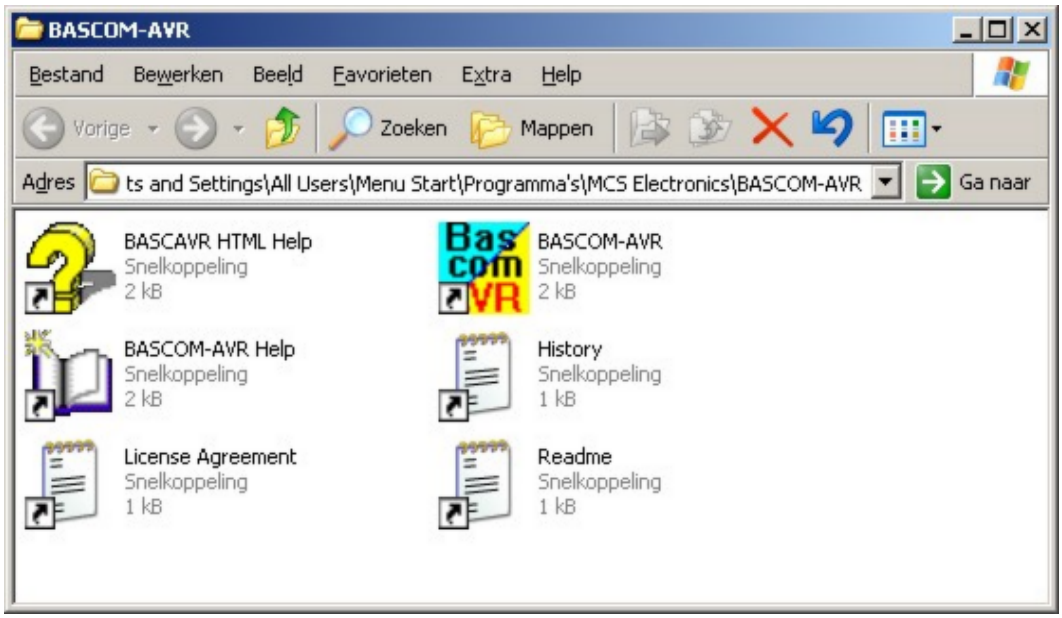


When the installation is ready you will see the last screen :



You need to click the Finish button to close the setup program.

The BASCOM-AVR Program folder is created:



You can view the read me and license file content and you can start BASCOM-AVR.

BASCOM IDE

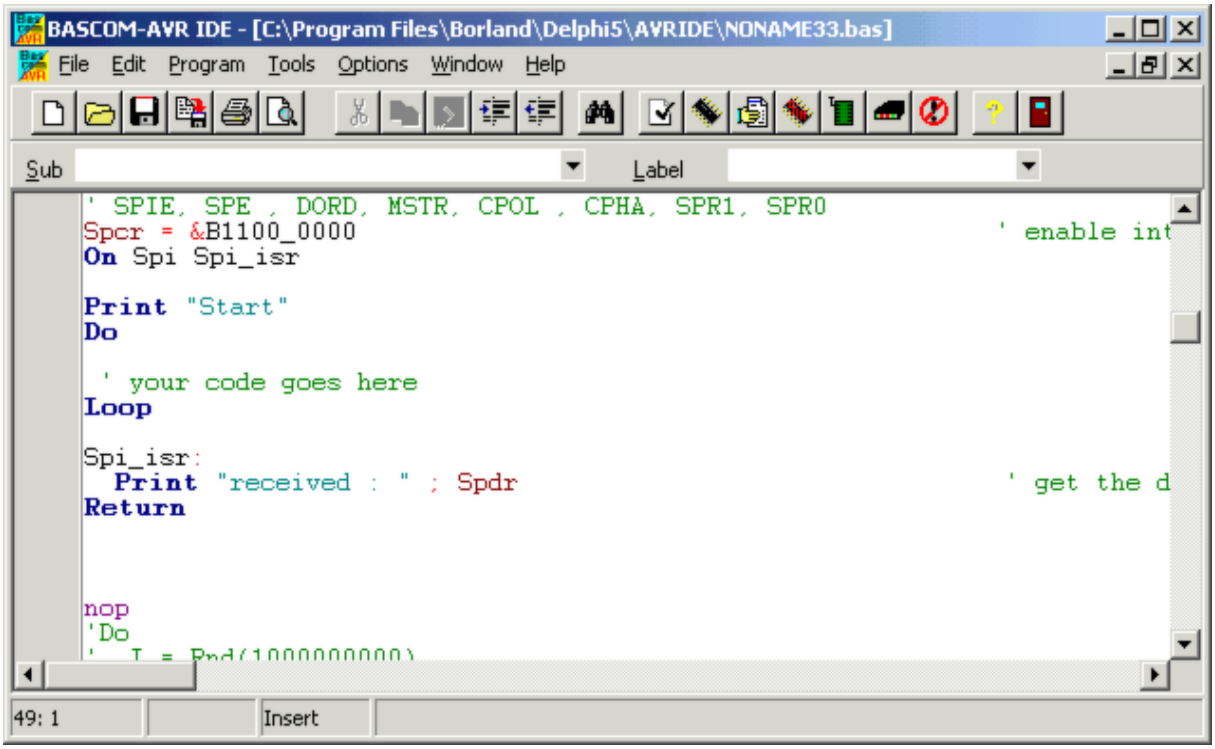
Running BASCOM-AVR

After you have installed BASCOM, you will find a program entry under *MCS Electronics\BASCOM-AVR*

Double-click the BASCOM-AVR icon

to run BASCOM.

The following window will appear. (If this is your first run, the edit window will be empty.)



The most-recently opened file will be loaded automatically. Like most Windows programs, there is a menu and a toolbar. The toolbar can be hidden so you will have more screen space. The toolbar allows you to have quick access to the various program functions.

File New

This option creates a new window in which you will write your program.
The focus is set to the new window.
You can have multiple windows open at the same time.
Only one window can have the focus. When you execute other functions such as Simulate or Program Chip, BASCOM will use the files that belong to the current active program. This is in most cases the program which has the focus.

File new shortcut: , CTRL + N

File Open

With this option you can load an existing program from disk.

BASCOM saves files in standard ASCII format. Therefore, if you want to load a file that was made with another editor be sure that it is saved as an ASCII file. Most programs allow you to export the file as a DOS or ASCII file.

Note that you can specify that BASCOM must reformat the file when it opens it with the Options Environment option. This should only be necessary when loading files made with another editor.

File open shortcut : , CTRL+O

File Close

Close the current program.

The current editor window will be closed. When you have made changes to the program, you will be asked to save the program first. You can then decide to save, cancel, or not to save the changes you have made.

File close shortcut :

File Save

With this option, you save your current program to disk under the same file name.
The file name is visible in the Windows caption of the edit window.

If the program was created with the File New option, you will be asked to name the file first. Use the File Save As option to give the file another name.

Note that the file is saved as an ASCII file.

File save shortcut : , CTRL+S

File Save As

With this option, you can save your current program to disk under a different file name. When you want to make some changes to your program, but you do not want to make changes to the current version you can use the "Save As" option. It will leave your program as it was saved, and will create a new file with a new name so you end up with two copies. You then make changes to the new created file.

Note that the file is saved as an ASCII file.

File save as shortcut :

File Print Preview

With this option, you can preview the current program before it is printed.
Note that the current program is the program that has the focus.

File print preview shortcut :

File Print

With this option, you can print the current program.
Note that the current program is the program that has the focus.

File print shortcut : , CTRL+P

File Exit

With this option, you can leave BASCOM.
If you have made changes to your program, you can save them upon leaving BASCOM.

All of the files you have open, at the moment you choose exit, will be remembered.
The next time you run BASCOM, they will be opened automatically.

File exit shortcut :

Edit Undo

With this option, you can undo the last text manipulation.

Edit Undo shortcut : , CTRL+Z

Edit Redo

With this option, you can redo the last undo.

Edit Redo shortcut : , CTRL+SHIFT+Z

Edit Cut

With this option, you can cut selected text into the clipboard.

Edit cut shortcut : , CTRL+X

Edit Copy

With this option, you can copy selected text into the clipboard.

Edit copy shortcut : , CTRL+C

Edit Paste

With this option, you can paste text from the clipboard starting at the current cursor position.

Edit paste shortcut : , CTRL+V

Edit Find

With this option, you can search for text in your program.
Text at the current cursor position will automatically be placed in the find dialog box.

Edit Find shortcut : , CTRL+F

Edit Find Next

With this option, you can search again for the last specified search item.
Edit Find Next shortcut : , F3

Edit Replace

With this option, you can replace selected text in your program.

Edit Replace shortcut : , CTRL+R

Edit Goto

With this option, you can immediately go to a specified line number.

Edit go to line shortcut : ,CTRL+G

Edit Toggle Bookmark

With this option, you can set/reset a bookmark, so you can jump in your code with the Edit Go to Bookmark option. Shortcut : CTRL+K + x where x can be 1-8

Bookmarks are stored in a file named <project>.BM

Edit Goto Bookmark

With this option, you can jump to a bookmark.

There can be up to 8 bookmarks. Shortcut : CTRL+Q+ x where x can be 1-8

Bookmarks are stored in a file named <project>.BM

Edit Indent Block

With this option, you can indent a selected block of text.

Edit Indent Block shortcut : , CTRL+SHIFT+I

Edit Unindent Block

With this option, you can un-indent a block.

Edit Unindent Block shortcut : , CTRL+SHIFT+U

Edit Remark Block

With this option, you can Remark or Unremark a selected block of text.
While you can use **'(** and **')** to remark a block of code, you might prefer the old BASIC way using just one **'** .
When a remark is found, it will be removed. When there is no remark, it will insert a remark.

Program Compile

With this option, you can compile your current program.

Your program will be saved automatically before being compiled.

The following files will be created depending on the Option Compiler Settings.

File	Description
xxx.BIN	Binary file which can be programmed into the microprocessor.
xxx.DBG	Debug file that is needed by the simulator.
xxx.OBJ	Object file for simulating using AVR Studio. Also needed by the internal simulator.
xxx.HEX	Intel hexadecimal file, which is needed by some programmers.
xxx.ERR	Error file. Only created when errors are found.
xxx.RPT	Report file.
xxx.EEP	EEPROM image file

If a serious error occurs, you will receive an error message in a dialog box and the compilation will end.

All other errors will be displayed at the bottom of the edit window, just above the status bar.

When you click on the line with the error info, you will jump to the line that contains the error. The margin will also display the sign.

At the next compilation, the error window will disappear or reappear if there are still errors.

Program compile shortcut: , F7

Program Syntax Check

With this option, your program is checked for syntax errors. No file will be created except for an error file, if an error is found.

Program syntax check shortcut , CTRL + F7

Program Show Result

Use this option to view information concerning the result of the compilation.

See the Options Compiler Output for specifying which files will be created.

The files that can be viewed are "report" and "error".

File show result shortcut : ,CTRL+W

Information provided in the report:

Info	Description
Report	Name of the program

Date and time	The compilation date and time.
Compiler	The version of the compiler.
Processor	The selected target processor.
SRAM	Size of microprocessor SRAM (internal RAM).
EEPROM	Size of microprocessor EEPROM (internal EEPROM).
ROMSIZE	Size of the microprocessor FLASH ROM.
ROMIMAGE	Size of the compiled program.
BAUD	Selected baud rate.
XTAL	Selected XTAL or frequency.
BAUD error	The error percentage of the baud rate.
XRAM	Size of external RAM if available.
Stack start	The location in memory, where the hardware stack points to. The HW-stack pointer grows downward.
S-Stacksize	The size of the software stack.
S-Stackstart	The location in memory where the software stack pointer points to. The software stack pointer grows downward.
Framesize	The size of the frame. The frame is used for storing local variables.
Framestart	The location in memory where the frame starts.
LCD address	The address that must be placed on the bus to enable the LCD display E-line.
LCD RS	The address that must be placed on the bus to enable the LCD RS-line
LCD mode	The mode the LCD display is used with. 4 bit mode or 8 bit mode.
LCD DB7-DB4	The port pins used for controlling the LCD in pin mode.
LCD E	The port pin used to control the LCD enable line.
LCD RS	The port pin used to control the LCD RS line.
Variable	The variable name and address in memory
Constant	Constants name and value Some internal constants are : _CHIP : number that identifies the selected chip _RAMSIZE : size of SRAM _ERAMSIZE : size of EEPROM _XTAL : value of crystal _BUILD : number that identifies the version of the compiler

Program Simulate

With this option, you can simulate your program.

You can simulate your programs with AVR Studio or any other Simulator available or you can use the built in Simulator.

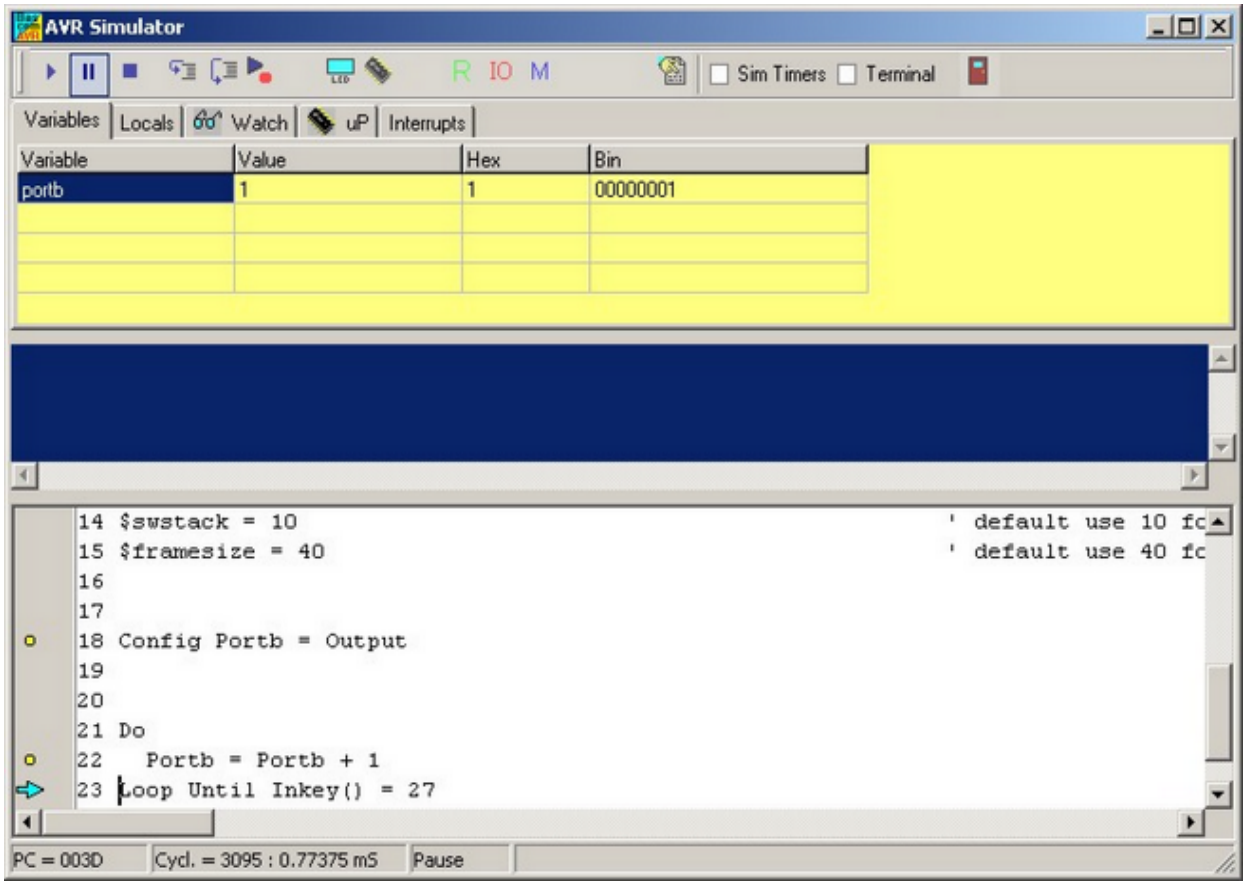
The simulator that will be used when you press F2, depends on the selection you made in the Options Simulator TAB. The default is the built in Simulator.

Program Simulate shortcut : , F2

To use the built in Simulator the files DBG and OBJ must be selected from the Options Compiler Output TAB.

The OBJ file is the same file that is used with the AVR Studio simulator.

The DBG file contains info about variables and many other info needed to simulate a program.



The Simulator window is divided into a few sections:

The Toolbar

The toolbar contains the buttons you can press to start an action.

This is the RUN button, it starts a simulation. You can also press F5. The simulatorion will pause when you press the pause button. It is advised, that you step through your code at the first debug session. When you press F8, you step through the code line by line which is a clearer way to see what is happening.

This is the PAUSE button. Pressing this button will pause the simulation.

This is the STOP button. Pressing this button will stop the simulation. You can't continue from this point, because all of the variables are reset. You need to press the RUN button

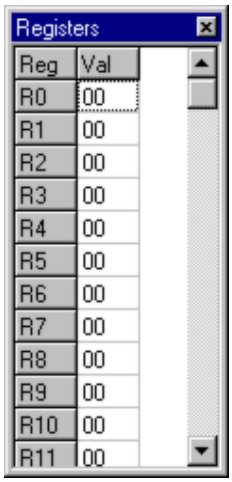
when you want to simulate your program again.

This is the STEP button. Pressing this button (or F8) will simulate one code line of your BASIC program. The simulator will go to the RUN state. After the line is executed the simulator will be in the PAUSE state. If you press F8 again, and it takes a long time too simulate the code, press F8 again, and the simulator will go to the pause state.

This is the STEP OVER button or SHIFT+F8). It has the same effect as the STEP button, but sub programs are executed completely, and th simulator does not step into the SUB program.

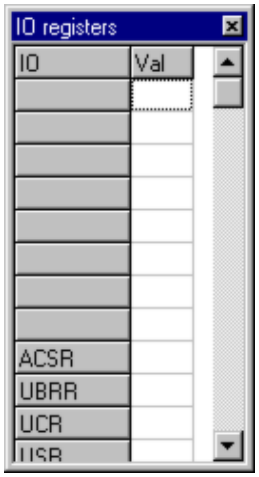
This is the RUN TO button. The simulator will RUN until it gets to the current line. The line must contain executable code. Move the cursor to the desired line before pressing the button.

This button will show the processor registers window.



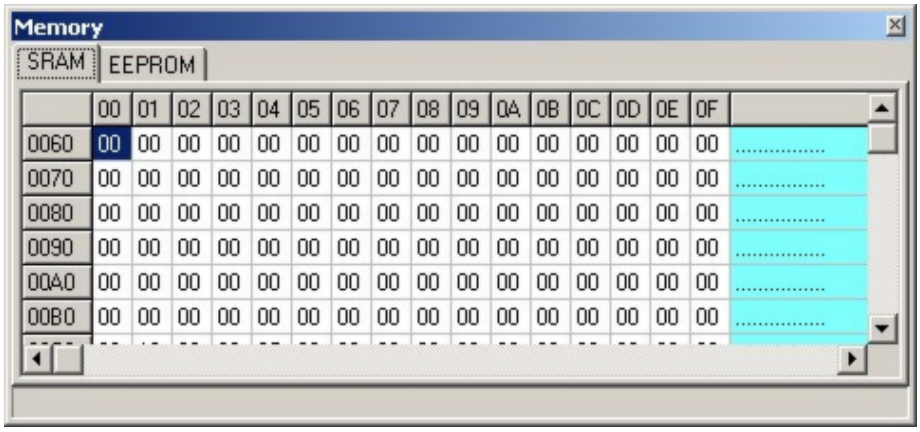
The values are shown in hexadecimal format. To change a value, click the cell in the Val column, and type the new value.

This is the IO button and will show processor Input and Output registers.



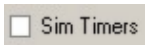
The IO window works similar to the Register window. Blank rows indicate that there is no IO-register assigned to that address. (The blank rows might be deleted later.)

Pressing this button shows the Memory window.

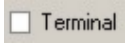


The values can be changed the same way as in the Register window.
When you move from cell to cell you can view in the status bar which variable is stored at that address.
The SRAM TAB will show internal memory and XRAM memory.
The EEPROM TAB will show the memory content of the EEPROM.

The refresh variables button will refresh all variables during a run (F5). When you use the hardware simulator, the LEDS will only update their state when you have enabled this option. Note that using this option will slow down simulation. That is why it is an option. When you use F8 to step through your code you do not need to turn this option on as the variables are refreshed after each step.



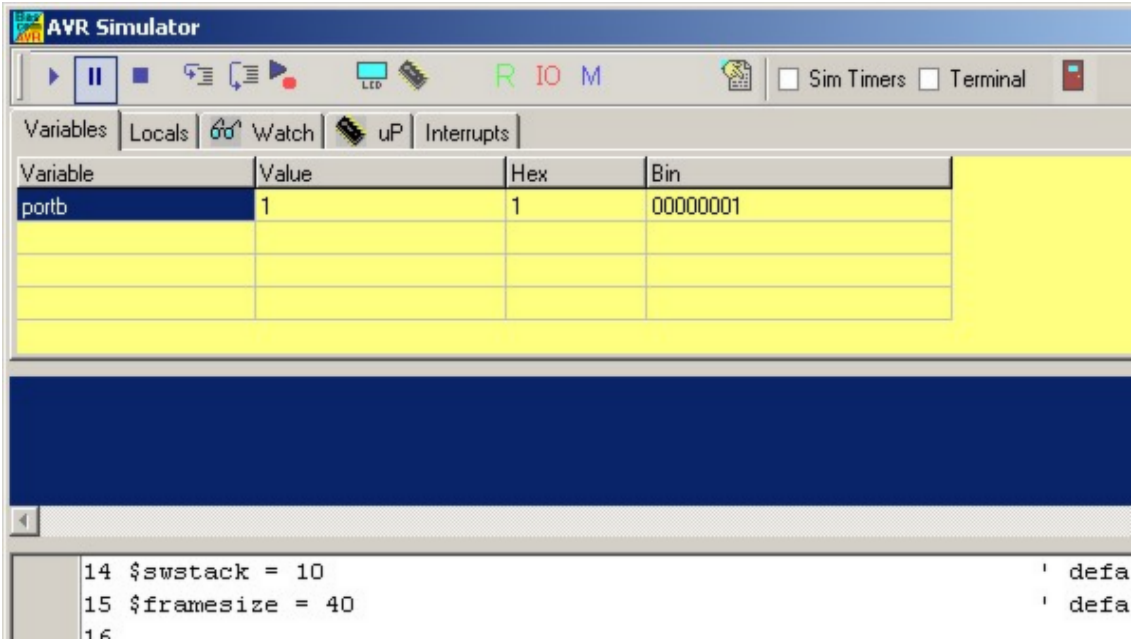
When you want to simulate the processors internal timers you need to turn this option on. Simulating the timers uses a lot of processor time, so you might not want this option on in most cases. When you are debuging timer code it is helpful to simulate the timers.
The simulator supports the basic timer modes. As there are many new chips with new timer modes it is possible that the simulator does not support all modes. When you need to simulate a timer the best option may be to use the latest version of AVR Studio and load the BASCOM Object file.
Even AVR Studio may have some flaws, so the best option remains to test the code in a real chip.



This option allows you to use a real terminal emulator for the serial communication simulation.
Normally the simulator prints serial output to the blue window, and you can also enter data that needs to be sent to the serial port.
When you enable the terminal option, the data is sent to the actual serial port, and when serial data is received by the serial port, it will be shown.

Under the toolbar section there is a TAB with a number of pages:

VARIABLES



This section allows you to see the value of program variables. You can add variables by double clicking in the Variable-column. A list will pop up from which you can select the variable.
To watch an array variable, type the name of the variable with the index.

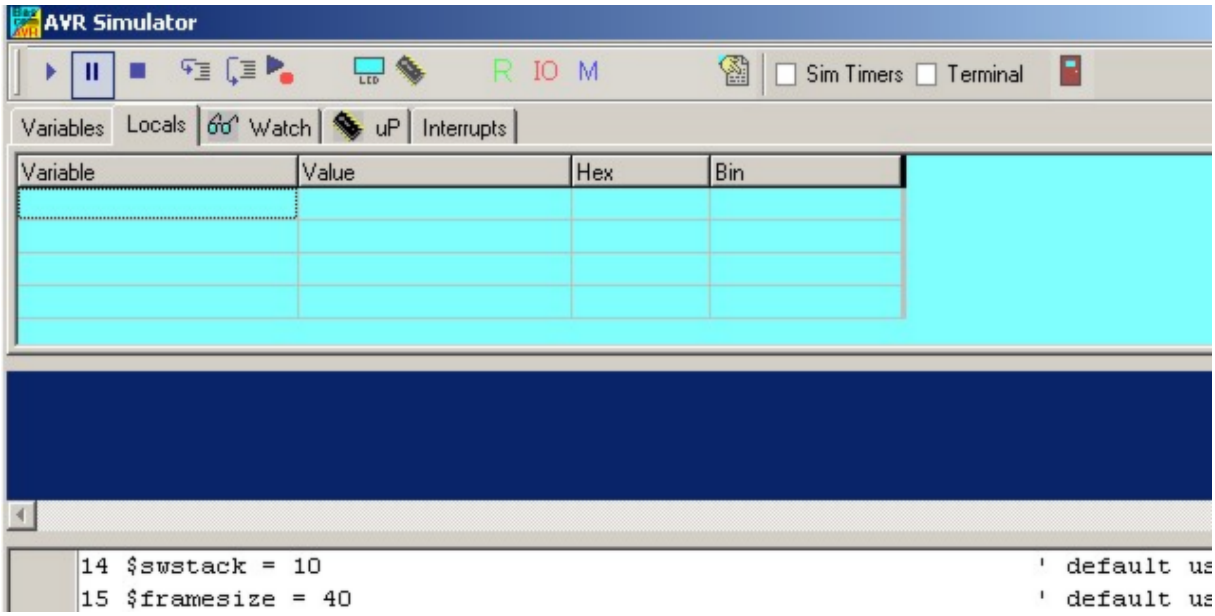
During simulation you can change the values of the variables in the Value-column, Hex-column or Bin-column. You must press ENTER to store the changes.

To delete a variable, you can press CTRL+DEL.

To enter more variables, press the DOWN-key so a new row will become visible.

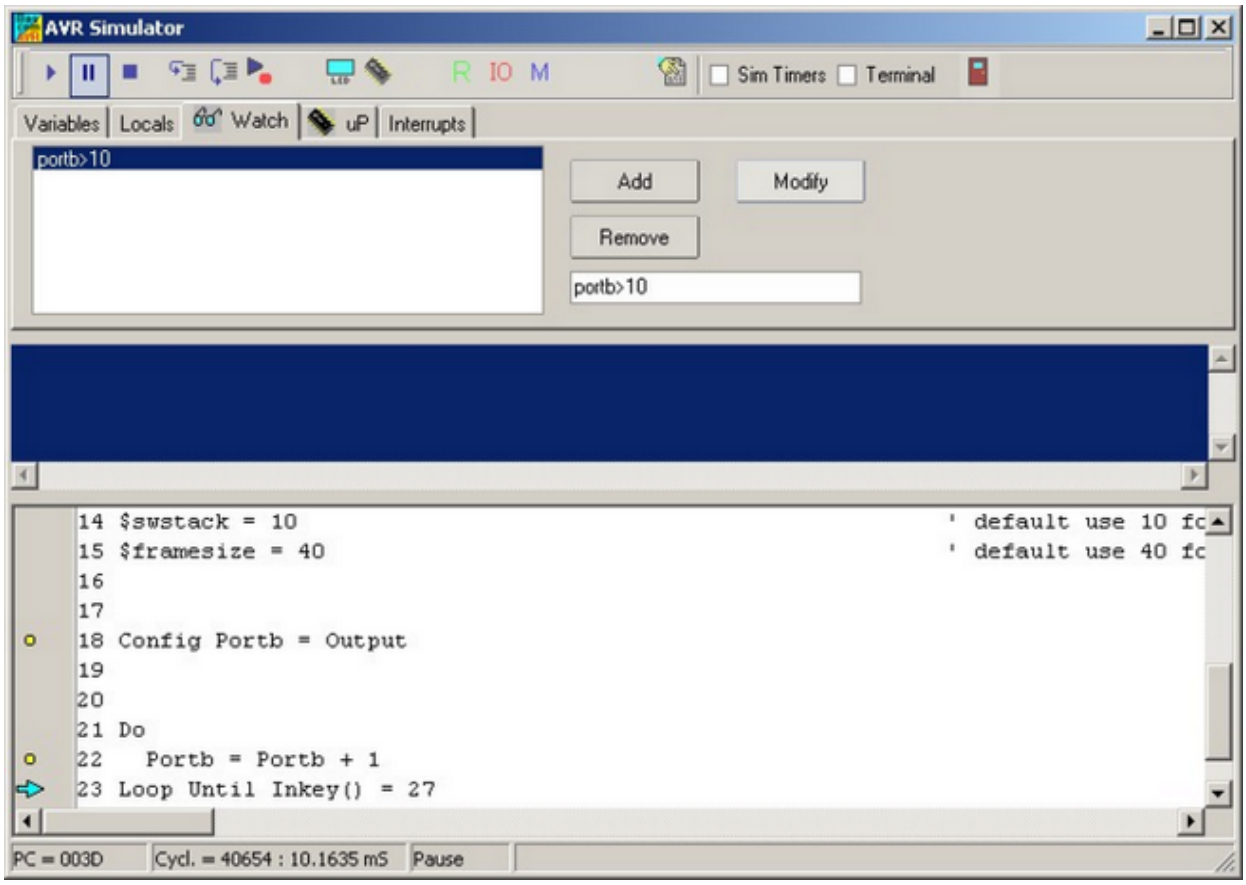
It is also possible to watch a variable by selecting it in the code window, and then pressing enter. It will be added to the variable list automatically.
Notice that it takes time to refresh the variables. So remove variables that do not need to be watched anymore for faster simulation speed.

LOCALS



The LOCALS window shows the variables found in a SUB or FUNCTION. Only local variables are shown. You can not add variables in the LOCALS section.
Changing the value of local variables works the same as in the Variables TAB.

WATCH



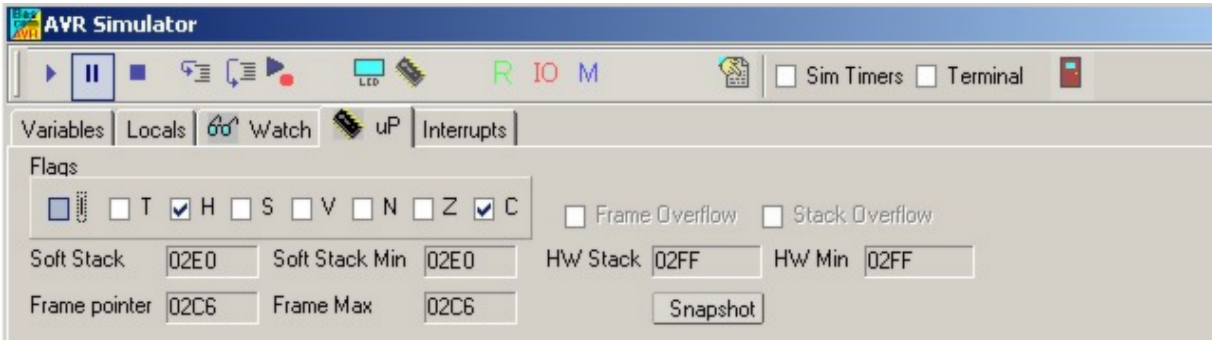
The Watch-TAB can be used to enter an expression that will be evaluated during simulation. When the expression is true the simulation is paused.

To enter a new expression, type the expression in the text-field below the Remove button,

and press the Add-button.
When you press the Modify-button, the current selected expression from the list will be replaced with the current typed value in the text field.

To delete an expression, select the desired expression from the list, and press the Remove-button.
During simulation when an expression becomes true, the expression that matches will be selected and the Watch-TAB will be shown.

uP



This TAB shows the value of the microprocessor status register (SREG).

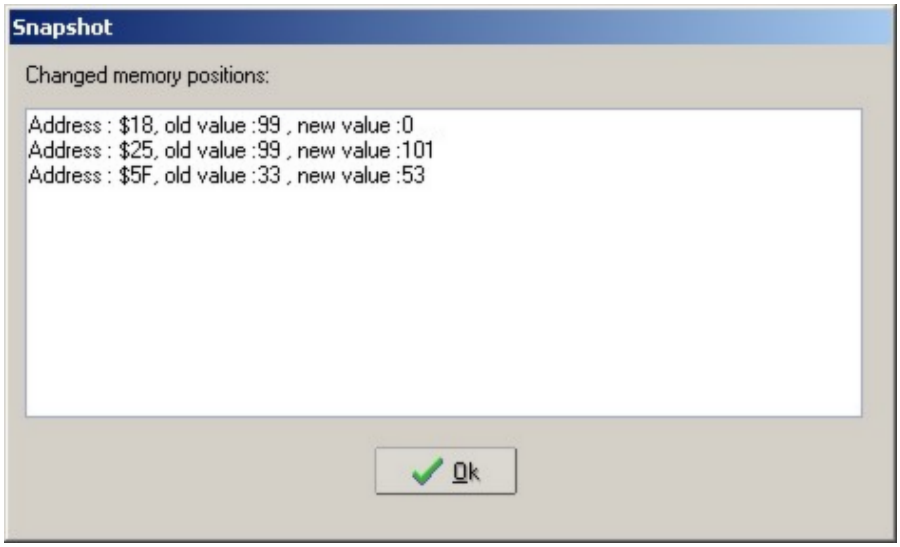
The flags can be changed by clicking on the check boxes.

The software stack, hardware stack, and frame pointer values are shown. The minimum or maximum value that occurred during simulation is also shown. When one of these data areas enter or overlap another one, a stack or frame overflow occurs.
This will be signaled with a pause and a check box.

Pressing the snapshot-button will save a snapshot of the current register values and create a copy of the memory.
You will notice that the Snapshot-button will change to 'Stop'

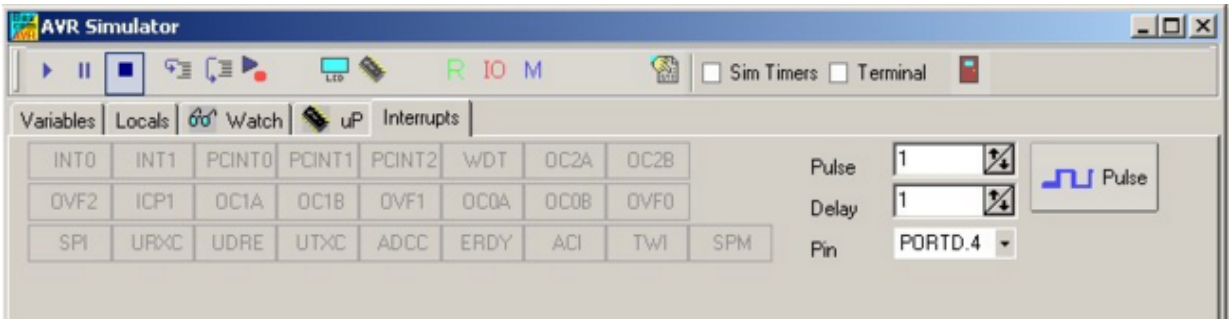
Now execute some code by pressing F8 and press the Snapshot-button again.

A window will pop up that will show all modified address locations.
This can help to determine which registers or memory a statement uses.



When you write an ISR (Interrupt Service Routine) with the NOSAVE option, you can use this to determine which registers are used and then save only the modified registers.

INTERRUPTS



This TAB shows the interrupt sources. When no ISR's are programmed all buttons will be disabled.
When you have written an ISR (using ON INT...), the button for that interrupt will be enabled. Only the interrupts that are used will be enabled.

By clicking an interrupt button the corresponding ISR is executed.
This is how you simulate the interrupts. When you have enabled 'Sim Timers' it can also trigger the event.

The pulse generator can be used to supply pulses to the timer when it is used in counter mode.
First select the desired pin from the pull down box. Depending on the chip one or more pins are available. Most chips have 2 counters so there will usually be 2 input pins.
Next, select the number of pulses and the desired delay time between the pulses, then press the Pulse-button to generate the pulses.

The delay time is needed since other tasks must be processed as well.

The option 'Sim timers' must be selected when you want to simulate timers/counters.

TERMINAL Section

Under the window with the TABS you will find the terminal emulator window. It is the dark blue area.

In your program when you use PRINT, the output will be shown in this window.

When you use INPUT in your program, you must set the focus to the terminal window and type in the desired value.

You can also make the print output go directly to the COM port.
Check the Terminal option to enable this feature.
The terminal emulator settings will be used for the baud rate and COM port.
Any data received by the COM port will also be shown in the terminal emulator window.

SOURCE Section

Under the Terminal section you find the Source Window.
It contains the sorce code of the program you are simulating. All lines that contain executable code have a yellow point in the left margin.

You can set a breakpoint on these lines by selecting the line and pressing F9.

By holding the mouse cursor over a variable name, the value of the variable is shown in the status bar.
If you select a variable, and press ENTER, it will be added to the Variable window.

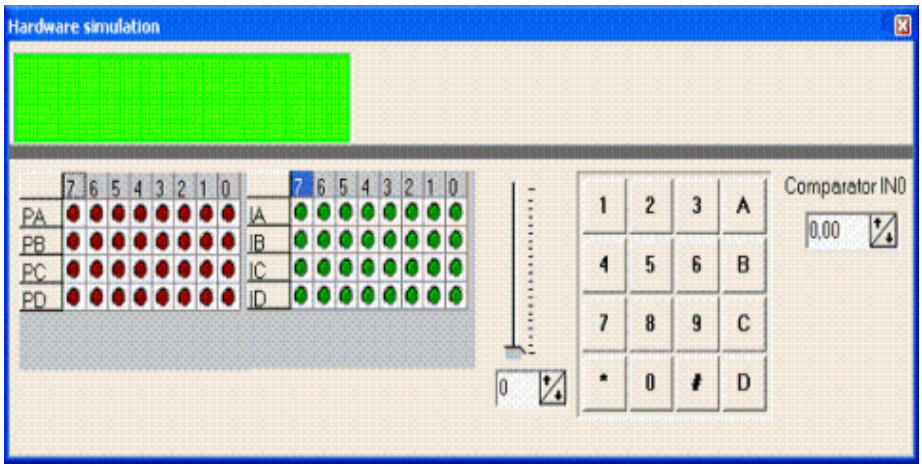
In order to use the function keys (F8 for stepping for example), the focus must be set to the Source Window.

A blue arrow will show the line that will be executed next..

The hardware simulator.

By pressing the hardware simulation button

the windows shown below will be displayed.



The top section is a virtual LCD display. It works to display code in PIN mode, and bus mode. For bus mode, only the 8-bit bus mode is supported by the simulator.

Below the LCD display area are LED bars which give a visual indication of the ports.

By clicking an LED it will toggle.
PA means PORTA, PB means PORTB, etc.
IA means PINA, IB means PINB etc. (Shows the value of the Input pins)
It depends on the kind of microprocessor you have selected, as to which ports will be shown.

Right beside the PIN led's, there is a track bar. This bar can be used to simulate the input voltage applied the ADC converter. Note that not all chips have an AD converter. You can set a value for each channel by selecting the desired channel below the track bar.

Next to the track bar is a numeric keypad. This keypad can be used to simulate the GETKBD() function.

When you simulate the Keyboard, it is important that you press/click the keyboard button **before** simulating the getkbd() line !!!

To simulate the Comparator, specify the comparitor input voltage level using Comparitor IN0.

Enable Real Hardware Simulation

By clicking the
button you can simulate the actual processor ports in-circuit!

The processor chip used must have a serial port.

In order simulate real hardware you must compile the basmon.bas file.

To do this, follow this example:
Lets say you have the DT006 simmstick, and you are using a 2313 AVR chip.

Open the basmon.bas file and change the line $REGFILE = "xxx" to $REGFILE = "2313def.dat"
Now compile the program and program the chip.
It is best to set the lock bits so the monitor does not get overwritten if you accidentally press F4.
The real hardware simulation only works when the target micro system has a serial port. Most have and so does the DT006.

Connect a cable between the COM port of your PC and the DT006. You probably already have one connected. Normally it is used to send data to the terminal emulator with the PRINT statement.

The monitor program is compiled for 19200 baud. The Options Communication settings must be set to the same baud rate!
The same settings for the monitor program are used for the Terminal emulator, so select the COM port, and the baud rate of 19200.

Power up or reset the DT006. It probably already is powered since you just previously compiled the basmon.bas program and stored it in the 2313.
When you press the real hardware simulation button now the simulator will send and receive data when a port, pin or DDR register is changed.

This allows you to simulate an attached hardware LCD display for example, or something simpler, like an LED. In the SAMPLES dir, you will find the program DT006. You can compile the program and press F2.

When you step through the program the LED's will change!

All statements can be simulated this way but they have to be able to use static timing. Which means that 1-wire will not work because it depends on timing. I2C has a static bus and thus will work.

NOTE: It is important that when you finish your simulation sessions that you click the button again to disable the Real hardware simulation.

When the program hangs it probably means that something went wrong with the serial communication. The only way to escape is to press the Real hardware Simulation button again.

The Real Hardware Simulation is a cost effective way to test attached hardware.

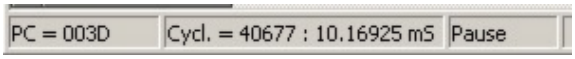
The refresh variables button will refresh all variables during a run(F5). When you use the hardware simulator, the LEDS will only update their state when you have enabled this option. Note that using this option will slow down the simulation.

Watchdog Simulation

Most AVR chips have an internal Watchdog. This Watchdog timer is clocked from an internal oscillator. The frequency is approximately 1 MHz. Voltage and temperature variations can have an impact on the WD timer. It is not a very precise timer. So some tolerance is needed when you refresh/reset the WD-timer. The Simulator will warn you when a WD overflow will

occur. But only when you have enabled the WD timer.

The status bar



The status bar shows the PC (program counter) and the number of cycles. You can reset the cycles by positioning the mouse cursor on the status bar and then right click. You will then get a pop up menu with the option to reset the cycles.
You can use this to determine how much time a program statement takes.
Do not jump to a conclusion too quick, the time shown might also depend on the value of a variable.
For example, with WAITMS var this might be obvious, but with the division of a value the time might vary too.

Program Send to Chip

Program send to chip shortcut , F4

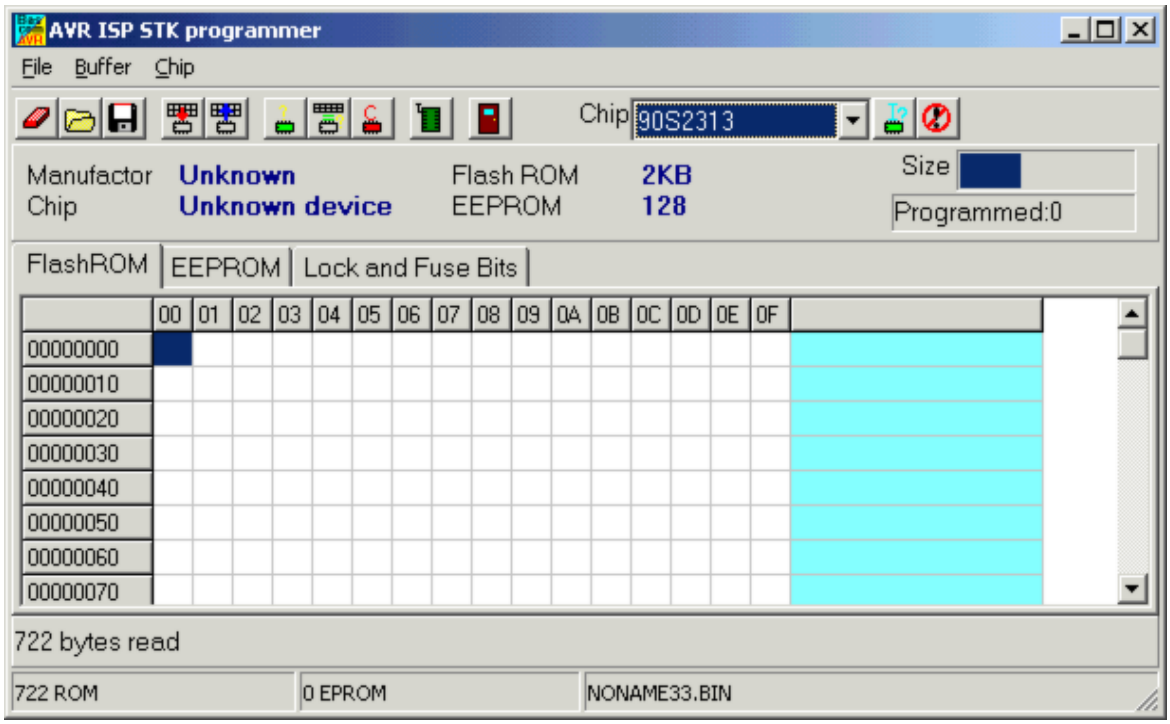
This option will bring up the selected programmer window, or will program the chip directly if the program the chip directly option is selected in the Programmer options section.

The following section applies to the Programmer window (program chip directly NOT selected) otherwise this is not shown to the user.

"Buffer" below refers to the buffer memory that holds data to be programmed to, or read from the chip.

Menu item	Description
File Exit	Return to editor
File, Test	With this option you can set the logic level to the LPT pins. This is only intended for the Sample Electronics programmer.
Buffer Clear	Clears buffer
Buffer Load from file	Loads a file into the buffer
Buffer Save to file	Saves the buffer content to a file
Chip Identify	Identifies the chip
Write buffer into chip	Programs the buffer into the chip ROM or EEPROM
Read chipcode into buffer	Reads the code or data from the chips code memory or data memory
Chip blank check	Checks if the chip is blank or erased
Chip erase	Erase the content of both the program memory and the data memory
Chip verify	Verifies if the buffer is the same as the chip program or data memory
Chip Set lock bits	Writes the selected lock bits LB1 and/or LB2. Only an erase will reset the lock bits
Chip auto program	Erases the chip and programs the chip. After the programming is completed, verification is performed.
RCEN	Writes a bit to enable the internal oscillator. This RCEN bit is only available on some AVR chips.

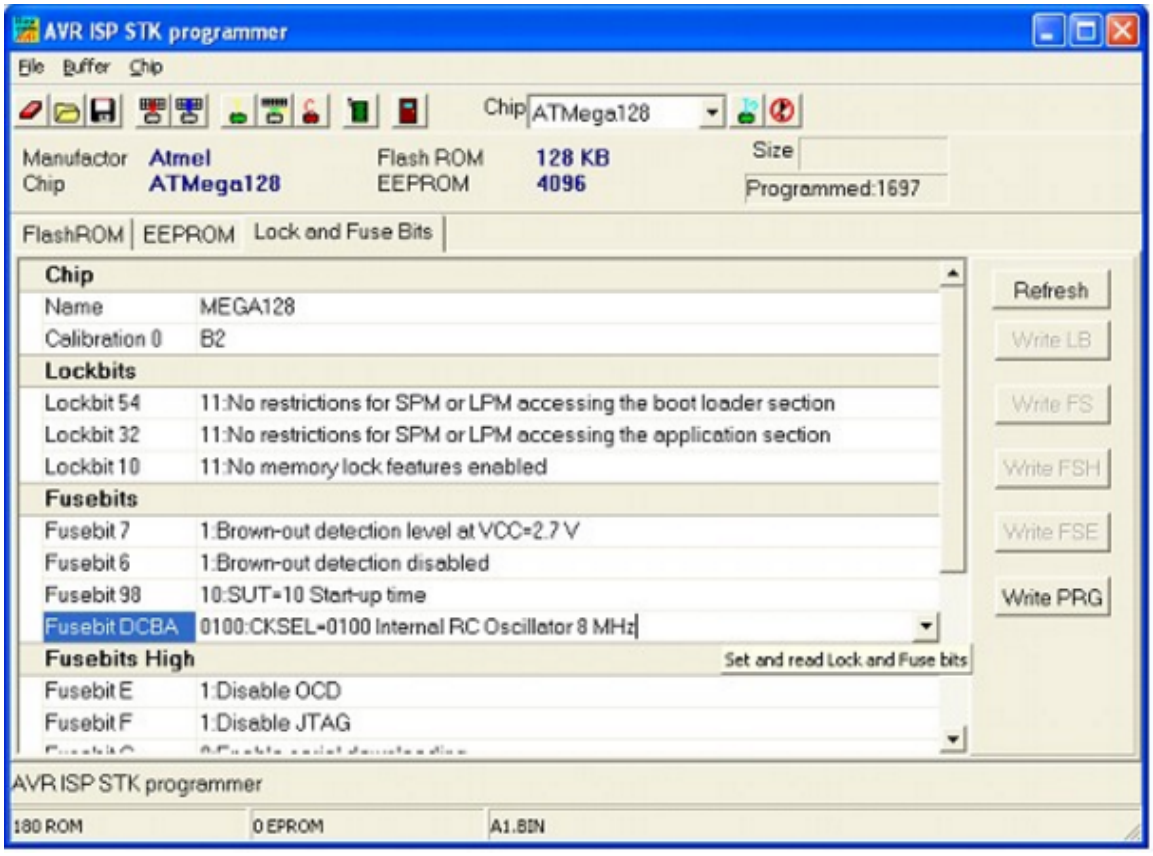
The following window will be shown for most programmers:



Note that a chip must be ERASED before it can be programmed.

By default the FlashROM TAB is shown and the binary data is displayed.
When you have an EEPROM in your project, the EEPROM TAB will show this data too.

The most important TAB is in many cases the Lock & Fuse Bits TAB.
When you select it , the lock and fusebits will be read.



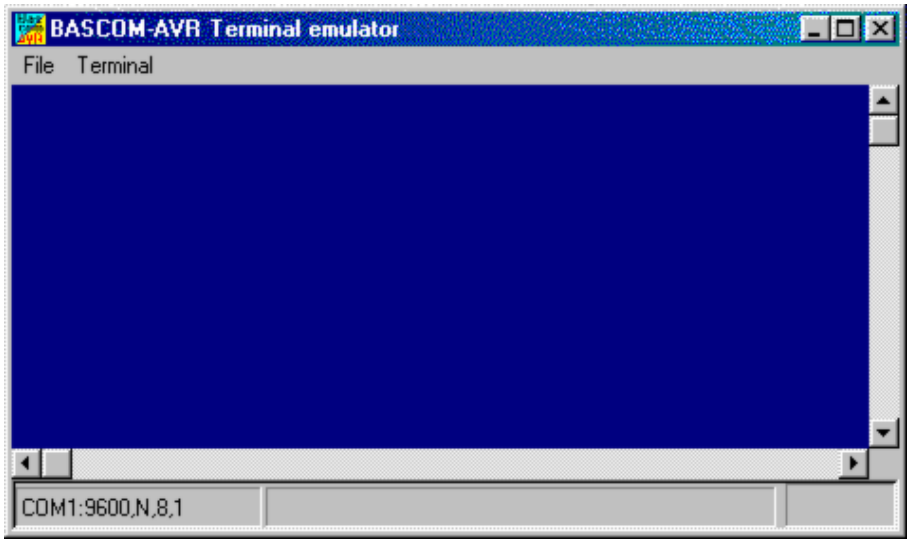
These Lock and Fuse bits are different in almost every chip !
You can select new settings and write them to the chip. But be careful ! When you select a wrong oscillator option , you can not program the chip anymore without applying an external clock signal.
This is also the solution to communicate with the chip again : connect a clock pulse to the oscillator input. You could use an output from a working micro, or a clock generator or simple 555 chip circuit.

When you found the right settings, you can use $PROG to write the proper settings to new, unprogrammed chips. To get this setting you press the 'Write PRG' button.
After a new is programmed with $PROG, you should remark the line for safety and quicker programming.

Notice that the Write xxx buttons are disabled by default. Only after you have changed a lock or fusebit value, the corresponding button will be enabled.

Tools Terminal Emulator

With this option you can communicate via the RS-232 interface to the microcomputer. The following window will appear:



Information you type and information that the computer board sends are displayed in the same window.

Note that you must use the same baud rate on both sides of the transmission. If you compiled your program with the Compiler Settings at 4800 baud, you must also set the Communication Settings to 4800 baud.

The setting for the baud rate is also reported in the report file.

NOTE: The focus MUST be on this window in order to see any data (text, etc) sent from the processor. You will NOT see any data sent by the processor right after a reset. You must use an external hardware reset AFTER the terminal Emulator window is given focus in order to see the data. Using the Reset shortcut, you will not be able to see any data because

pressing the shortcut causes the Terminal emulator to lose focus. This is different than "HyperTerminal" which always receives data even when the Hyperterminal window does not have focus. Use Hyperterminal if you need to see the program output immediately after programming or reset.

File Upload
Uploads the current program from the processor chip in HEX format. This option is meant for loading the program into a monitor program for example. It will send the current compiled program HEX file to the serial port.

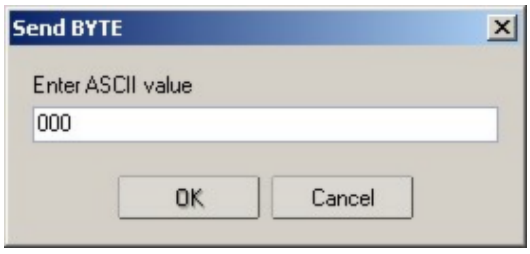
File Escape
Aborts the upload to the monitor program.

File Exit
Closes terminal emulator.

Terminal Clear
Clears the terminal window.

Terminal Open Log
Opens or closes the LOG file. When there is no LOG file selected you will be asked to enter a filename or to select a filename. All info that is printed to the terminal window is captured into the log file. The menu caption will change into 'Close Log' and when you choose this option the file will be closed.

Terminal Send ASCII
This option allows you to send any ASCII character you need to send. Values from 000 to 255 may be entered.



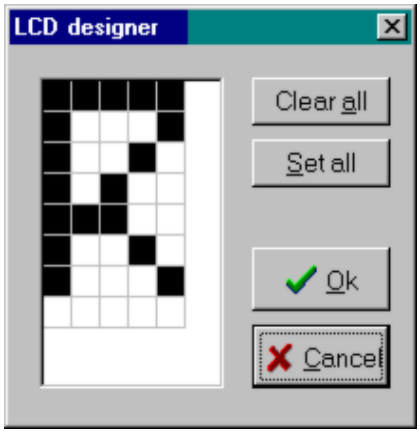
Terminal Send Magic number
This option will send 4 bytes to the terminal emulator. The intention is to use it together with the boot loader examples. Some of the boot loader samples check for a number of characters when the chip resets. When they receive 4 'magic' characters after each other, they will start the boot load procedure. This menu options send these 4 magic characters.

Terminal Setting
This options will show the terminal settings so you can change them quickly.
It is the same as Options, Communication.

Tools LCD Designer

With this option you can design special characters for LCD-text displays.

The following window will appear:



The LCD-matrix has 7x5 points. The bottom row is reserved for the cursor but can be used. You can select a point by clicking the left mouse button. If a cell was selected it will be unselected.

Clicking the Set All button will set all points.
Clicking the Clear All button will clear all points.

When you are finished you can press the Ok button : a statement will be inserted in your active program-editor window at the current cursor position. The statement looks like this :

Deflcdchar ?,1,2,3,4,5,6,7,8

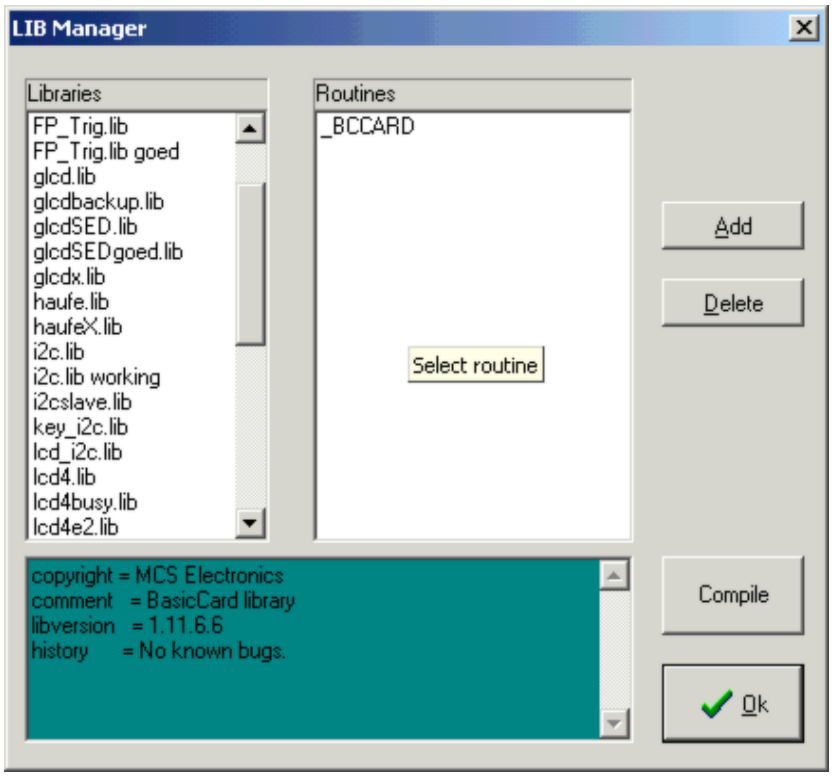
You must replace the ?-sign with a character number ranging from 0-7.
The eight bytes define how the character will appear. So they will be different depending on the character you have drawn.

See Also

Font Editor

Tools LIB Manager

With this option the following window will appear:



The Libraries are shown in the left pane. When you select a library, the routines that are in the library will be shown in the right pane.

After selecting a routine in the left pane, you can DELETE it with the DELETE button..

Clicking the ADD button allows you to add an ASM routine to the library.

The COMPILE button will compile the lib into a LBX file. When an error occurs you will get an error. By watching the content of the generated lbx file you can determine the error.

A compiled LBX file does not contain comments and a huge amount of mnemonics are compiled into object code. This object code is inserted at compile time of the main BASIC program. This results in faster compilation time.

The DEMO version comes with the compiled MCS.LIB file which is named MCS.LBX. The ASM source (MCS.LIB) is included only with the commercial edition.

With the ability to create LBX files you can create add on packages for BASCOM and sell them. For example, the LBX files could be distributed for free, and the ASM source could be sold.

Some library examples :

- MODBUS crc routine for the modbus slave program.
- Glcd.lib contains the graphical LCD asm code

Commercial packages available from MCS:

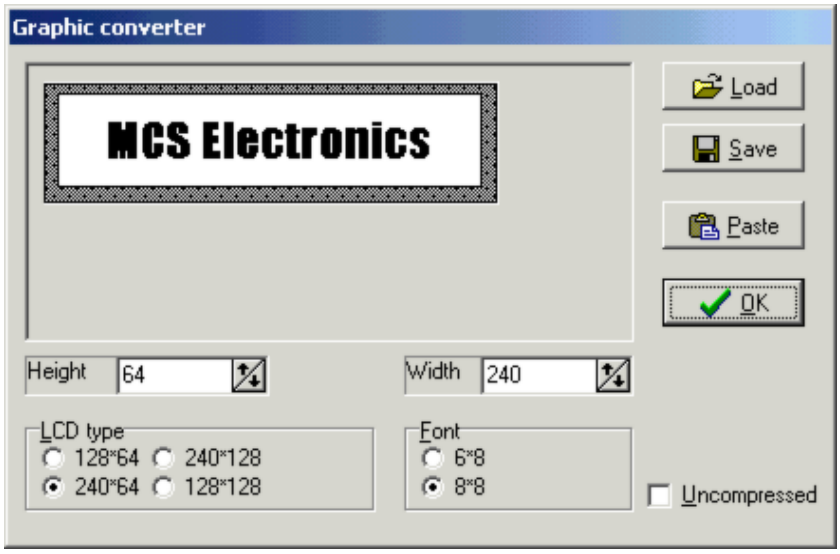
- I2CSLAVE library
- BCCARD for communication with www.basiccard.com chipcards

See Also
$LIB for writing your own libraries

Tools Graphic Converter

The Graphic converter is intended to convert BMP files into BASCOM Graphic Files (.BGF) that can be used with Graphic LCD displays.

The following dialog box will be shown:



To load a picture click the Load button.
The picture can be maximum 128 pixels high and 240 pixels width.

When the picture is larger it will be adjusted.

You can use your favorite graphic tool to create the bitmaps and use the Graphic converter to convert them into black and white images.

When you click the Save-button the picture will be converted into black and white.
Any non-white color will be converted into black.

The resulting file will have the BGF extension.

You can also paste a picture from the clipboard by clicking the Paste button.

Press the Ok-button to return to the editor.

The picture can be shown with the ShowPic statement or the ShowpicE statement.

The BGF files are RLE encoded to save space.

When you use your own drawing routine you can also save the pictures uncompressed by setting the Uncompressed check box. The resulting BGF files can not be shown with the

showpic or showpicE statements anymore in that case!

The BGF format is made up as following:

- first byte is the height of the picture
- second byte is the width of the picture
- for each row, all pixels are scanned from left to right in steps of 6 or 8 depending on the font size. The resulting byte in stored with RLE compression

The RLE method used is : byte value, AA(hex), repeats.
So a sequence of 5, AA, 10 means that a byte with the value of 5 must be repeated 16 times (hex notation used)

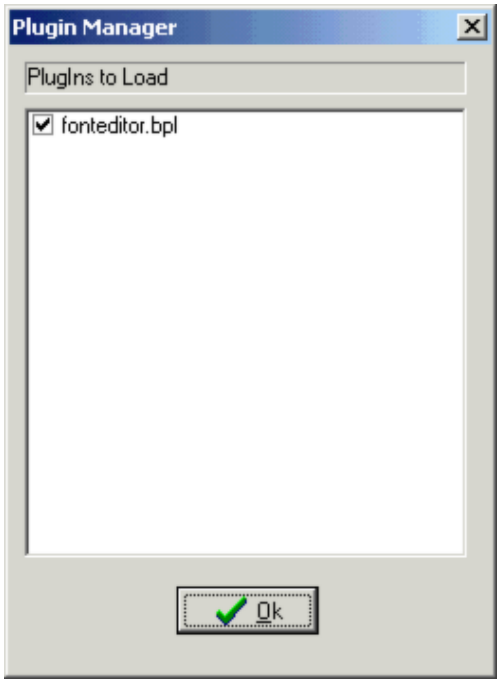
Tools Stack Analyzer

The Stack analyzer helps to determine the proper stack size.

See $DBG for the proper usage of this option.

Tools Plugin Manager

The Plugin Manager allows you to specify which Plug-in's needs to be loaded the next time you start BASCOM.



Just select the plug in's you want to load/use by setting the check box.
The plug in's menu's will be loaded under the Tools Menu.

To add a button to the toolbar, press the right mouse button while the mouse cursor is over

the toolbar.

When you want to write your own plug in's, contact support@mcselec.com

Options Compiler

With this option, you can modify the compiler options.

The following TAB pages are available:

Options Compiler Chip

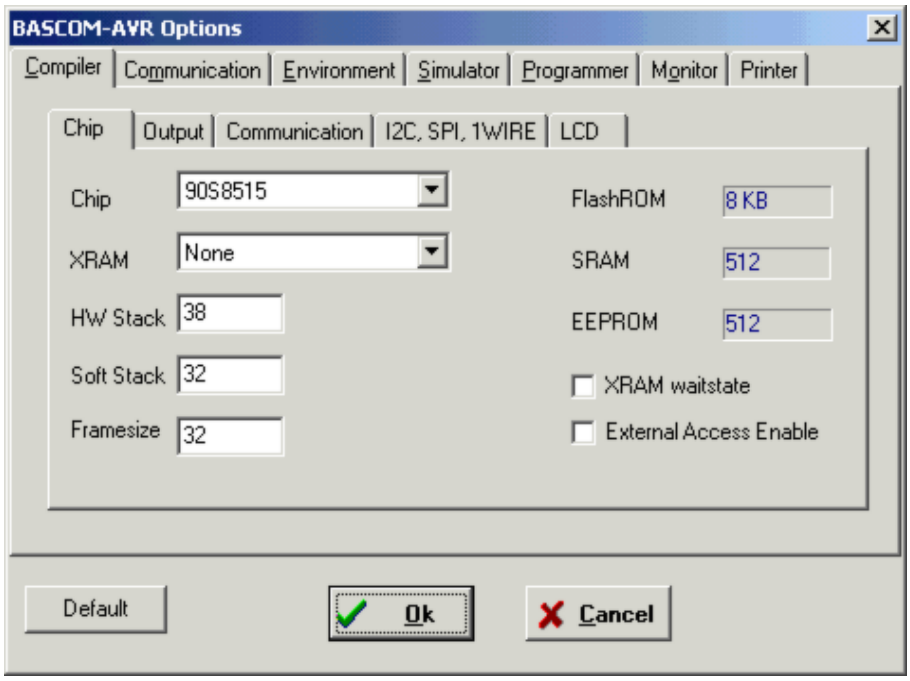
Options Compiler Output

Options Compiler Communication

Options Compiler I2C , SPI, 1WIRE

Options Compiler LCD

Options Compiler Chip



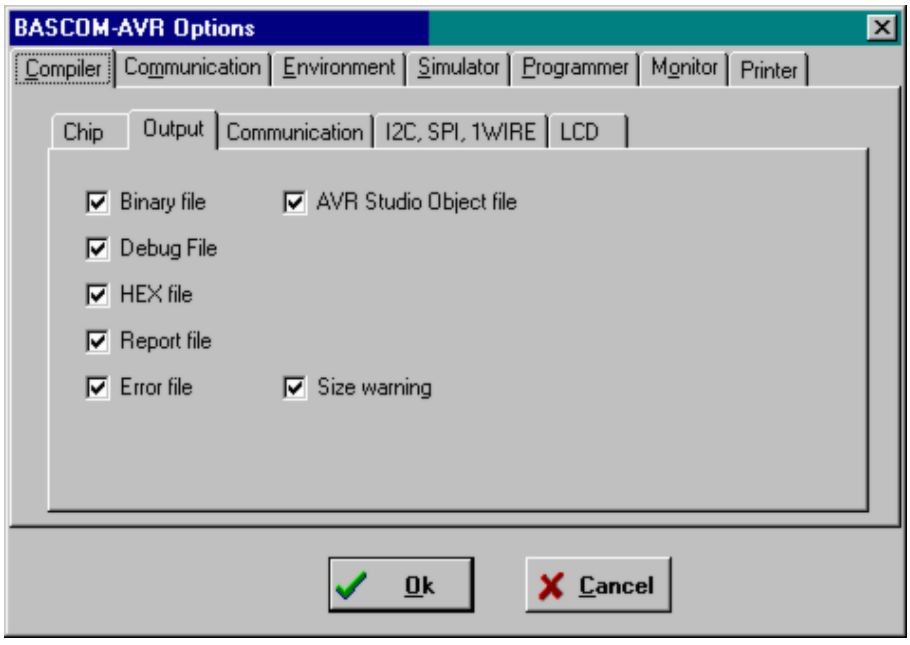
The following options are available:

Options Compiler Chip

Item	Description

Chip	Selects the target chip. Each chip has a corresponding x.DAT file with specifications of the chip. Note that some DAT files are not available yet.
XRAM	Selects the size of the external RAM. KB means Kilo Bytes. For 32 KB you need a 62256 STATIC RAM chip.
HW Stack	The amount of bytes available for the hardware stack. When you use GOSUB or CALL, you are using 2 bytes of HW stack space. When you nest 2 GOSUB's you are using 4 bytes (2*2). Most statements need HW stack too. An interrupt needs 32 bytes.
Soft Stack	Specifies the size of the software stack. Each local variable uses 2 bytes. Each variable that is passed to a sub program uses 2 bytes too. So when you have used 10 locals in a SUB and the SUB passes 3 parameters, you need 13 * 2 = 26 bytes.
Frame size	Specifies the size of the frame. Each local variable is stored in a space that is named the frame space. When you have 2 local integers and a string with a length of 10, you need a frame size of (2*2) + 11 = 15 bytes. The internal conversion routines used when you use INPUT num, or STR(), or VAL(), etc, also use the frame. They need a maximum of 16 bytes. So for this example 15+16 = 31 would be a good value.
XRAM wait state	Select to insert a wait state for the external RAM.
External Access enable	Select this option to allow external access of the micro. The 8515 for example can use port A and C to control a RAM chip. This is almost always selected if XRAM is used
Default	Press or click this button to use the current Compiler Chip settings as default for all new projects.

Options Compiler Output

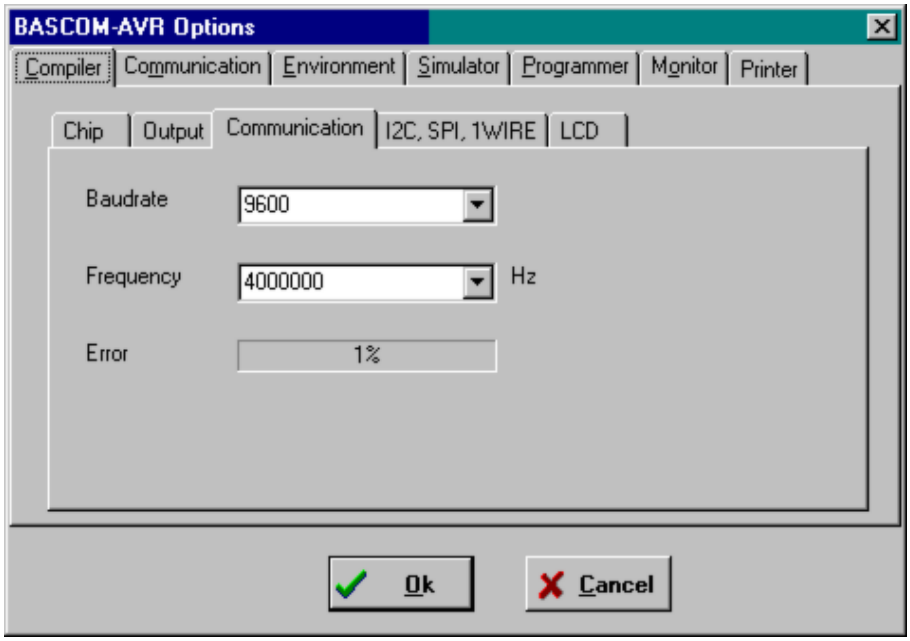


Options Compiler Output

Item	Description
Binary file	Select to generate a binary file. (xxx.bin)
Debug file	Select to generate a debug file (xxx.dbg)
Hex file	Select to generate an Intel HEX file (xxx.hex)
Report file	Select to generate a report file (xxx.rpt)
Error file	Select to generate an error file (xxx.err)
AVR Studio object file	Select to generate an AVR Studio object file (xxx.obj)
Size warning	Select to generate a warning when the code size exceeds the Flash ROM size.
Swap words	This option will swap the bytes of the object code words. Useful for some programmers. Should be disabled for most programmers. Don't use it with the internal supported programmers.
Optimize code	This options does additional optimization of the generated code. Since it takes more compile time it is an option.
Show internal variables	Internal variables are used. Most of them refer to a register. Like _TEMP1 = R24. This option shows these variables in the report.

Select only the options needed for fastest comple time.

Options Compiler Communication



Options Compiler Communication

Item	Description
Baud rate	Selects the baud rate for the serial communication statements. You can also type in a new baud rate.

Frequency	Select the frequency of the used crystal. You can also type in a new frequency.

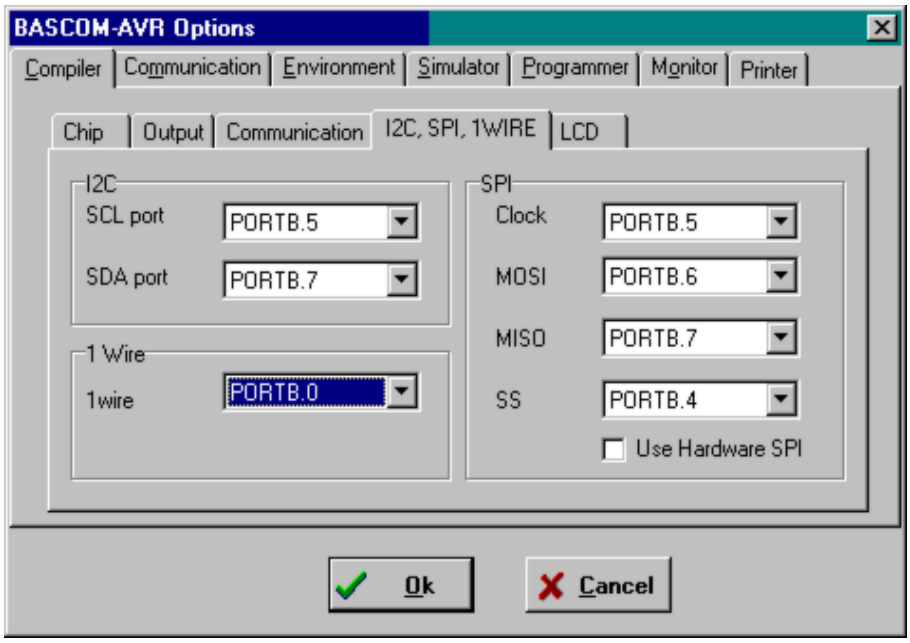
The settings for the internal hardware UART are:

No parity , 8 data bits , 1 stop bit

Some AVR chips have the option to specify different data bits and different stop bits and parity.

Note that these settings must match the settings of the terminal emulator. In the simulator the output is always shown correct since the baud rate is not taken in consideration during simulation. With real hardware when you print data at 9600 baud, the terminal emulator will show weird characters when not set to the same baud rate, in this example, to 9600 baud.

Options Compiler I2C, SPI, 1WIRE

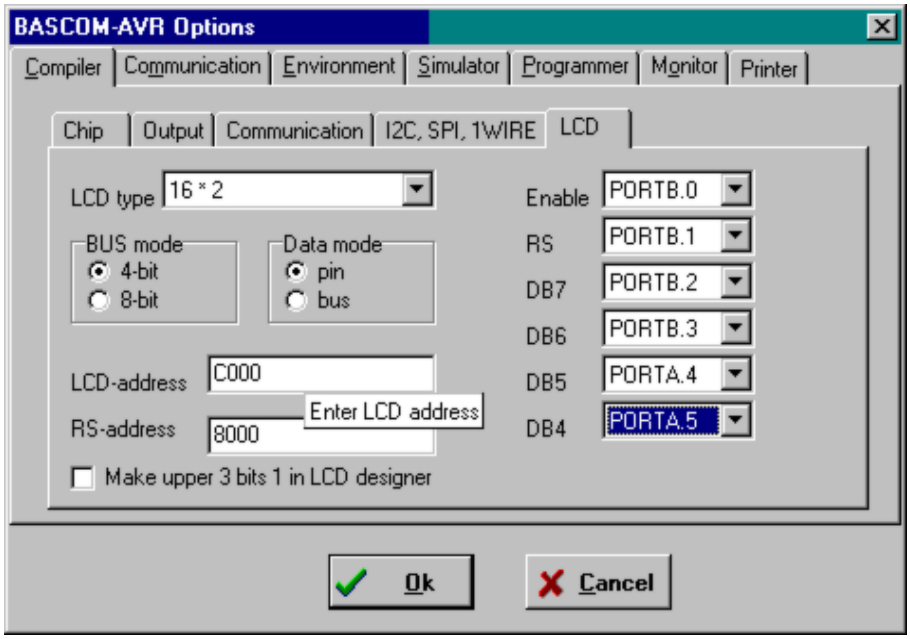


Options Compiler I2C, SPI, 1WIRE

Item	Description
SCL port	Select the port pin that serves as the SCL-line for the I2C related statements.
SDA port	Select the port pin that serves as the SDA-line for the I2C related statements.
1WIRE	Select the port pin that serves as the 1WIRE-line for the 1Wire related statements.
Clock	Select the port pin that serves as the clock-line for the SPI related statements.
MOSI	Select the port pin that serves as the MOSI-line for the SPI related statements.

MISO	Select the port pin that serves as the MISO-line for the SPI related statements.
SS	Select the port pin that serves as the SS-line for the SPI related statements.
Use hardware SPI	Select to use built-in hardware for SPI, otherwise software emulation of SPI will be used. The 2313 does not have internal HW SPI so it can only be used with software spi mode. When you do use harware SPI, the above settings are not used anymore since the SPI pins are dedicated pins and can not be choosen by the user.

Options Compiler LCD



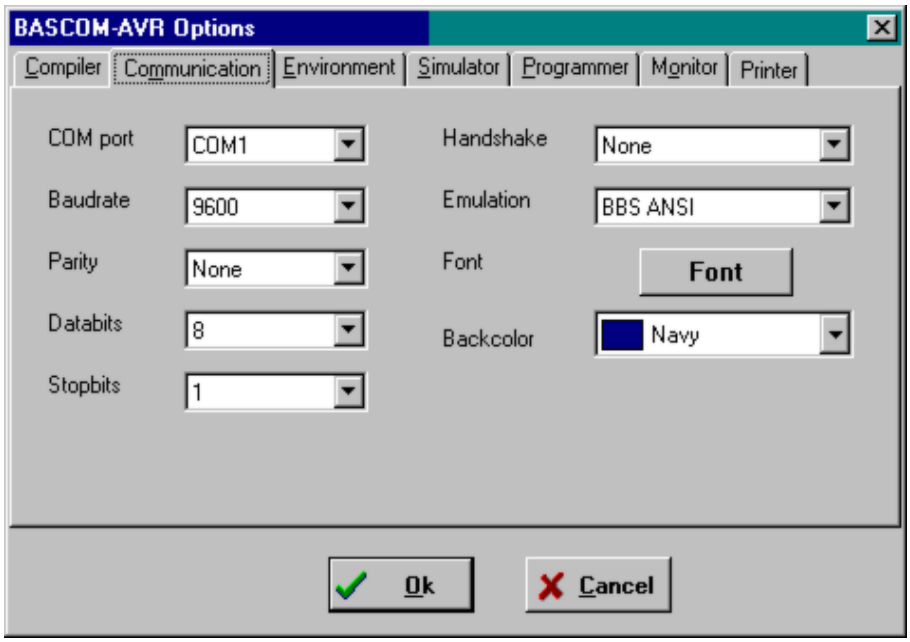
Options Compiler LCD

Item	Description
LCD type	The LCD display used.
Bus mode	The LCD can be operated in BUS mode or in PIN mode. In PIN mode, the data lines of the LCD are connected to the processor port pins. In BUS mode the data lines of the LCD are connected to the data lines of the BUS. Select 4 when you have only connect DB4-DB7. When the data mode is 'pin' , you should select 4.
Data mode	Select the mode in which the LCD is operating. In PIN mode, individual processor pins can be used to drive the LCD. In BUS mode, the external data bus is used to drive the LCD.
LCD address	In BUS mode you must specify which address will select the enable line of the LCD display. For the STK200, this is C000 = A14 + A15.

RS address	In BUS mode you must specify which address will select the RS line of the LCD display. For the STK200, this is 8000 = A15
Enable	For PIN mode, you must select the processor pin that is connected to the enable line of the LCD display.
RS	For PIN mode, you must select the processor pin that is connected to the RS line of the LCD display.
DB7-DB4	For PIN mode, you must select the processor pins that are connected to the upper four data lines of the LCD display.
Make upper 3 bits high in LCD designer	Some displays require that for setting custom characters, the upper 3 bits must be 1. Should not be used by default.

Options Communication

With this option, you can modify the communication settings for the terminal emulator.

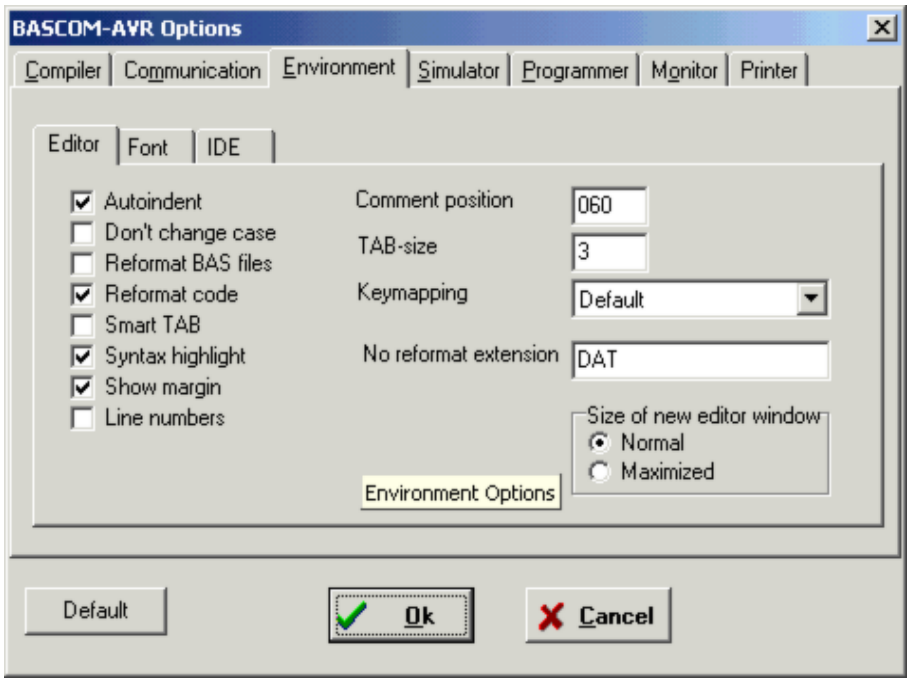


Item	Description
Comport	The communication port of your PC that you use for the terminal emulator.
Baud rate	The baud rate to use.
Parity	Parity, default None.
Data bits	Number of data bits, default 8.
Stop bits	Number of stop bits, default 1.
Handshake	The handshake used, default is none.
Emulation	Emulation used, default BBS ANSI.
Font	Font type and color used by the emulator.
Back color	Background color of the terminal emulator.

Note that the baud rate of the terminal emulator and the baud rate setting of the compiler options, must be the same in order to work correctly.

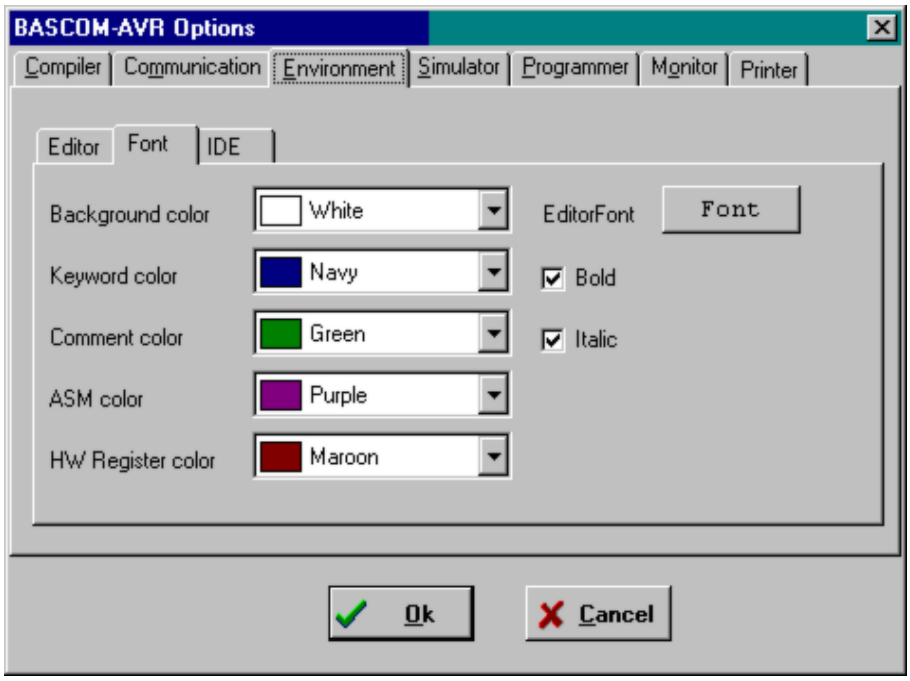
The reason why you can specify them both to be different is that you can use the terminal emulator for other purposes too.

Options Environment

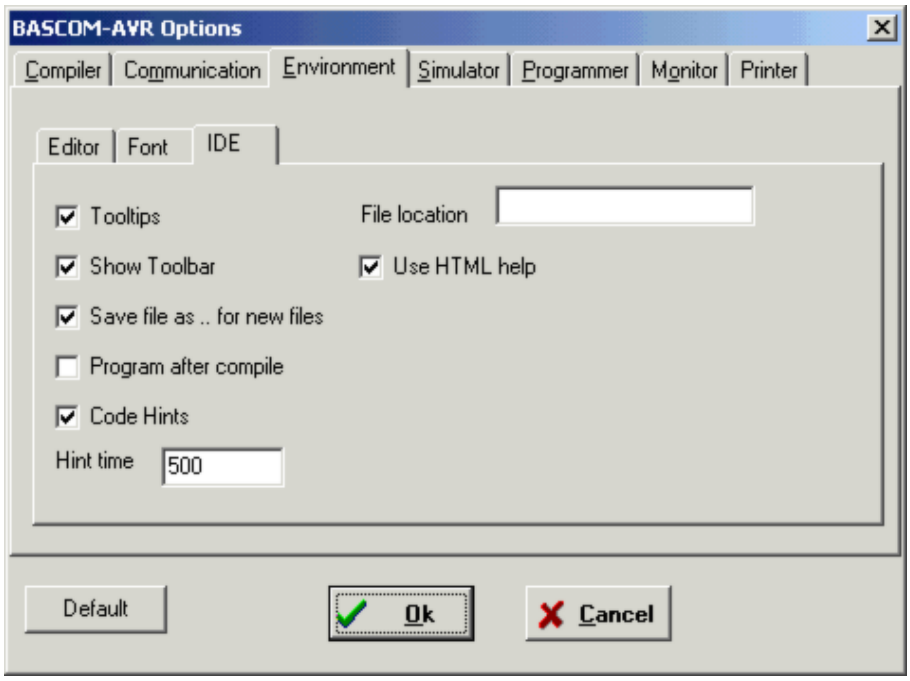


OPTION	DESCRIPTION
Auto Indent	When you press return, the cursor is set to the next line at the current column position
Don't change case	When set, the reformat won't change the case of the text. Default is that the text is reformatted so every word begins with upper case.
Reformat BAS files	Reformat files when loading them into the editor. All lines are reformatted so that multiple spaces are removed. This is only necessary when you are loading files that where created with another editor. Normally you won't need to set this option.
Reformat code	Reformat code when entered in the editor. The reformat option will change the entered line when you move away from the current edited line. For example a = a + 1 will be changed into : a = a + 1 . When you forget a string end marker ", one will be added, and endif will be changed into End IF.
Smart TAB	When set, a TAB will go to the column where text starts on the previous line.
Syntax highlighting	This options highlights BASCOM statements in the editor.
Show margin	Shows a margin on the right side of the editor.
Comment	The position of the comment. Comment is positioned to the right of your source code. Exception if comment is first character of a line.
TAB-size	Number of spaces that are generated for a TAB.

Key mapping	Choose default, Classic, Brief or Epsilon.
No reformat extension	File extensions separated by a space that will not be reformatted when loaded.
Size of new editor window	When a new editor window is created you can select how it will be made. Normal or Maximized (full window)



OPTION	DESCRIPTION
Background color	The background color of the editor window.
Keyword color	The color of the reserved words. Default Navy. The keywords can be displayed in bold too.
Comment color	The color of comment. Default green. Comment can be shown in Italic too.
ASM color	Color to use for ASM statements. Default purple.
HW registers color	The color to use for the hardware registers/ports. Default maroon.
Editor font	Click on this label to select another font for the editor window.



OPTION	DESCRIPTION
Tool tips	Show tool tips.
Show toolbar	Shows the toolbar with the shortcut icons.
Save File As … for new files.	Will display a dialog box so you can give new files a name when they must be saved. When you don't select this option the default name will be give to the file (nonamex.bas). Where x is a number.
Program after Compile	This option will run the programmer after the program is compiled with success.
File location	Double click to select a directory where your program files are stored. By default Windows will use the My Documents path.
Use HTML Help	HTML help is available for download and when your OS supports HTML help, you can turn this option on. W98,W98SE,W98ME, W2000 and XP support HTML Help.
Auto backup	Check this option to make periodic backups. When checked you can specify the backup time in minutes.

Options Simulator

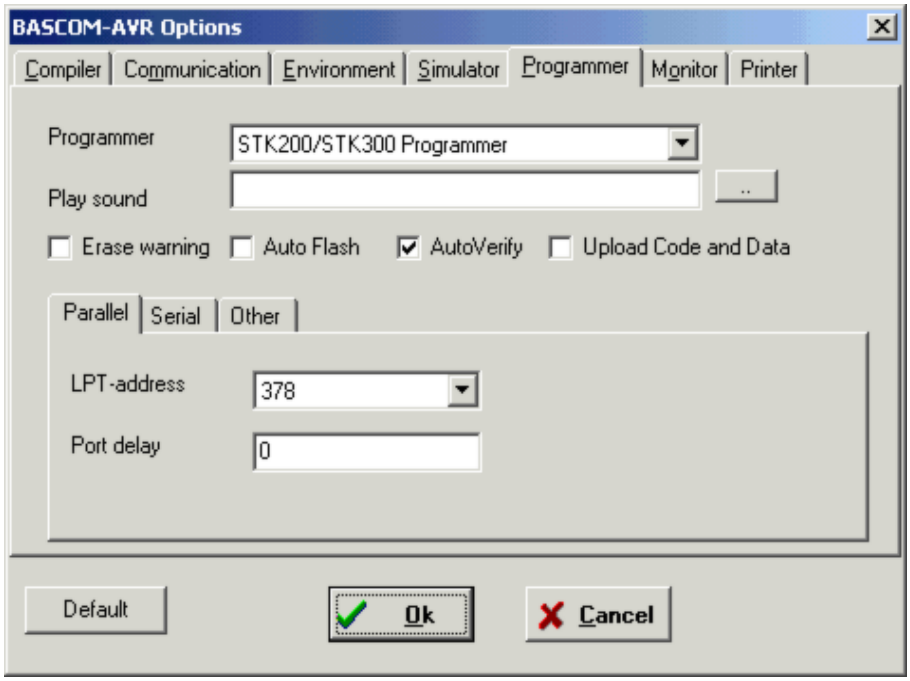
With this option you can modify the simulator settings.

OPTION	DESCRIPTION
Use integrated simulator	Set this option to use BASCOM's simulator. You can also use AVR Studio by clearing this option.
Run simulator after compilation	Run the selected simulator after a successful compilation.
Program	The path with the program name of the simulator.

Parameter	The parameter to pass to the program. {FILE}.OBJ will supply the name of the current program with the extension .OBJ to the simulator.

Options Programmer

With this option you can modify the programmer settings.



OPTION	DESCRIPTION
Programmer	Select one from the list.
Play sound	Name of a WAV file to be played when programming is finished. Press the [..]-button to select the file.
Erase Warning	Set this option when you want a confirmation when the chip is erased.
Auto flash	Some programmers support auto flash. Pressing F4 will program the chip without showing the programmer window.
Auto verify	Some programmers support verifying. The chip content will be verified after programming.
Upload code and data	Set this option to program both the FLASH memory and the EEPROM memory
	Parallel printer port programmers
LPT address	Port address of the LPT that is connected to the programmer.
	Serial port programmer
COM port	The com port the programmer is connected to.
STK500 EXE	The path of stk500.exe. This is the full file location to the files stk500.exe that comes with the STK500.

USB	For mkII and other Atmel USB programmers you can enter the serial number here. Or you can look it up from the list.
	Other
Use HEX	Select when a HEX file must be sent instead of the bin file.
Program	The program to execute. This is your programmer software.
Parameter	The optional parameter that the program might need. Use {FILE} to insert the binary filename(file.bin) and {EEPROM} to insert the filename of the generated EEP file. When 'Use Hex' is checked the filename (file.hex) will be inserted for {FILE}. In all cases a binary file will be inserted for {EEPROM} with the extension .EEP

Supported Programmers

BASCOM supports the following programmers

AVR ICP910 based on the AVR910.ASM application note

STK200 ISP programmer from Atmel

The PG302 programmer from Iguana Labs

The simple cable programmer from Sample Electronics.

KITSRUS KIT122 Programmer

MCS Universal Interface Programmer

The MCS Universal Interface supports a number of programmers as well. In fact it is possible to support most parallel printer port programmers.

STK500 programmer and Extended STK500 programmer.

Lawicel BootLoader

USB-ISP Programmer

MCS Bootloader

ISP programmer

BASCOM supports the STK200 and STK200+ and STK300 ISP programmer from Atmel.

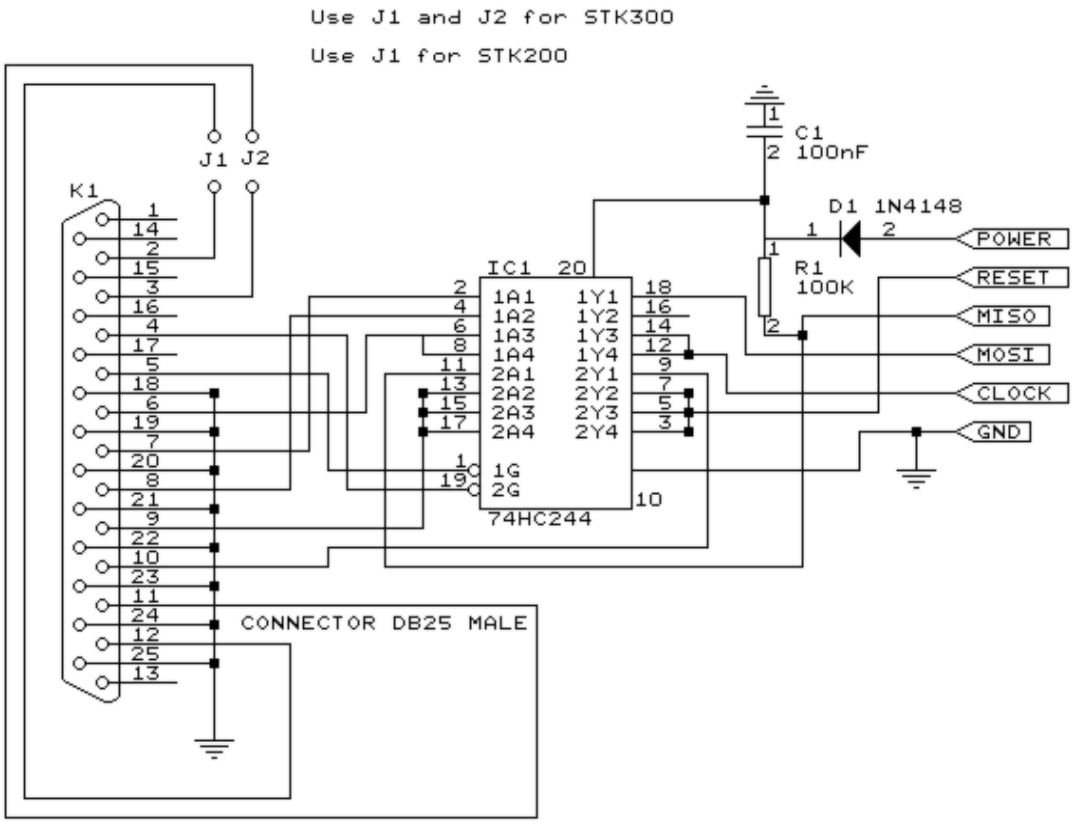
This is a very reliable parallel printer port programmer.
The STK200 ISP programmer is included in the STK200 starter kit.
Most programs were tested with the STK200.

For those who don't have this kit and the programmer the following schematic shows how to make your own programmer:

The dongle has a chip with no identification but since the schematic is all over the web, it is included. MCS also sells a STK200 compatible programmer.

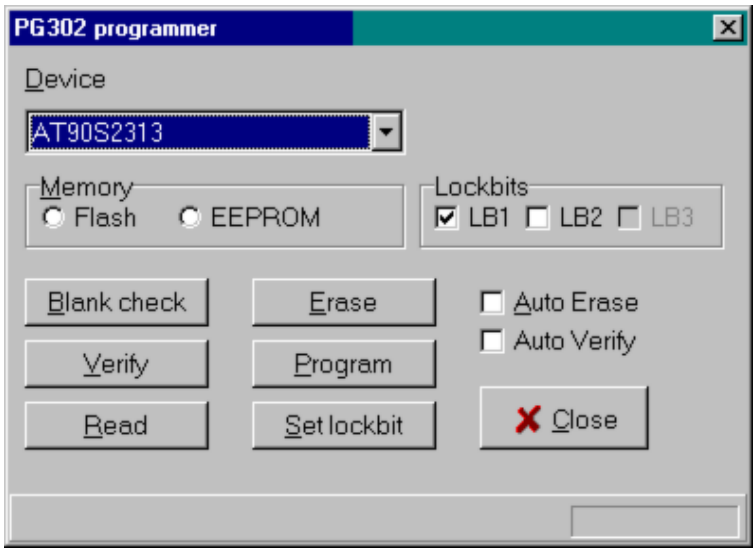
Here is a tip received from a user :

If the parallel port is disconnected from the interface and left floating, the '244 latch outputs will waver, causing your microcontroller to randomly reset during operation. The simple addition of a 100K pull-up resisistor between pin 1 and 20 of the latch, and another between pin 19 and 20, will eliminate this problem. You'll then have HIGH-Z on the latch outputs when the cable is disconnected (as well as when it's connected and you aren't programming), so you can use the MOSI etc. pins for I/O.



PG302 programmer

The PG302 is a serial programmer. It works and looks exactly as the original PG302 software.



Select the programmer from The Option Programmer menu or right click on the button to show the Option Programmer menu

Sample Electronics cable programmer

Sample Electronics submitted the simple cable programmer.

They produce professional programmers too. This simple programmer you can make yourself within 10 minutes.
What you need is a DB25 centronics male connector, a flat cable and a connector that can be connected to the target MCU board.

The connections to make are as following:

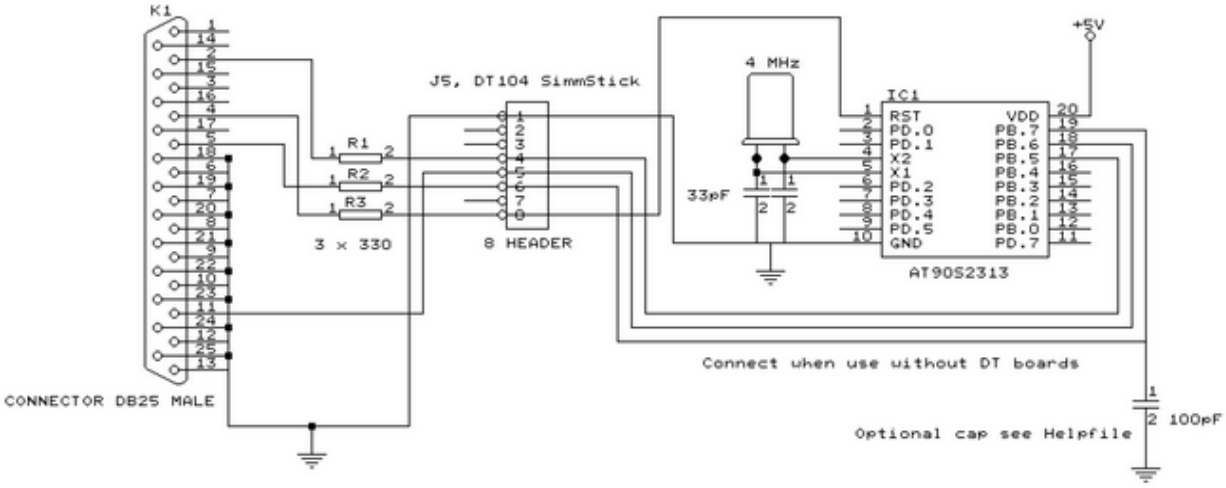
DB25 pin	Target MCU pin(AT90S8535)	Target MCU M103/M128	Target MCU pin 8515	DT104
2, D0	MOSI, pin 6	PE.0, 2	MOSI, 6	J5, pin 4
4, D2	RESET, pin 9	RESET, 20	RESET, 9	J5, pin 8
5, D3	CLOCK, pin 8	PB.1,11	CLOCK, 8	J5, pin 6
11, BUSY	MISO, pin 7	PE.1, 3	MISO, 7	J5, pin 5
18-25,GND	GROUND	GROUND	GND,20	J5, pin 1

The MCU pin numbers are shown for an 8535! And 8515
Note that 18-25 means pins 18,19,20,21,22,23,24 and 25

You can use a small resistor of 100-220 ohm in series with the D0, D2 and D3 line in order not to short circuit your LPT port in the event the MCU pins are high.
It was tested without these resistors and no problems occured.

Tip : when testing programmers etc. on the LPT it is best to buy an I/O card for your PC that has a LPT port. This way you don't destroy your LPT port that is on the motherboard in the event you make a mistake!

The following picture shows the connections to make. Both a setup for the DT104 and stand-alone PCB are shown.



I received the following useful information:

I have been having spurious success with the simple cable programmer from Sample Electronics for the AVR series.
After resorting to hooking up the CRO I have figured it out (I think). When trying to identify the chip, no response on the MISO pin indicates that the Programming Enable command has not been correctly received by the target.

The SCK line Mark/Space times were okay but it looked a bit sad with a slow rise time but a rapid fall time. So I initially tried to improve the rise
time with a pull-up. No change ie still could not identify chip. I was about to add some buffers when I came across an Atmel app note for their serial programmer "During this first phase of the programming cycle, keeping the SCK line free from pulses is critical, as pulses will cause the target AVR to loose synchronization with the programmer. When synchronization is lost, the only means of regaining synchronization is to release the RESET line for more than 100ms."

I have added a 100pF cap from SCK to GND and works first time every time now. The SCK rise time is still sad but there must have been enough noise to corrupt the initial command despite using a 600mm shielded cable.

KITSRUS Programmer

The K122 is a KIT from KITSRUS. (www.kitsrus.com)

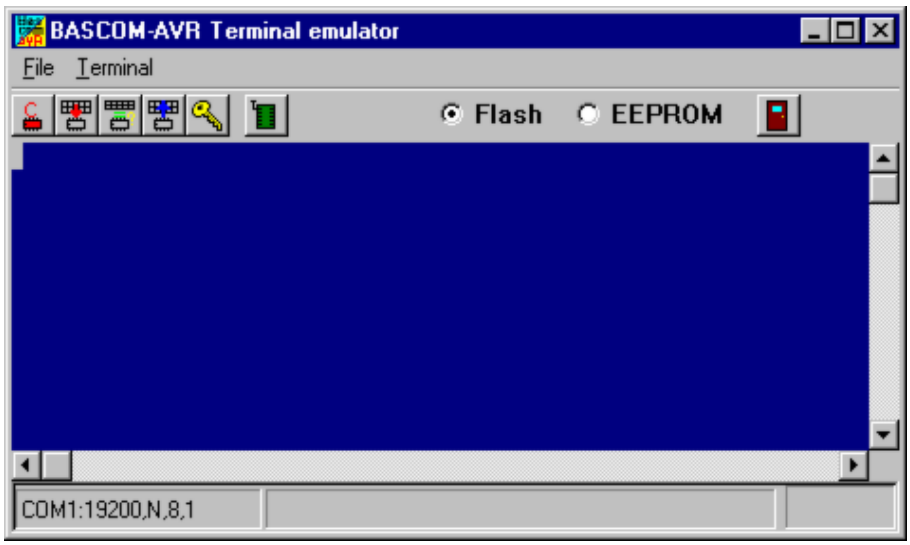
The programmer supports the most popular 20 and 40 pins AVR chips.

On the Programmer Options tab you must select this programmer and the COM port it is

connected to.

On the Monitor Options tab you must specify the upload speed of 9600, Monitor delay of 1 and Prefix delay 1.

When you press the Program button the Terminal Emulator screen will pop up:



A special toolbar is now visible.
You must press the Program enable button to enable the programmer.
When you enable the programmer the right baud rate will be set.
When you are finished you must press the Enable button again to disable it.
This way you can have a micro connected to your COM port that works with a different BAUD rate.
There is an option to select between FLASH and EEPROM.
The prompt will show the current mode which is set to FLASH by default.

The buttons on the toolbar allow you to :
ERASE, PROGRAM, VERIFY, DUMP and set the LOCK BITS.
When DUMP is selected you will be asked for a file name.
When the DUMP is ready you must CLOSE the LOGFILE where the data is stored. This can be done to select the CLOSE LOGFILE option form the menu.

MCS Universal Interface Programmer

The MCS Universal Interface programmer allows you to customize the pins that are used for the ISP interface. The file prog.settings stores the various interfaces.

The content :

;how to use this file to add support for other programmers

;first create a section like [newprog]

; then enter the entries:

```
; BASE= $hexaddress

; MOSI= address in form of BASE[+offset] , bit [,inverted]

; CLOCK= same as MOSI

; RESET=same as MOSI

; MISO=same as MOSI

; The bit is a numer that must be written to set the bit

; for example 128 to set bit 7

; Optional is ,INVERTED to specify that inverse logic is used

; When 128 is specified for the bit, NOT 128 will be written(127)



[FUTURELEC]

;tested and ok
BASE=$378
MOSI=BASE+2,1,inverted
CLOCK=BASE,1
RESET=BASE,2
MISO=BASE+1,64

[sample]
;tested and ok
BASE=$378
MOSI=BASE,1
CLOCK=BASE,8
RESET=BASE,4
MISO=BASE+1,128,INVERTED


[stk200]
;tested and ok
BASE=$378
MOSI=BASE,32
CLOCK=BASE,16
RESET=BASE,128
MISO=BASE+1,64
```

Four programmers are supported : Futurelec, Sample and STK200/STK300 and WinAVR/ SP12.
To add your own programmer open the file with notepad and add a new section name. For the example I will use stk200 that is already in the file.

[stk200]
The LPT base address must be specified. For LPT1 this is in most cases $378. $ means hexadecimal.

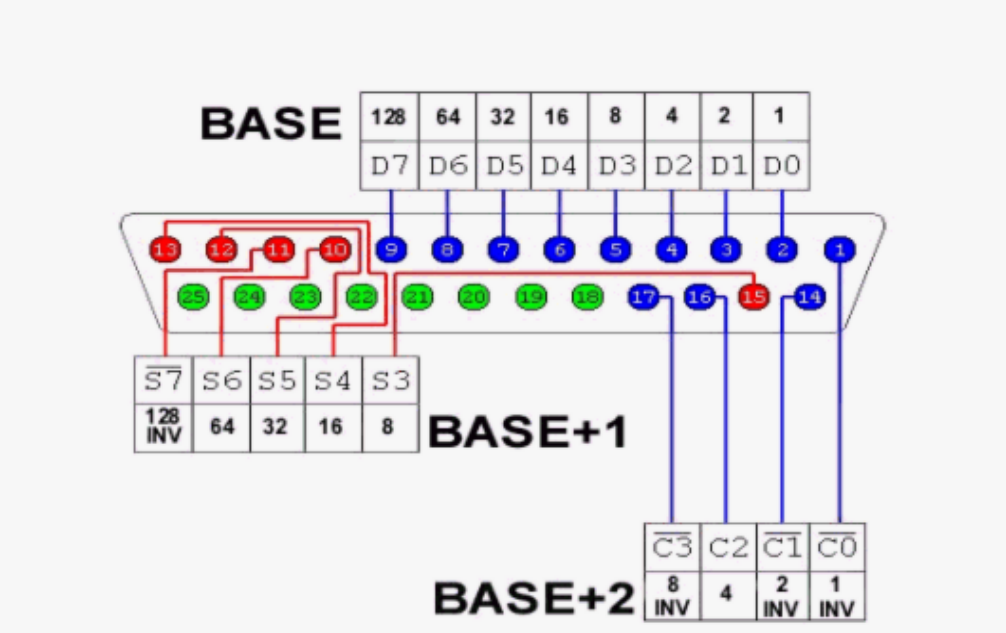
The pins that are needed are MOSI, CLOCK, RESET and MISO.
Add the pin name MOSI =

After the pin name add the address of the register. For the STK200 the data lines are used so

BASE must be specified. After the address of the register, specify the bit number value to set the pin high. Pin 0 will be 1, pin 1 would be 2, pin 2 would be 4 etc. D5 is used for the stk so we specify 32.

When the value is set by writing a logic 0, also specify, INVERTED.
After you have specified all pins, save the file and restart BASCOM.
Select the Universal Programmer Interface and select the entry you created.
After you have selected an entry save your settings and exit BASCOM. At the next startup of BASCOM, the settings will be used.

The following picture shows the LPT connector and the relation of the pins to the LPT registers.



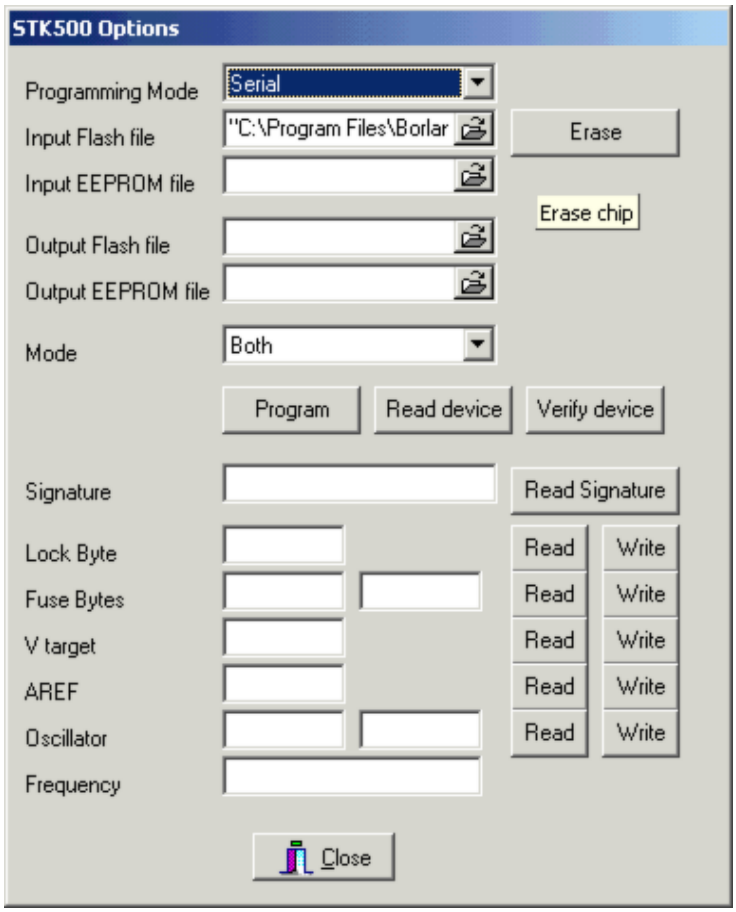
Always add your entry to the bottom of the file and email the settings to support@mcselec.com so it can be added to BASCOM.

STK500 Programmer

When you select the STK500 programmer, BASCOM will run the files named stk500.exe that is installed with AVR Studio.

That is why you have to specify the file location of the stk500.exe
The normal STK500 support will erase, and program the flash.
The STK500.EXE supports a number of Atmel programmers which all use the STK500 V1 or V2 protocol.
For the AVR ISP mkII, you need to supply the serial number of the USB programmer. The USB port will be used then instead of the serial port.

The extended STK500 support will show the following window:



Option	Description
Programming mode	Serial or parallel. Some options require the parallel mode.
Input Flash File	The program HEX file. It is loaded automatic
Input EEPROM File	The program EEP file. It is loaded automatic when it exists
Output Flash File	The name of the output flash file. Only needed when you want to read a device.
Output EEPROM File	The name of the output EEPROM file. Only needed when you want to read the EEPROM from a device
Mode	Both will work on the FLASH and EEPROM, Flash will only work on the FLASH ROM and EEPROM will only work on the EEPROM. Use both when you want to program both a program and an EEPROM (EEP) file.
Erase	Erase chip. Must be done before programming the chip.
Program	Program the chip
Read device	Read the flash and or EEPROM content and store in the specified files.
Verify device	Verify the chip content with the files.
Read signature	Read the signature bytes that identify the chip.
Read/Write Lock Byte	Read and write the lock byte. Hex notation!
Read/Write Fuse Bytes	Read and write the fuse bytes. Hex notation!
Read/Write Vtarget	Read or set the Vtarget voltage
Read/Write Aref	Read or set the Aref voltage
Read/Write oscillator	Read or write the oscillator settings
Read/Write frequency	Read or set the board frequency

All options will set the command line parameters. A file named stk500.cmd will be created by the compiler with the proper syntax.

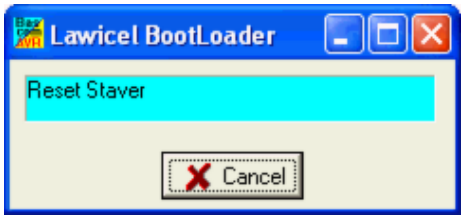
This file will be executed and the result is stored in the stk500.log file.

Lawicel BootLoader

The Lawicel Bootloader must be used with the StAVeR. The StAVeR contains a bootloader so you only need a serial interface, no parallel programmer or other programmers.

You can also use Hyperterminal.

When you have selected the Lawicel Bootloader from the Options, Programmer, the following window will appear when you press F4.



As the window suggests, press the reset button on the activity board or StAVeR, and the chip will be programmed. This is visible by a second wind that will be shown during programming.

When the programming succeeds, both windows will be closed.

When an error occurs, you will get an error message and you can clock the Cancel button in order to return to the Editor.

AVR ISP Programmer

The AVRISP programmer is AVR ICP910 based on the AVR910.ASM application note.

The old ICP910 does not support Mega chips. Only a modified version of the AVR910.ASM supports Universal commands so all chips can be programmed.

The new AVRISP from Atmel that can be used with AVR Studio, is not compatible! You need to select STK500 programmer because the new AVRISP programmer from Atmel, uses the STK500 protocol.

When you do not want to use the default baud rate that AVR910 is using, you can edit the file bascavr.ini from the Windows directory.
Add the section [AVRISP]
Then add: COM=19200,n,8,1

This is the default. When you made your own dongle, you can increase the baud rate

You need to save the file and restart BASCOM before the settings will be in effect.

USB-ISP Programmer

The USB-ISP Programmer is a special USB programmer that is fully compatible with BASCOM's advanced programmer options.
Since many new PC's and especial Laptop's do not have a parallel programmer anymore, MCS selected the USB-ISP programmer from EMBUD.

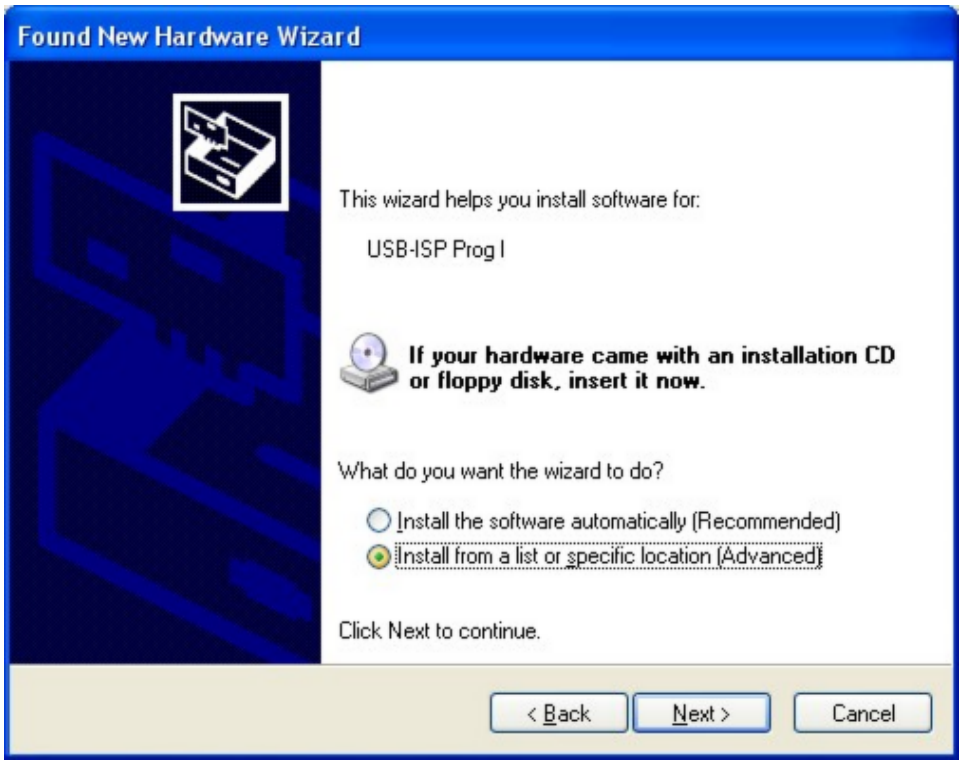
The drivers are located in the USB sub directory that is located in the BASCOM-AVR appliation folder.

When you connect the programmer, Windows (98, ME, 2000, XP) will recognize the new device automaticly.

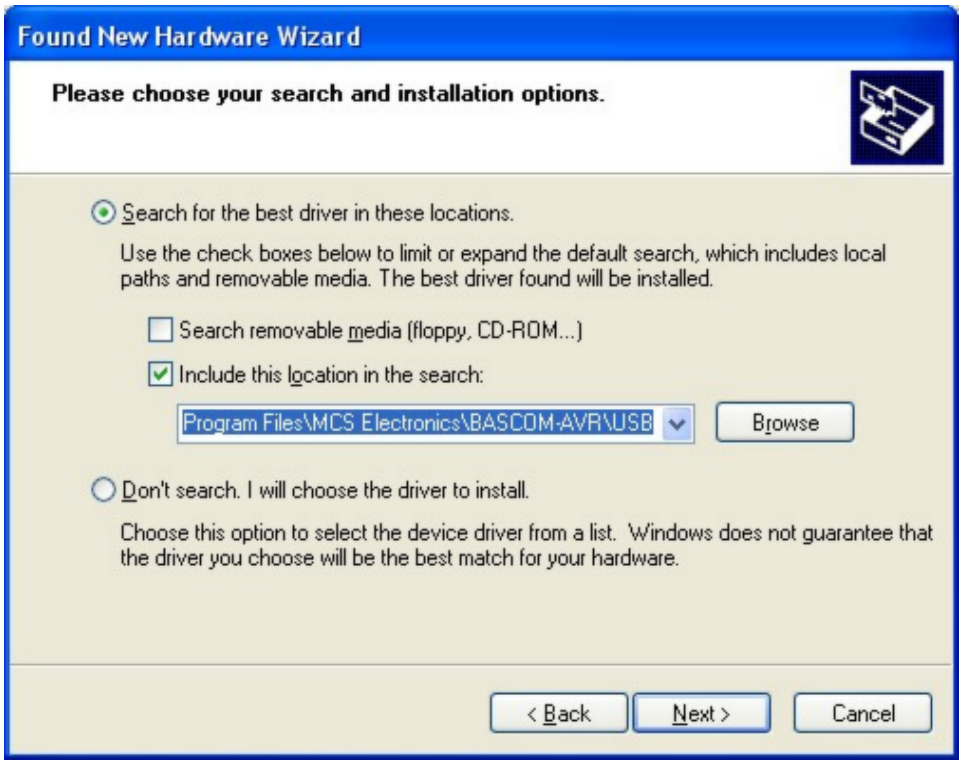
Then the Hardware wizard will be started :

Select 'No, not this time' and click Next, as there is no driver at Microsofts web.

The Wiz will show :



You need to select 'Install from a list or specific location' and click Next.



You can specify the path of the USB driver. This is by default :

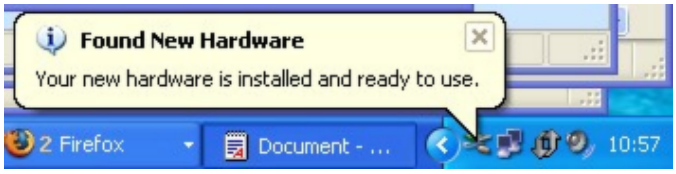
C:\Program Files\MCS Electronics\BASCOM-AVR\USB

Use the Browse-button to select it, or a different location, depending on your installation.

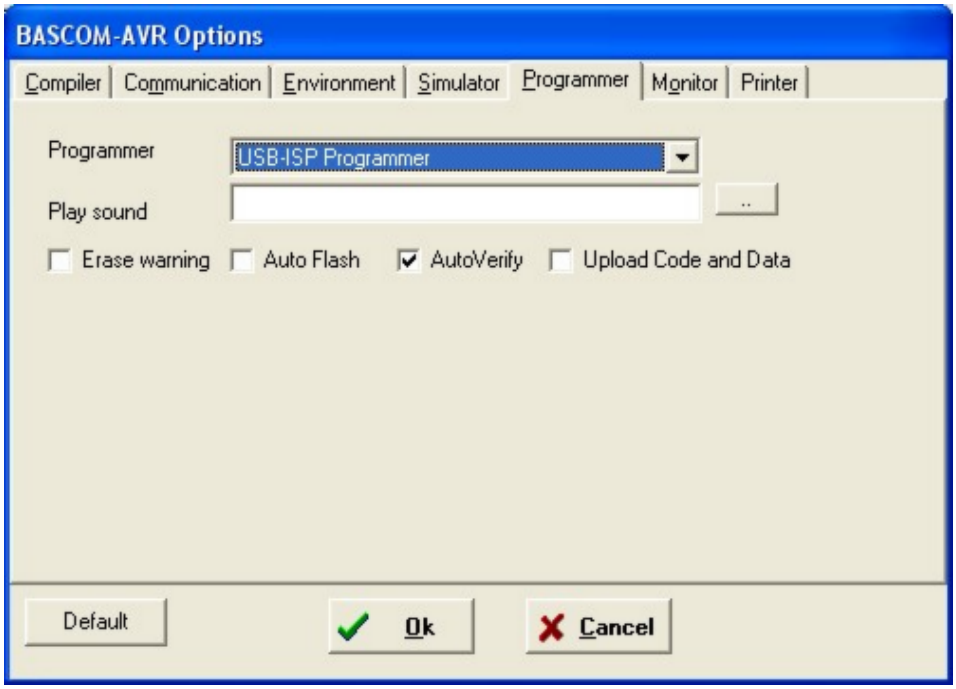
As the driver is not certified by Microsft, you will see the following window:

You need to select 'Continue Anyway'. A restore point will be made if your OS supports this and the driver will be installed.
After installation you must see the following window :

After you press Finish you will see Windows can use the programmer :



In BASCOM , Options, Programmer you can select the new programmer now.
There are no specific options for the USB programmer.



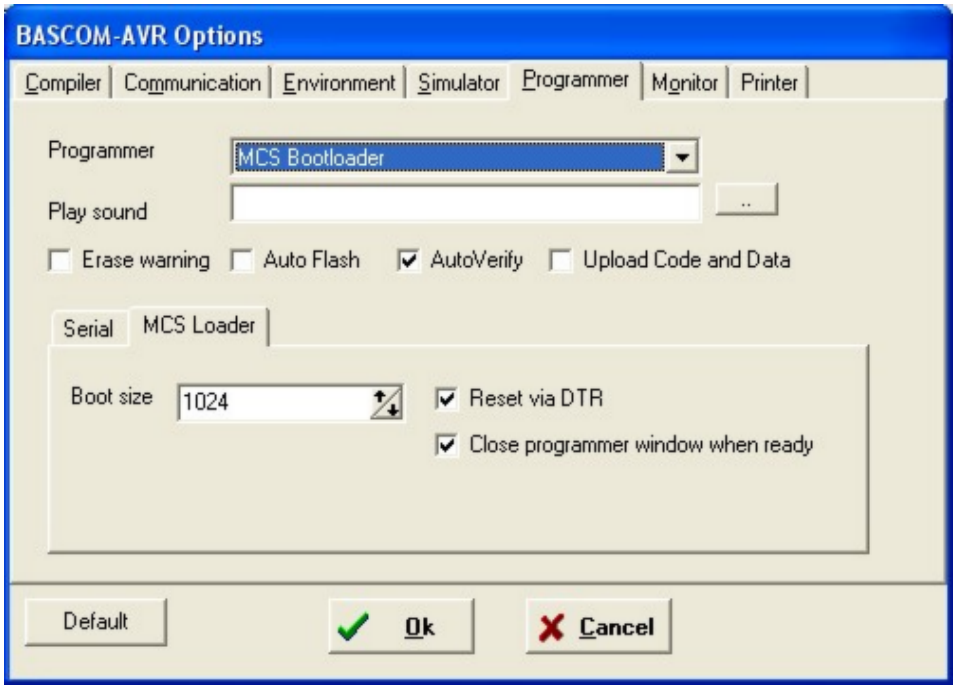
So only the basic programming options are visible.
The USB-ISP programmer is very quick and supports all options that the Sample Electronics and STK200 programmers support.

MCS Bootloader

The MCS Boot loader is intended to be used with the $LOADER sample.
It uses the X-modem Checksum protocol to upload the binary file. It works very quick.
The Boot loader sample can upload both normal flash programs and EEPROM images.
The Boot loader sends a byte with value of 123 to the AVR Boot loader. This boot loader program then enter the boot loader or will jump to the reset vector (0000) to execute the normal flash program.

When it receive 124 instead of 123, it will upload the EEPROM.
When you select a BIN file the flash will be uploaded. When you select an EEP file, the EEPROM will be uploaded.

The Boot loader has some specific options.

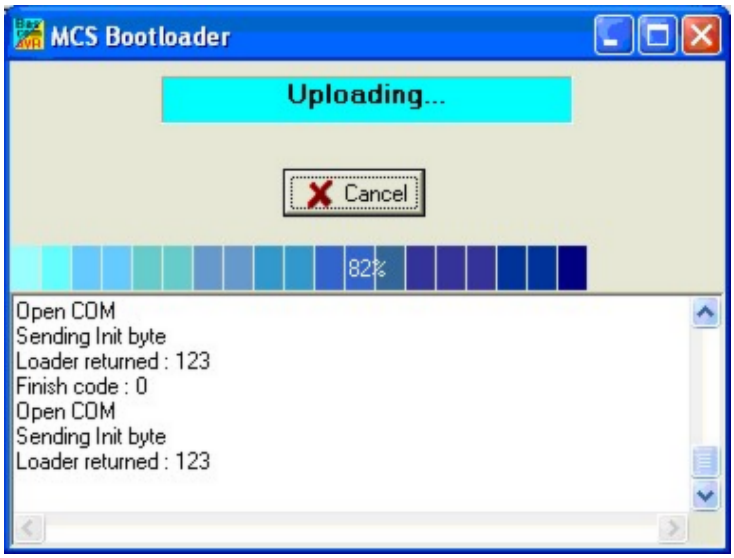


You can choose the boot size which is 1024 for the BASCOM $LOADER example.
Since this space is used from the normal flash memory, it means your application has 1024 less words for the main application. (A word is 2 byte, so 2KB less)

The boot loader is started when the chip is reset. Thus you need to reset the chip after you have pressed F4(program). But when you have connected the DTR line to the chip reset (with a MAX232 buffer) you can reset the chip automatically. You do need to set the 'Reset via DTR' option then.

By choosing 'Close programmer window when ready' the window will be closed when the loader returns 0.
In all other cases it will remain opened so you can look at a possible cause.

After you have pressed F4 to following window will appear :



As you can see, the loader sends a byte with value of 123.
You need to reset the chip, and then you see that the loader returned 123 which means it received the value.
It will start the upload and you see a progress bar. After the loader is ready, you see a finish code of 0.
A finish code of 0 means that all wend well.
Other finish codes will not close the window even if this option is enabled.
You need to manual close the window then.

Options Monitor

With this option you can modify the monitor settings.

OPTION	DESCRIPTION
Upload speed	Selects the baud rate used for uploading
Monitor prefix	String that will be send to the monitor before the upload starts
Monitor suffix	String that us sent to the monitor after the download is completed.
Monitor delay	Time in milliseconds to wait after a line has been sent to the monitor.
Prefix delay	Time in milliseconds to wait after a prefix has been sent to the monitor.

Options Printer

With this option you can modify the printer settings.

There are only settings to change the margins of the paper.

OPTION	DESCRIPTION
Left	The left margin.
Right	The right margin.
Top	The top margin.

Bottom	The bottom margin.

Window Cascade

Cascade all open editor windows.

Window Tile

Tile all open editor windows.

Window Arrange Icons

Arrange the icons of the minimized editor windows.

Window Minimize All

Minimize all open editor windows.

Help About

This option shows an about box as shown below.

Your serial number is shown on the second line of the about box.
You will need this when you have questions about the product.

You can compare it with the one on our web site in case you need an update.

Click on Ok to return to the editor.

Help Index

Shows the BASCOM help file.

When you are in the editor window, the current word selected or by the cursor will be used as a keyword.

Help on Help

Shows help on how to use the Windows help system.

Help MCS Forum

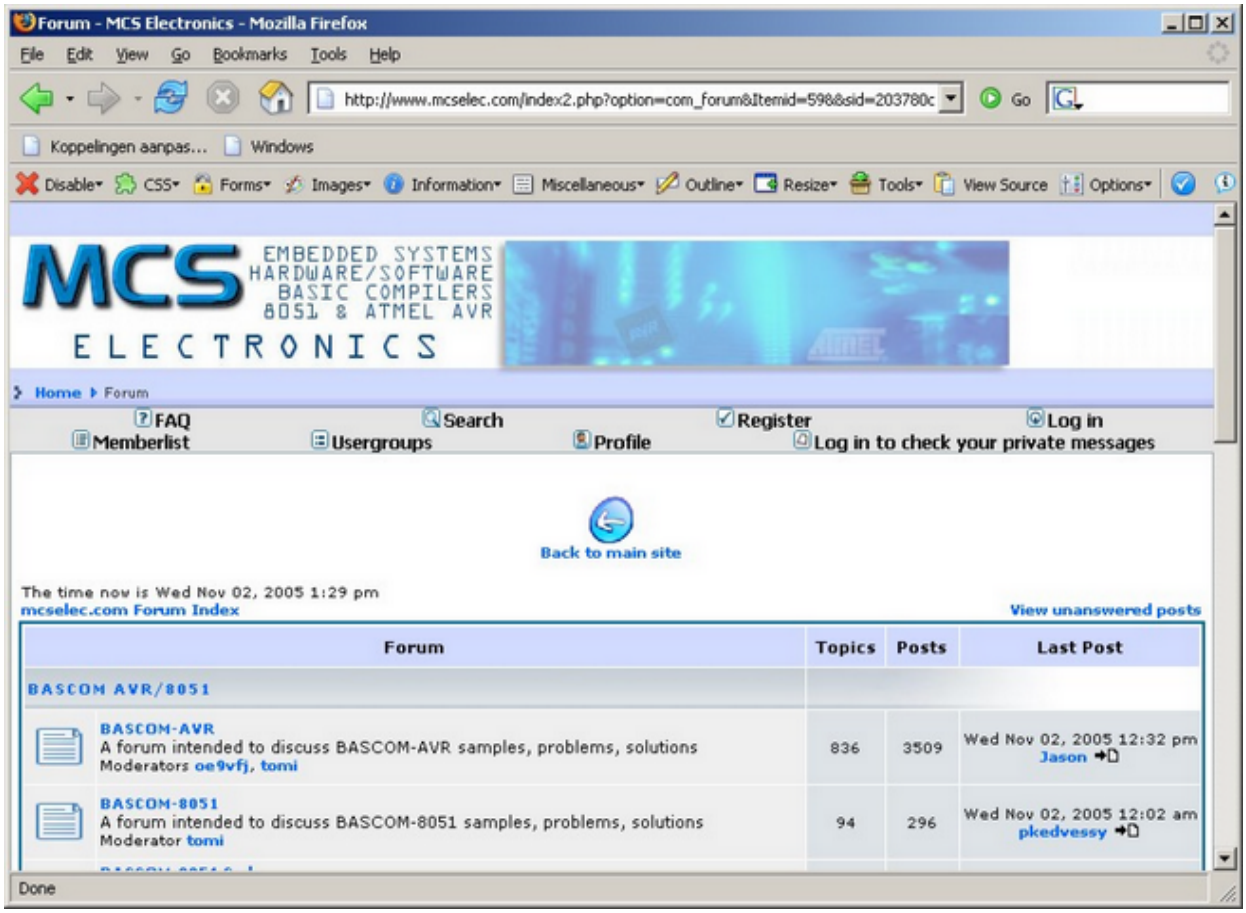
This option will start your default Webbrowser and direct it to
http://www.mcselec.com/index2.php?option=com_forum&Itemid=59

This forum is hosted by MCS Electronics. There are various forums available. You can post your questions there. Do not cross post your questions on multiple forums and to support.

The forum is available for all users : demo or commercial users.
Note that everything you write might be on line for ever. So mind your language.

Users of the commercial version can email MCS support.

The forum allows uploads for code examples, circuits etc.
If you try to abuse the forum or any other part of the MCS web, you will be banned from the site.

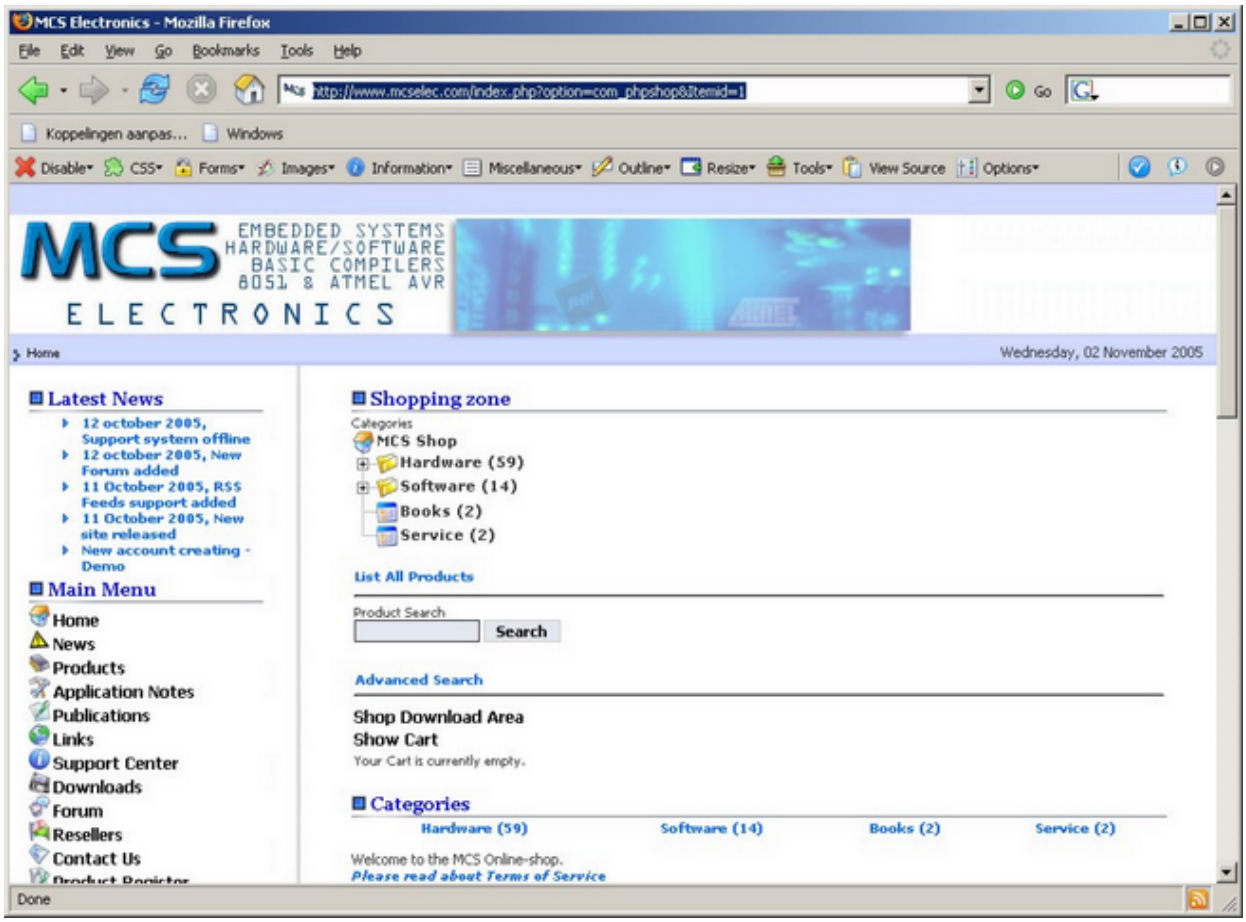


Help MCS Shop

This option will start your default web browser and direct it to
http://www.mcselec.com/index.php?option=com_phpshop&Itemid=1

You can order items and pay with PayPal. PayPal will accept most credit cards.

Before you order, it is best to check the resellers page to find a reseller near you. Resellers can help you in your own language, have all MCS items on stock, and are in the same time zone.



Before you can order items, you need to create an account.
Read the following about the new website :
http://www.mcselec.com/index.php?option=com_content&task=view&id=133&Itemid=1

Help Support

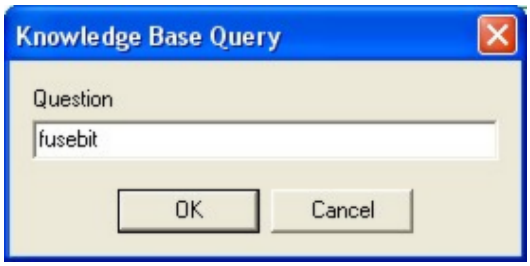
This option will start your default browser with the following URL :

http://www.mcselec.com/support-center/

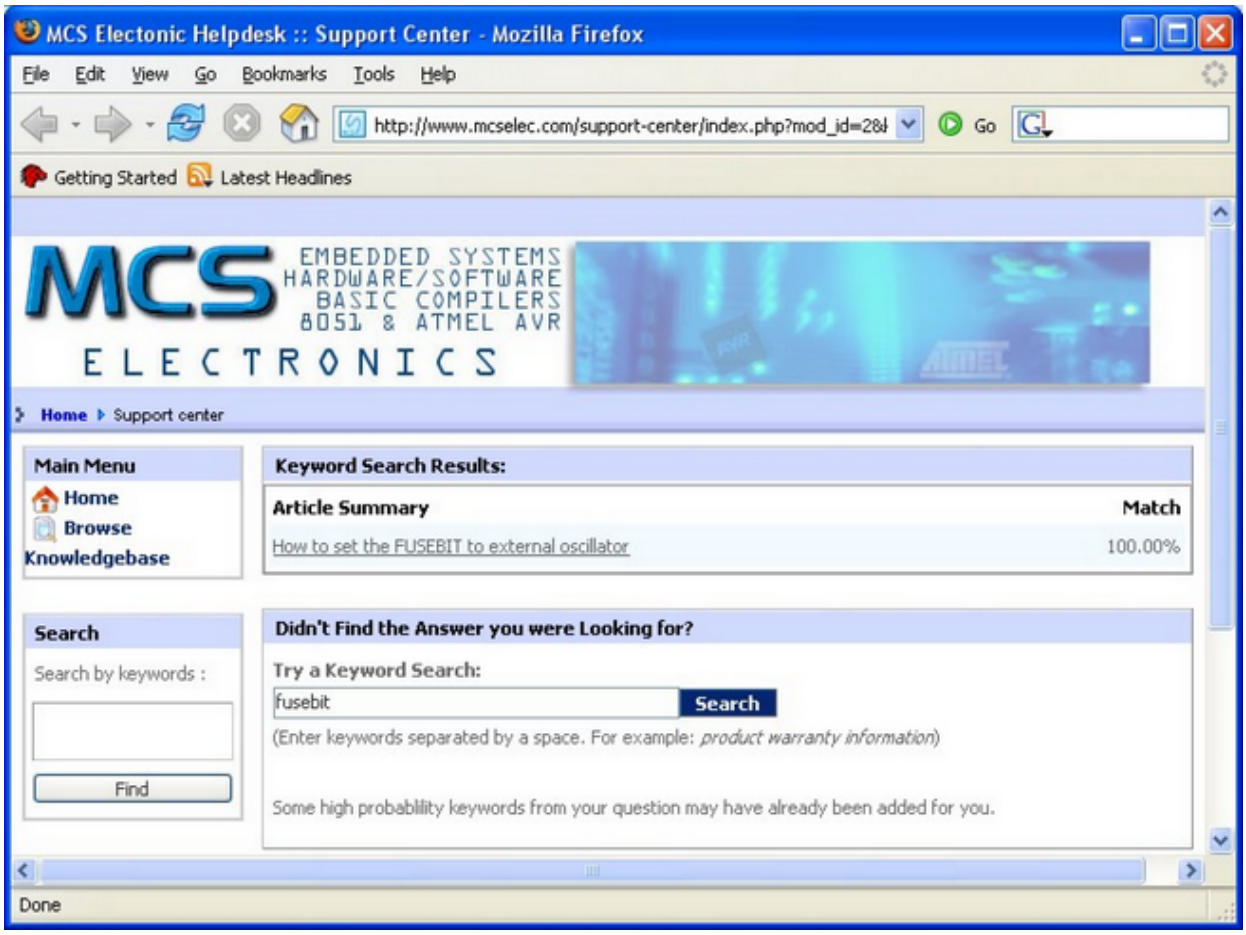
It depends from your browser settinge if a new window or TAB will be created.
At the support site you can browse articles. You can also search on keywords.

Help Knowledge Base

This option will ask you to enter a search string.



This search string will be passed to the MCS support site.
The above example that searches for "FUSEBIT" will result in the following :



You can click one of the found articles to read it.

Help Credits

BASCOM was invented in 1995. Many users gave feedback and helped with tips, code, suggestions, support, a user list, and of course with buying the software.
The software improved a lot during the last 10 years and will so during the next decade.

While it is impossible to thank everybody there are a few people that deserve credits :

- Josef Franz Vögel. He wrote a significant part of the libraries in BASCOM-AVR. He is also author of AVR-DOS.

- Dr.-Ing. Claus Kuehnel for his book 'AVR RISC' , that helped me a lot when I began to study the AVR chips. Check his website at http://www.ckuehnel.ch
- Atmel, who gave permission to use the AVR picture in the start up screen. And for the great tech support. Check their website at http://www.atmel.com
- Brian Dickens, who did most of the Beta testing. He also checked the documentation on grammar and spelling errors. (he is not responsible for the spelling errors i added later :-))
- Jack Tidwell. I used his FP unit for singles. It is the best one available.

BASCOM Editor Keys

Key	Action
LEFT ARROW	One character to the left
RIGHT ARROW	One character to the right
UP ARROW	One line up
DOWN ARROW	One line down
HOME	To the beginning of a line
END	To the end of a line
PAGE UP	Up one window
PAGE DOWN	Down one window
CTRL+LEFT	One word to the left
CTRL+RIGHT	One word to the right
CTRL+HOME	To the start of the text
CTRL+END	To the end of the text
CTRL+ Y	Delete current line
INS	Toggles insert/over strike mode
F1	Help (context sensitive)
F2	Run simulator
F3	Find next text
F4	Send to chip (run flash programmer)
F5	Run
F7	Compile File
F8	Step
F9	Set breakpoint
F10	Run to
CTRL+F7	Syntax Check
CTRL+F	Find text
CTRL+G	Go to line
CTRL+K+x	Toggle bookmark. X can be 1-8
CTRL+L	LCD Designer
CTRL+M	File Simulation
CTRL+N	New File
CTRL+O	Load File
CTRL+P	Print File

CTRL+Q+x	Go to Bookmark. X can be 1-8
CTRL+R	Replace text
CTRL+S	Save File
CTRL+T	Terminal emulator
CTRL+P	Compiler Options
CTRL+W	Show result of compilation
CTRL+X	Cut selected text to clipboard
CTRL+Z	Undo last modification
SHIFT+CTRL+Z	Redo last undo
CTRL+INS	Copy selected text to clipboard
SHIFT+INS	Copy text from clipboard to editor
CTRL+SHIFT+J	Indent Block
CTRL+SHIFT+U	Unindent Block
Select text	Hold the SHIFT key down and use the cursor keys to select text. or keep the left mouse key pressed and drag the cursor over the text to select.

Program Development Order

- Start BASCOM
- Open a file or create a new one
- ! Important ! Check the chip settings, baud rate and frequency settings for the target system
- Save the file
- Compile the file (this will also save the file !!!)
- If an error occurs fix it and recompile (F7)
- Run the simulator(F2)
- Program the chip(F4)

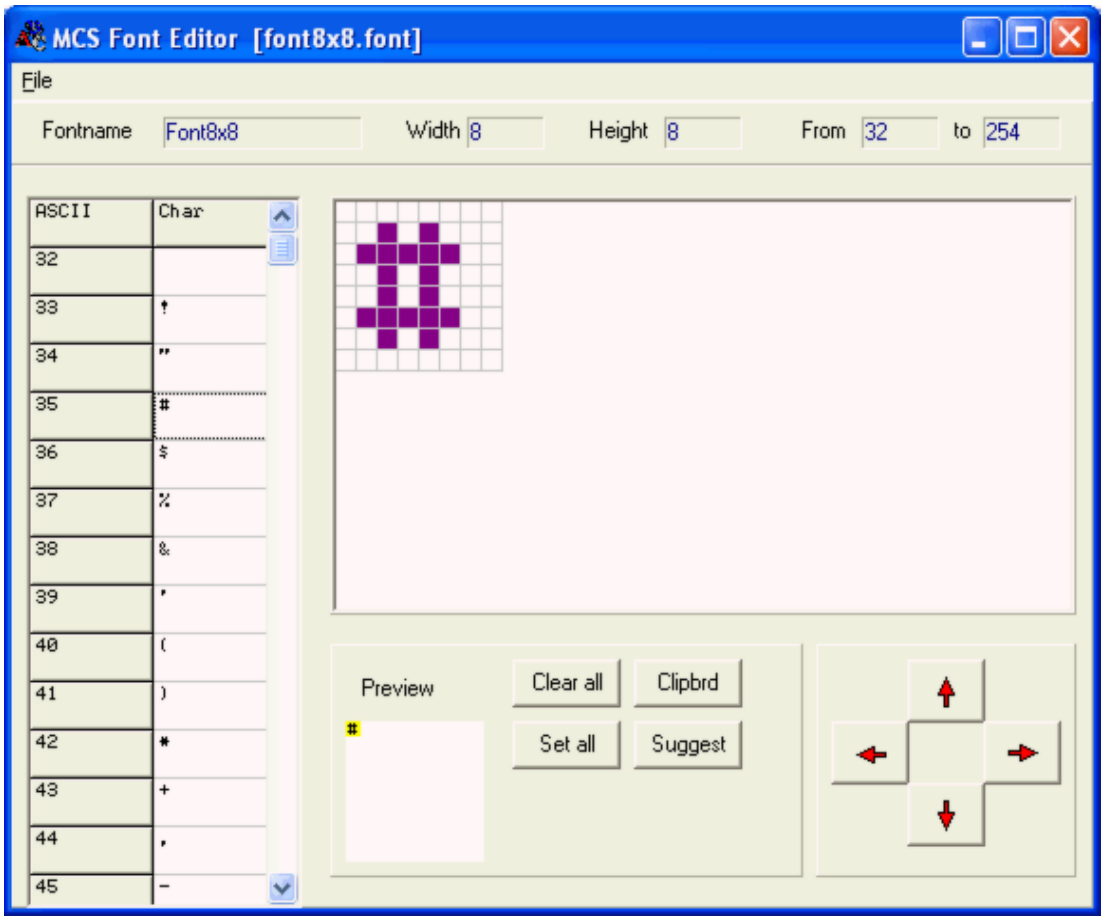
PlugIns

Font Editor

The Font Editor is a Plugin that is intended to create Fonts that can be used with Graphical display such as SED1521, KS108, color displays, etc.

When you have installed the Font Editor , a menu option becomes available under the Tools menu : Font Editor.

When you choose this option the following window will appear:



You can open an existing Font file, or Save a modified file.

The supplied font files are installed in the Samples directory.
You can copy an image from the clipboard, and you can then move the image up , down, left and right.

When you select a new character, the current character is saved. The suggest button will draw an image of the current selected character.

When you keep the left mouse button pressed, you can set the pixels in the grid. When you keep the right mouse button pressed, you can clear the pixels in the grid.

When you choose the option to create a new Font, you must provide the name of the font, the height of the font in pixels and the width of the font in pixels.

The Max ASCII is the last ASCII character value you want to use. Each character will occupy space. So it is important that you do not choose a value that is too high and will not be used.

When you display normal text, the maximum number is 127 so it does not make sense to specify a value of 255.

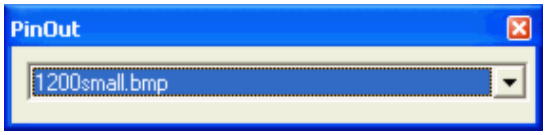
PinOut

This Plugin is based on the PinOut Viewer from Karl Jan Skontorp.

You can download the Karl Jan's program from the MCS website

This program contains all the pinput pictures of the AVR chips.
The PinOut Plugin uses the same pictures , or you can add your own pictures.

When the Plugin is selected it will show a small window :



When you choose, a picture from the list will be displayed.

BASCOM HARDWARE

Additional Hardware

Of course just running a program on the chip is not enough. You will probably attach many types of electronic devices to the processor ports.
BASCOM supports a lot of hardware and so it has lots of hardware related statements.
Before explaining about programming the additional hardware, it might be better to talk about the chip.

The AVR internal hardware

Attaching an LCD display

Using the I2C protocol

Using the 1WIRE protocol

Using the SPI protocol

You can attach additional hardware to the ports of the microprocessor.
The following statements will then be able to be used:

I2CSEND and I2CRECEIVE and other I2C related statements.

CLS,LCD,DISPLAY and other related LCD-statements.

1WRESET , 1WWRITE and 1WREAD

AVR Internal Hardware

The AVR chips all have internal hardware that can be used.

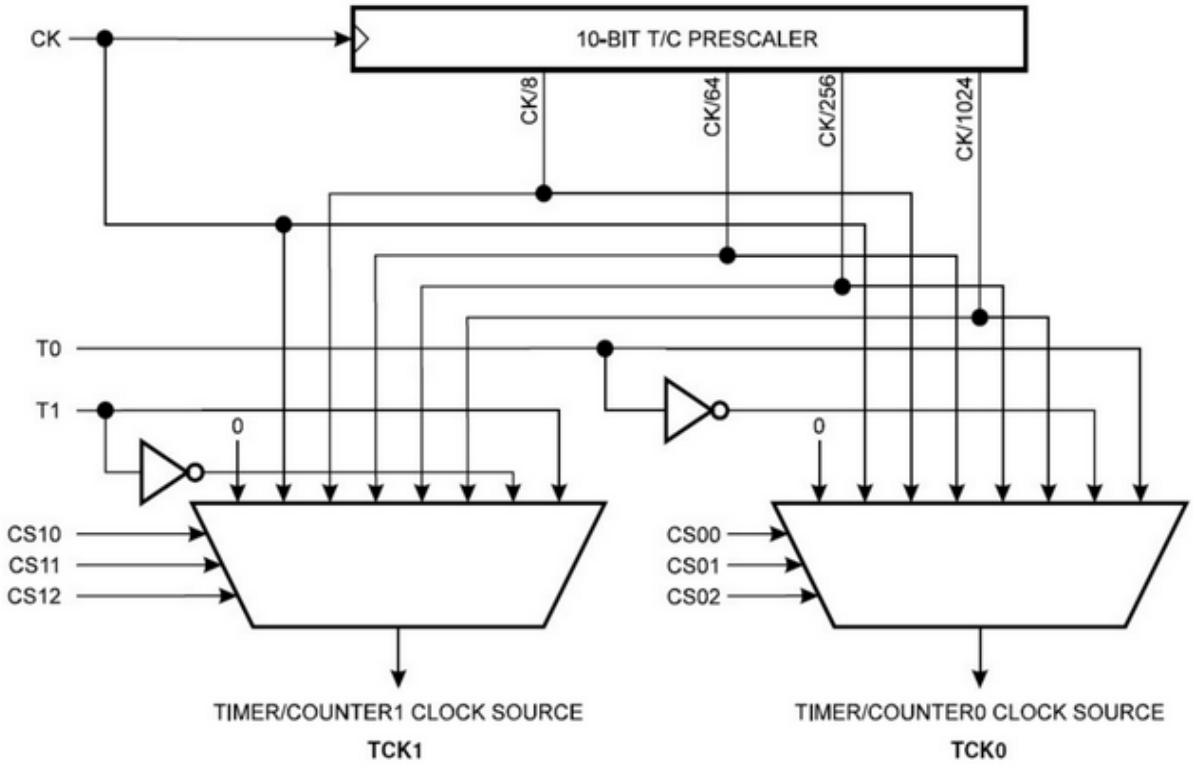
For this description of the hardware the 90S8515 was used. Newer chips like the Mega8515 may differ and have more or less internal hardware.

You will need to read the manufacturers data sheet for the processor you are using to learn about the special internal hardware available.

Timer / Counters

The AT90S8515 provides two general purpose Timer/Counters - one 8-bit T/C and one 16-bit T/C. The Timer/Counters have individual pre-scaling selection from the same 10-bit pre-scaling timer. Both Timer/Counters can either be used as a timer with an internal clock time base or as a counter with an external pin connection which triggers the counting.

Figure 28. Timer/Counter Prescaler



More about TIMER0

More about TIMER1

The WATCHDOG Timer

Almost all AVR chips have the ports B and D. The 40 or more pin devices also have ports A and C that also can be used for addressing an external RAM chip (XRAM). Since all ports are similar except that PORT B and PORT D have alternative functions, only these ports are described.

PORT B
PORT D

AVR Internal Registers

You can manipulate the internal register values directly from Bascom. They are also reserved words. Each register acts like a memory location or program variable, except that the bits of each byte have a special meaning. The bits control how the internal hardware functions, or report the status of internal hardware functions. Read the data sheet to determine what each bit function is for.

The internal registers for the AVR90S8515 are : (other processors are similar, but vary)

Addr.	Register
$3F	SREG I T H S V N Z C

$3E	SPH SP15 SP14 SP13 SP12 SP11 SP10 SP9 SP8
$3D	SPL SP7 SP6 SP5 SP4 SP3 SP2 SP1 SP0
$3C	Reserved
$3B	GIMSK INT1 INT0 - - - - - -
$3A	GIFR INTF1 INTF0
$39	TIMSK TOIE1 OCIE1A OCIE1B - TICIE1 - TOIE0 -
$38	TIFR TOV1 OCF1A OCF1B -ICF1 -TOV0 -
$37	Reserved
$36	Reserved
$35	MCUCR SRE SRW SE SM ISC11 ISC10 ISC01 ISC00
$34	Reserved
$33	TCCR0 - - - - - CS02 CS01 CS00
$32	TCNT0 Timer/Counter0 (8 Bit)
$31	Reserved
$30	Reserved
$2F	TCCR1A COM1A1 COM1A0 COM1B1 COM1B0 - -PWM11 PWM10
$2E	TCCR1B ICNC1 ICES1 - - CTC1 CS12 CS11 CS10
$2D	TCNT1H Timer/Counter1 - Counter Register High Byte
$2C	TCNT1L Timer/Counter1 - Counter Register Low Byte
$2B	OCR1AH Timer/Counter1 - Output Compare Register A High Byte
$2A	OCR1AL Timer/Counter1 - Output Compare Register A Low Byte
$29	OCR1BH Timer/Counter1 - Output Compare Register B High Byte
$28	OCR1BL Timer/Counter1 - Output Compare Register B Low Byte
$27	Reserved
$26	Reserved
$25	ICR1H Timer/Counter1 - Input Capture Register High Byte
$24	ICR1L Timer/Counter1 - Input Capture Register Low Byte
$23	Reserved
$22	Reserved
$21	WDTCR - - - WDTOE WDE WDP2 WDP1 WDP0
$20	Reserved
$1F	Reserved - - - - - - - EEAR8
$1E	EEARL EEPROM Address Register Low Byte
$1D	EEDR EEPROM Data Register
$1C	EECR - - - - - EEMWE EEWE EERE
$1B	PORTA PORTA7 PORTA6 PORTA5 PORTA4 PORTA3 PORTA2 PORTA1 PORTA0
$1A	DDRA DDA7 DDA6 DDA5 DDA4 DDA3 DDA2 DDA1 DDA0
$19	PINA PINA7 PINA6 PINA5 PINA4 PINA3 PINA2 PINA1 PINA0
$18	PORTB PORTB7 PORTB6 PORTB5 PORTB4 PORTB3 PORTB2 PORTB1 PORTB0
$17	DDRB DDB7 DDB6 DDB5 DDB4 DDB3 DDB2 DDB1 DDB0
$16	PINB PINB7 PINB6 PINB5 PINB4 PINB3 PINB2 PINB1 PINB0
$15	PORTC PORTC7 PORTC6 PORTC5 PORTC4 PORTC3 PORTC2 PORTC1 PORTC0
$14	DDRC DDC7 DDC6 DDC5 DDC4 DDC3 DDC2 DDC1 DDC0
$13	PINC PINC7 PINC6 PINC5 PINC4 PINC3 PINC2 PINC1 PINC0

$12	PORTD PORTD7 PORTD6 PORTD5 PORTD4 PORTD3 PORTD2 PORTD1 PORTD0
$11	DDRD DDD7 DDD6 DDD5 DDD4 DDD3 DDD2 DDD1 DDD0
$10	PIND PIND7 PIND6 PIND5 PIND4 PIND3 PIND2 PIND1 PIND0
$0F	SPDR SPI Data Register
$0E	SPSR SPIF WCOL - - - - - -
$0D	SPCR SPIE SPE DORD MSTR CPOL CPHA SPR1 SPR0
$0C	UDR UART I/O Data Register
$0B	USR RXC TXC UDRE FE OR - - -
$0A	UCR RXCIE TXCIE UDRIE RXEN TXEN CHR9 RXB8 TXB8
$09	UBRR UART Baud Rate Register
$08	ACSR ACD - ACO ACI ACIE ACIC ACIS1 ACIS0
$00	Reserved

The registers and their addresses are defined in the xxx.DAT files which are placed in the BASCOM-AVR application directory.

The registers can be used as normal byte variables.

PORTB = 40 will place a value of 40 into port B.

Note that internal registers are reserved words. This means that they can't be dimensioned as BASCOM variables!

So you can't use the statement DIM SREG As Byte because SREG is an internal register.

You can however manipulate the register with the SREG = value statement, or var = SREG statement.

AVR Internal Hardware TIMER0

The 8-Bit Timer/Counter0

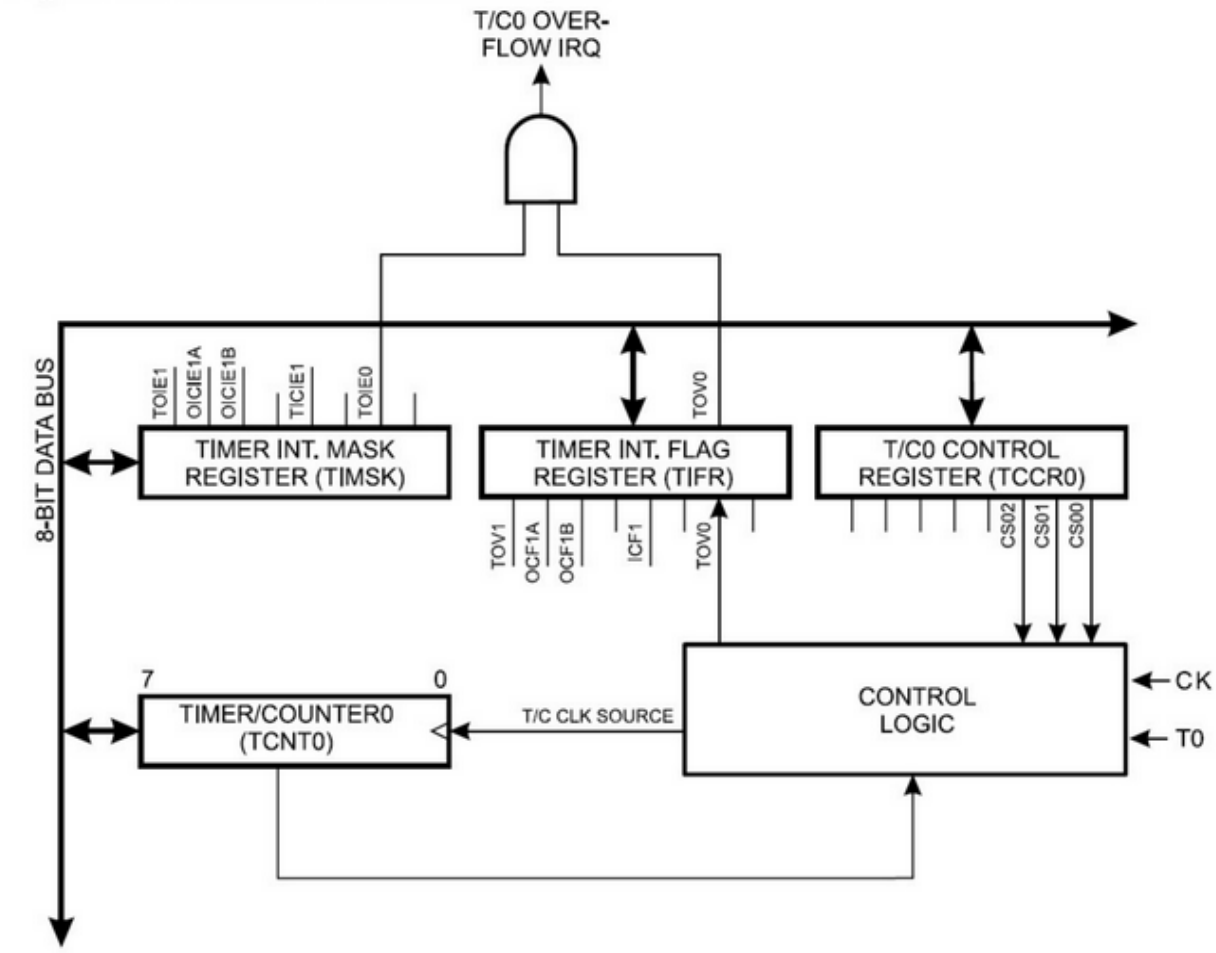
The 90S8515 was used for this example. Other chips might have a somewhat different timer.
The 8-bit Timer/Counter0 can select its clock source from CK, pre-scaled CK, or an external pin. In addition it can be stopped (no clock).

The overflow status flag is found in the Timer/Counter Interrupt Flag Register - TIFR. Control signals are found in the Timer/Counter0 Control Register - TCCR0. The interrupt enable/disable settings for Timer/Counter0 are found in the Timer/Counter Interrupt Mask Register - TIMSK.

When Timer/Counter0 is externally clocked, the external signal is synchronized with the oscillator frequency of the CPU. To assure proper sampling of the external clock, the minimum time between two external clock transitions must be at least one internal CPU clock

period. The external clock signal is sampled on the rising edge of the internal CPU clock.

Figure 29. Timer/Counter0 Block Diagram



The 8-bit Timer/Counter0 features both a high resolution and a high accuracy mode with lower pre-scaling values. Similarly, high pre-scaling values make the Timer/Counter0 useful for lower speed functions or exact timing functions with infrequent actions.

AVR Internal Hardware TIMER1

The 16-Bit Timer/Counter1

The 90S8515 was used for the documentation. Other chips might have a somewhat different timer.

The 16-bit Timer/Counter1 can select its clock source from CK, pre-scaled CK, or an external pin. In addition it can be stopped (no clock).

The different status flags (overflow, compare match and capture event) and control signals are found in the Timer/Counter1 Control Registers - TCCR1A and TCCR1B.

The interrupt enable/disable settings for Timer/Counter1 are found in the Timer/Counter Interrupt Mask Register - TIMSK.

When Timer/Counter1 is externally clocked, the external signal is synchronized with the oscillator frequency of the CPU. To assure proper sampling of the external clock, the minimum time between two external clock transitions must be at least one internal CPU clock period.

The external clock signal is sampled on the rising edge of the internal CPU clock.

The 16-bit Timer/Counter1 features both a high resolution and a high accuracy usage with lower pre-scaling values.

Similarly, high pre-scaling values make the Timer/Counter1 useful for lower speed functions or exact timing functions with infrequent actions.

The Timer/Counter1 supports two Output Compare functions using the Output Compare Register 1 A and B -OCR1A and OCR1B as the data values to be compared to the Timer/Counter1 contents.

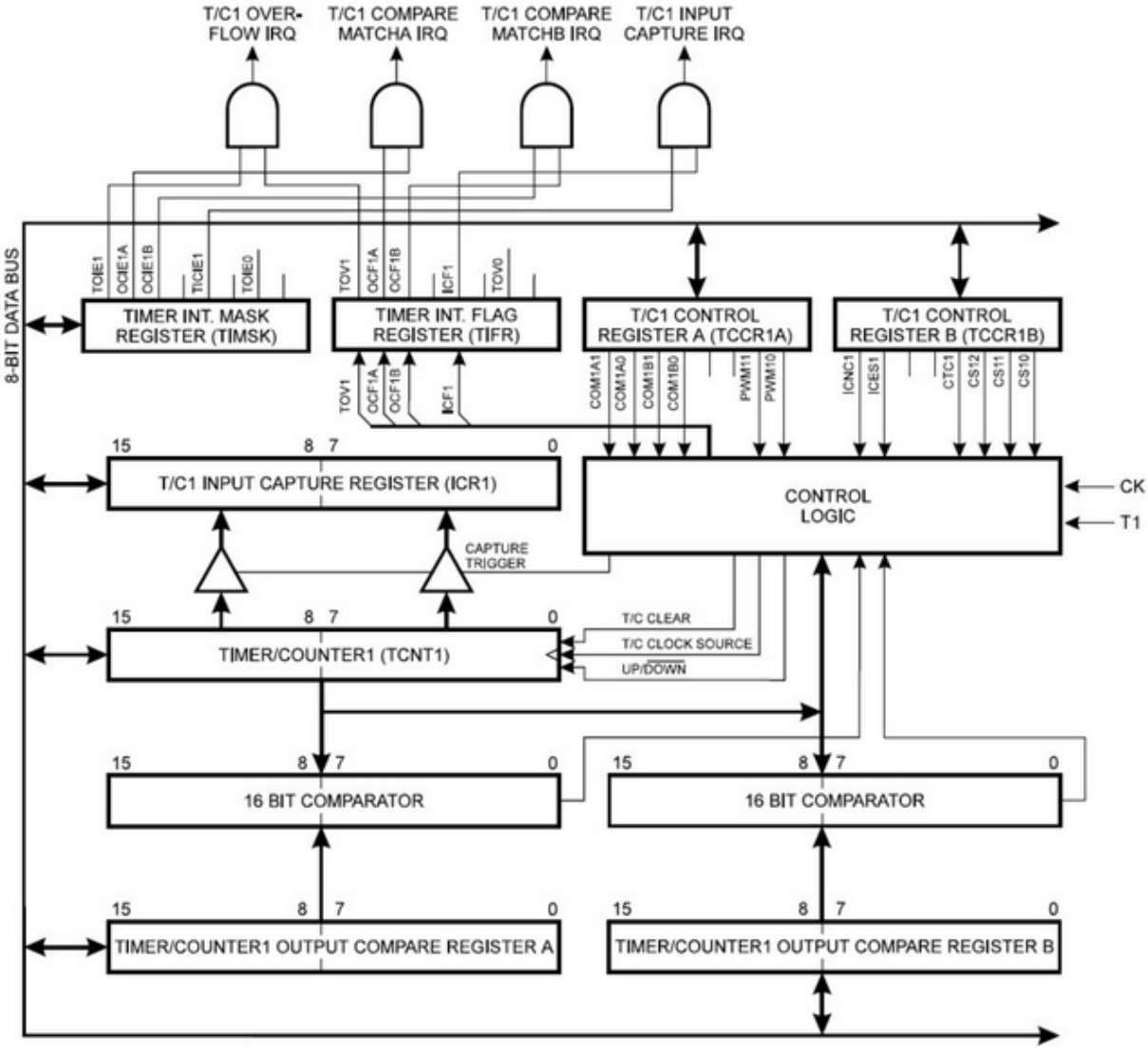
The Output Compare functions include optional clearing of the counter on compareA match, and can change the logic levels on the Output Compare pins on both compare matches.

Timer/Counter1 can also be used as a 8, 9 or 10-bit Pulse Width Modulator (PWM). In this mode the counter and the OCR1A/OCR1B registers serve as a dual glitch-free stand-alone PWM with centered pulses.

The Input Capture function of Timer/Counter1 provides a capture of the Timer/Counter1 value to the Input Capture Register - ICR1, triggered by an external event on the Input Capture Pin - ICP. The actual capture event settings are defined by the Timer/Counter1 Control Register -TCCR1B.

In addition, the Analog Comparator can be set to trigger the Capture.

Figure 30. Timer/Counter1 Block Diagram



AVR Internal Hardware Watchdog timer

The Watchdog Timer

The Watchdog Timer is clocked from a separate on-chip oscillator which runs at approximately 1MHz. This is the typical value at VCC = 5V.

By controlling the Watchdog Timer pre-scaler, the Watchdog reset interval can be adjusted from 16K to 2,048K cycles (nominally 16 - 2048 ms). The Bascom RESET WATCHDOG - instruction resets the Watchdog Timer.

Eight different clock cycle periods can be selected to determine the reset period.

If the reset period expires without another Watchdog reset, the AT90Sxxxx resets and program execution starts at the reset vector address.

AVR Internal Hardware Port B

Port B

Port B is an 8-bit bi-directional I/O port. Three data memory address locations are allocated for the Port B, one each for the Data Register - PORTB, $18($38), Data Direction Register - DDRB, $17($37) and the Port B Input Pins - PINB, $16($36). The Port B Input Pins address is read only, while the Data Register and the Data Direction Register are read/write.

All port pins have individually selectable pull-up resistors. The Port B output buffers can sink 20mA and thus drive LED displays directly. When pins PB0 to PB7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated.

The Port B pins with alternate functions are shown in the following table:

When the pins are used for the alternate function the DDRB and PORTB register has to be set according to the alternate function description.

Port B Pins Alternate Functions

Port	Pin	Alternate Functions
PORTB.0	T0	(Timer/Counter 0 external counter input)
PORTB.1	T1	(Timer/Counter 1 external counter input)
PORTB.2	AIN0	(Analog comparator positive input)
PORTB.3	AIN1	(Analog comparator negative input)
PORTB.4	SS	(SPI Slave Select input)
PORTB.5	MOSI	(SPI Bus Master Output/Slave Input)
PORTB.6	MISO	(SPI Bus Master Input/Slave Output)
PORTB.7	SCK	(SPI Bus Serial Clock)

The Port B Input Pins address - PINB - is not a register, and this address enables access to the physical value on each Port B pin. When reading PORTB, the PORTB Data Latch is read, and when reading PINB, the logical values present on the pins are read.

PortB As General Digital I/O

All 8 bits in port B are equal when used as digital I/O pins. PORTB.X, General I/O pin: The DDBn bit in the DDRB register selects the direction of this pin, if DDBn is set (one), PBn is configured as an output pin. If DDBn is cleared (zero), PBn is configured as an input pin. If PORTBn is set (one) when the pin configured as an input pin, the MOS pull up resistor is activated.

To switch the pull up resistor off, the PORTBn has to be cleared (zero) or the pin has to be configured as an output pin.

DDBn Effects on Port B Pins

DDBn	PORTBn	I/O	Pull up	Comment
0	0	Input	No	Tri-state (Hi-Z)
0	1	Input	Yes	PBn will source current if ext. pulled low.
1	0	Output	No	Push-Pull Zero Output
1	1	Output	No	Push-Pull One Output

AVR Internal Hardware Port D

Port D

Port D Pins Alternate Functions

Port	Pin	Alternate Function
PORTD.0	RDX	(UART Input line)
PORTD.1	TDX	(UART Output line)
PORTD.2	INT0	(External interrupt 0 input)
PORTD.3	INT1	(External interrupt 1 input)
PORTD.5	OC1A	(Timer/Counter1 Output compareA match output)
PORTD.6	WR	(Write strobe to external memory)
PORTD.7	RD	(Read strobe to external memory)

RD - PORTD, Bit 7

RD is the external data memory read control strobe.

WR - PORTD, Bit 6

WR is the external data memory write control strobe.

OC1- PORTD, Bit 5

Output compare match output: The PD5 pin can serve as an external output when the Timer/Counter1 com-pare matches.

The PD5 pin has to be configured as an out-put (DDD5 set (one)) to serve this f unction. See the Timer/Counter1 description for further details, and how to enable the output. The OC1 pin is also the output pin for the PWM mode timer function.

INT1 - PORTD, Bit 3

External Interrupt source 1: The PD3 pin can serve as an external interrupt source to the MCU. See the interrupt description for further details, and how to enable the source

INT0 - PORTD, Bit 2

INT0, External Interrupt source 0: The PD2 pin can serve as an external interrupt source to the MCU. See the interrupt description for further details, and how to enable the source.

TXD - PORTD, Bit 1

Transmit Data (Data output pin for the UART). When the UART transmitter is enabled, this pin is configured as an output regardless of the value of DDRD1.

RXD - PORTD, Bit 0

Receive Data (Data input pin for the UART). When the UART receiver is enabled this pin is configured as an output regardless of the value of DDRD0. When the UART forces this pin to be an input, a logical one in PORTD0 will turn on the internal pull-up.

When pins TXD and RXD are not used for RS-232 they can be used as an input or output pin.

No PRINT, INPUT or other RS-232 statement may be used in that case.

The UCR register will by default not set bits 3 and 4 that enable the TXD and RXD pins for RS-232 communication. It is however reported that this not works for all chips. In this case you must clear the bits in the UCR register with the following statements:

```
RESET UCR.3
RESET UCR.4
```

Adding XRAM

Some AVR chips like the 90S8515 for example can be extended with external RAM (SRAM) memory.
On these chips Port A serves as a Multiplexed Address (A0 – A7)/Data (D0 – D7) bus.
Port C also serves as the upper Address bits (A8 - A15) output when using external SRAM.

The maximum size of XRAM can be 64 KBytes.

Example: The STK200 has a 62256 ram chip (32K x 8 bit).

Here is some info from the BASCOM user list :

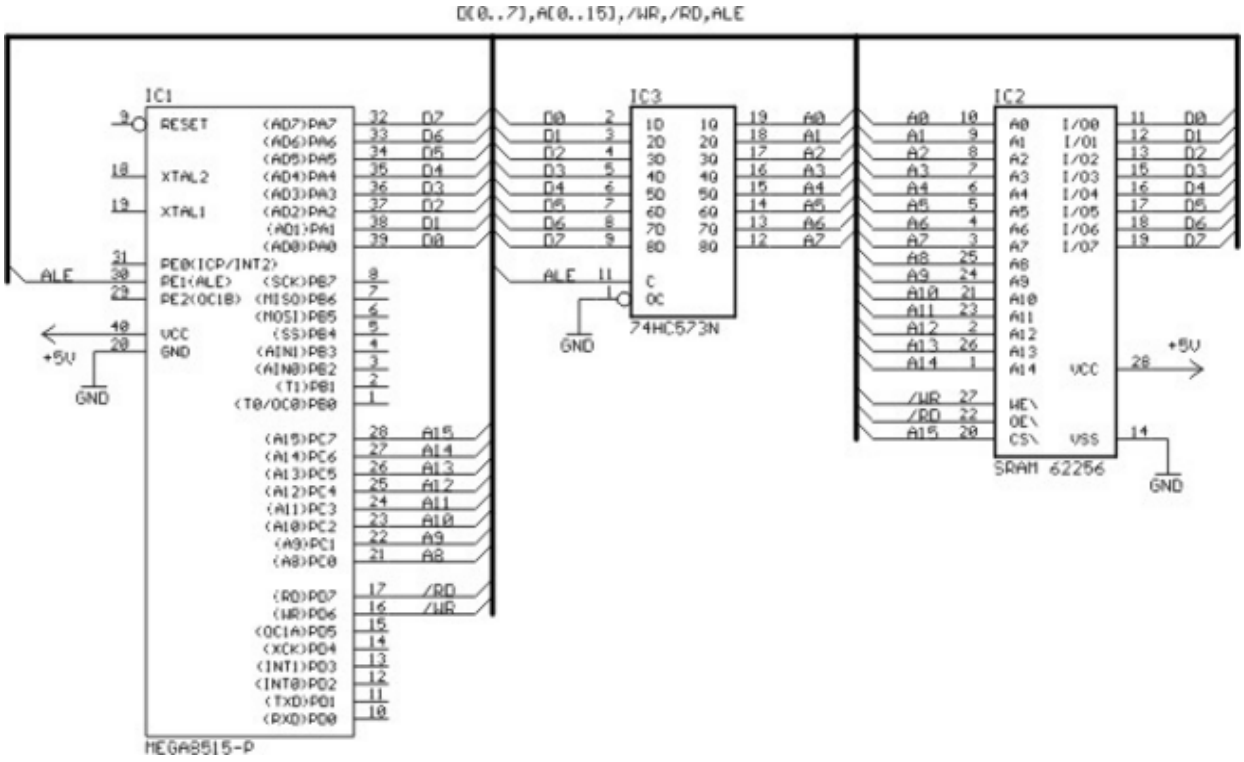
If you do go with the external ram , be careful of the clock speed.
Using a 4 Mhz crystal , will require a SRAM with 70 nS access time or less. Also the data latch (74HC573) will have to be from a faster
family such as a 74FHC573 if you go beyond 4 Mhz.

You can also program an extra wait state, to use slower memory.

Here you will find a pdf file showing the STK200 schematics:

http://www.avr-forum.com/Stk200_schematic.pdf

If you use a 32 KB SRAM, then connect the /CS signal to A15 which give to the range of &H0000 to &H7FFF, if you use a 64 KB SRAM, then
tie /CS to GND, so the RAM is selected all the time.



Attaching an LCD Display

A LCD display can be connected with two methods.

- By wiring the LCD-pins to the processor port pins. This is the pin mode. The advantage is that you can choose the pins and that they don't have to be on the same port. This can make your PCB design simple. The disadvantage is that more code is needed.

- By attaching the LCD-data pins to the data bus. This is convenient when you have an external RAM chip and will add only a little extra code.

The LCD-display can be connected in PIN mode as follows:

LCD DISPLAY	PORT	PIN
DB7	PORTB.7	14
DB6	PORTB.6	13
DB5	PORTB.5	12
DB4	PORTB.4	11

E	PORTB.3	6
RS	PORTB.2	4
RW	Ground	5
Vss	Ground	1
Vdd	+5 Volt	2
Vo	0-5 Volt	3

This leaves PORTB.1 and PORTB.0 and PORTD for other purposes.

You can change these pin settings from the Options LCD menu.

BASCOM supports many statements to control the LCD-display.

For those who want to have more control of the example below shows how to use the internal BASCOM routines.

```
$ASM
  Ldi _temp1, 5          'load register R24 with value
  Rcall _Lcd_control     'it is a control value to control the display
  Ldi _temp1,65          'load register with new value (letter A)
  Rcall _Write_lcd       'write it to the LCD-display
$END ASM
```

Note that _lcd_control and _write_lcd are assembler subroutines which can be called from BASCOM.

See the manufacturer's details from your LCD display for the correct pin assignment.

Memory usage

SRAM

Every variable uses memory. This memory is also called SRAM.

The available memory depends on the chip.

A special kind of memory are the registers in the AVR. Registers 0-31 have addresses 0-31.
Almost all registers are used by the compiler or might be used in the future.
Which registers are used depends on the program statements you use.

This brings us back to the SRAM.
No SRAM is used by the compiler other than the space needed for the software stack and frame.
Some statements might use some SRAM. When this is the case it is mentioned in the help topic of that statement.

Each 8 bits used occupy one byte.
Each byte variable occupies one byte.
Each integer/word variable occupies two bytes.
Each Long or Single variable occupies four bytes.

Each double variable occupies 8 bytes.
Each string variable occupies at least 2 byes.
A string with a length of 10. occupies 11 byes. The extra byte is needed to indicate the end of the string.
Use bits or byte variables whereever you can to save memory. (not allowed for negative values)

The software stack is used to store the addresses of LOCAL variables and for variables that are passed to SUB routines.

Each LOCAL variable and passed variable to a SUB, uses two bytes to store the address. So when you have a SUB routine in your program that passes 10 variables, you need 10 * 2 = 20 bytes. When you use 2 LOCAL variables in the SUB program that receives the 10 variables, you need additional 2 * 2 = 4 bytes.

The software stack size can be calculated by taking the maximum number of parameters in a SUB routine, adding the number of LOCAL variables and multiplying the result by 2. To be safe, add 4 more bytes for internally used LOCAL variables.

LOCAL variables are stored in a place that is named the Frame.

When you have a LOCAL STRING with a size of 40 bytes, and a LOCAL LONG, you need 41 + 4 bytes = 45 bytes of frame space.

When you use conversion routines such as STR(), VAL() etc. that convert from numeric to string and vice versa, you also need a frame. It should be 16 bytes in this case.
Add additional space for the local data.

Note that the use of the INPUT statement with a numeric variable, or the use of the PRINT or LCD statement with a numeric variable, will also force you to reserve 16 bytes of frame space. This because these routines use the internal numeric<>string conversion routines.

XRAM

You can easy add external memory to an 8515. Then XRAM (extended memory) will become available. When you add a 32 KB RAM, the first address will be 0.
But because the XRAM can only start after the internal SRAM, which is &H0260 for the 8515, the lower memory locations of the XRAM will not be available for use.

ERAM

Most AVR chips have internal EEPROM on board.
This EEPROM can be used to store and retrieve data.
In BASCOM, this data space is called ERAM.

An important difference is that an ERAM variable can only be written to a maximum of 100.000 times. So only assign an ERAM variable when it is needed, and never use it in a loop or the ERAM will become unusable.

Constant code usage

Constants are stored in a constant table.
Each used constant in your program will end up in the constant table.

For example:

Print "ABCD"
Print "ABCD"

This example will only store one constant (ABCD).

Print "ABCD"
Print "ABC"

In this example, two constants will be stored because the strings differ.

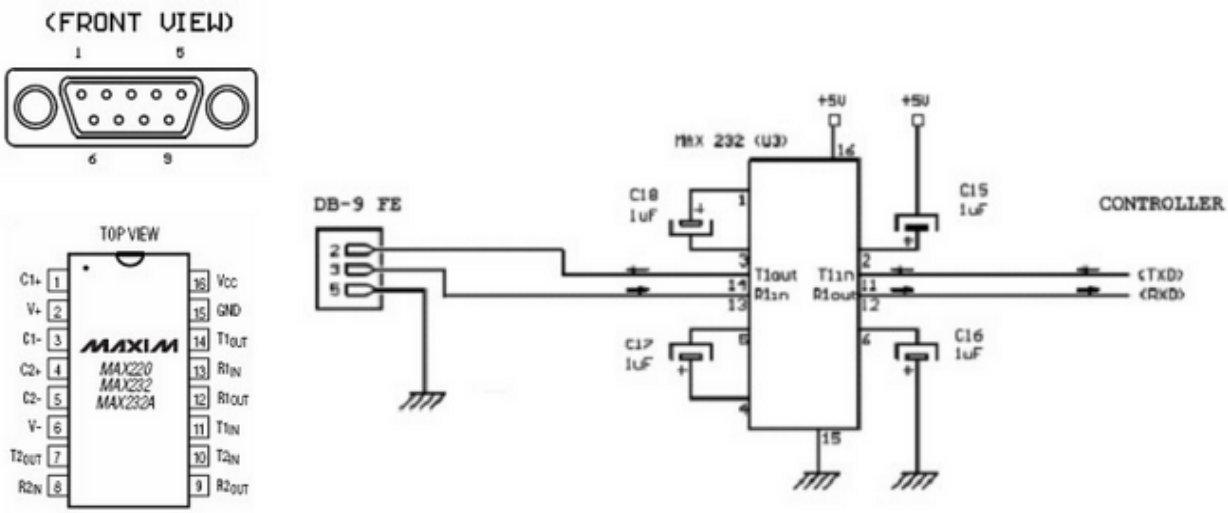
UART

UART

A Universal Asynchronous Receiver and Transmitter (UART) can be used to send and receive data between two devices. More specific these devices can be PC-to-PC, PC-to-microcontroller and microcontroller-to-microcontroller. The UART communicates using TTL voltages +5V and 0V or LVTTL depending on your microcontrollers VCC voltage.

If you wish to connect to a PC you need to use RS232 protocol specifications. This means that the hardware communication is done with sapecific voltage levels. (+15V and -15V) This can be achieved by using a MAX232 level shifter.

The hardware is explained in this schematic:



The DB-9 connector has 9 pins but you only need to use 3 of them. Notice that the drawing above shows the FRONT VIEW thus remember that you are soldering on the other side. On most connectors the pin outs can also be found on the connector itself.

If your controller has no UART you can use a software UART see below. If your controller has one UART you connect controller pins TxD and RxD to TxD and RxD in the schematic above. If your controller has more than one UART you connect controller pins TxD0 and RxD0 to TxD and RxD in the schematic above.
You now need to initialize the program in your microcontroller, open a new .bas file and add

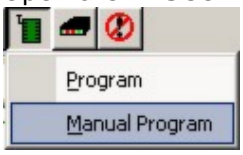
the following code in the beginning of your program.

```
$regfile = "your micro here def.dat"
$crystal = 8000000
$baud = 19200
```

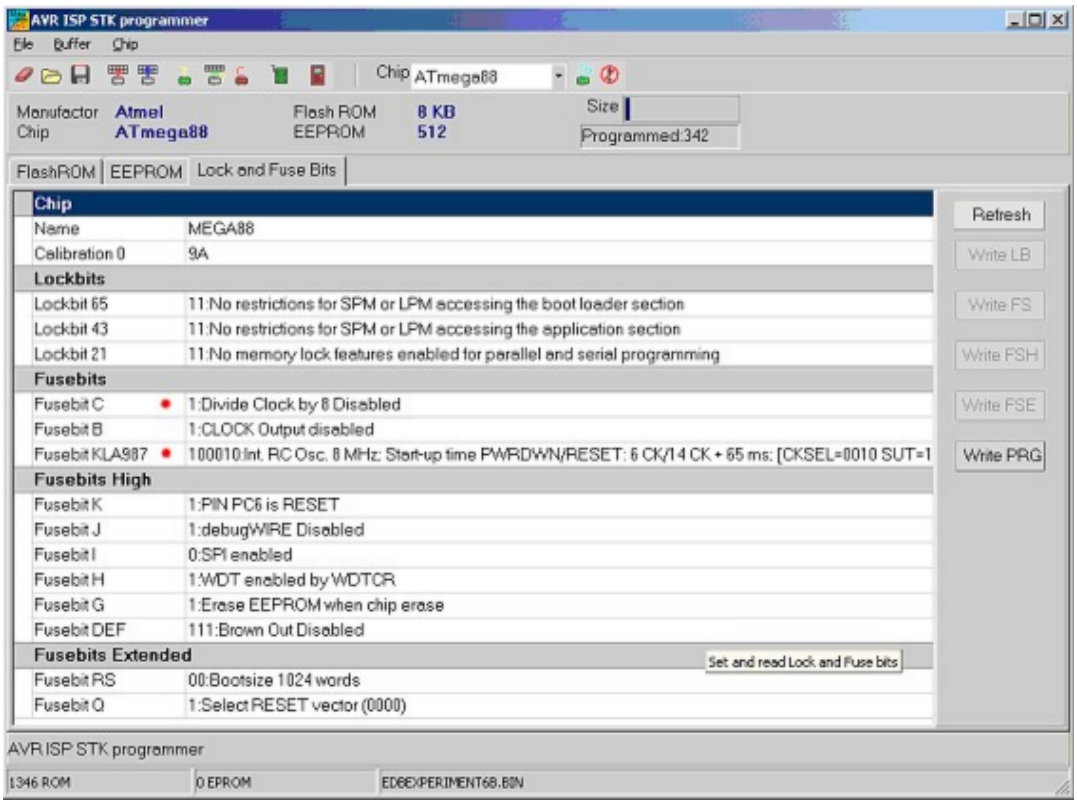
Make sure to define your microcontroller after $regfile for example if you use the ATMega32
```
$regfile = "m32def.dat"
```

Some new chips can use an internal oscillator, also some chips are configured to use the internal oscillator by default. Using an internal oscillator means you do not need an external crystal.

Perform this step only if you have an internal oscillator.
Open the BASCOM-AVR programmer like this:



- Select the "Lock and Fuse Bits" tab and maximize the programmer window.
- Check if you see the following in the "Fusebit" section:
  "1:Devide Clock by 8 Disabled"
  and
  "Int. RC Osc. 8 MHz; Start-up time: X CK + X ms; [CKSEL=XXXX SUT=XX]"



These options are not available for all AVR's, if you don't have the option do not change any fusebits.

If these options are available, but in a wrong setting. Change the setting in the drop down box and click another Fuse section. Finally click the "Program FS" button. Click "Refresh" to see the actual setting.

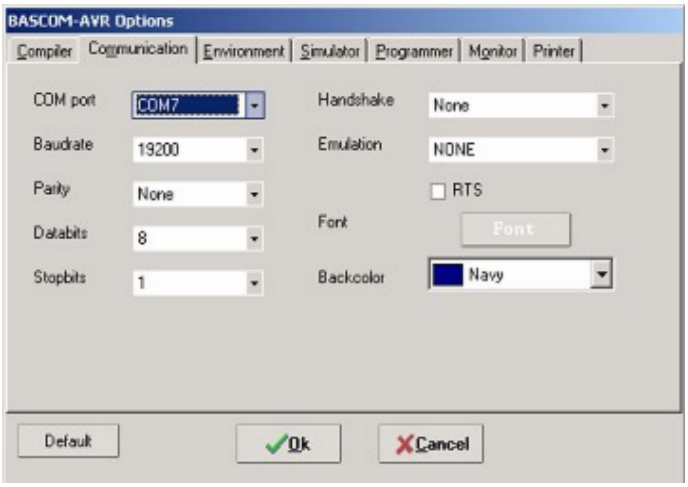
Now connect a straight cable between the DB-9 connector, microcontroller side and the PC side.
Program a test program into your microcontroller, it should look like this:

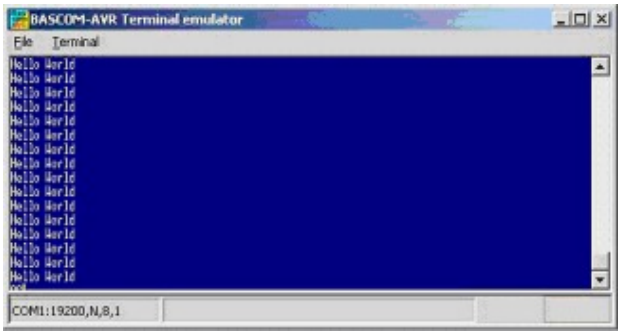
```
$regfile = "m32def.dat"                                    'Define your own
$crystal = 8000000
$baud = 19200

Do
   Print "Hello World"
   Waitms 25
Loop

End
```

Now open the BASCOM-AVR Terminal and set your connection settings by clicking “Terminal” -> “Settings” Select your computers COM port and select baud 19200, Parity none, Databits 8, Stopbits 1, Handshake none, emulation none.





If you see the Hello World displayed in the BASCOM-AVR Terminal emulator window, your configuration is OK. Congratulations.

Example

You can also try this example with the BASCOM Terminal emulator, it shows you how to send and receive with various commands.

```
$regfile = "m88def.dat"
$crystal = 8000000
$baud = 19200

Dim Akey As Byte                          'Here we declare a byte variable

Print
Print "Hello, hit any alphanumerical key..."
```

```
Akey = Waitkey()  'Waitket waits untill a char is received from the UART
Print Akey

Wait 1
Print
Print "Thanks!, as you could see the controller prints a number"
Print "but not the key you pressed."

Wait 1
Print
Print "Now try the enter key..."
Akey = Waitkey()
Akey = Waitkey()
Print Akey

Print
Print "The number you see is the ASCII value of the key you pressed."
Print "We need to convert the number back to the key..."
Print                                          'Notice what this line does
Print "Please try an alphanumerical key again..."
Akey = Waitkey()
Print Chr(akey)                                   'Notice what this does
Print "That's fine!"

Wait 1
Print
Print "For a lot of functions, just one key is not enough..."
Print "Now type your name and hit enter to confirm"

Dim Inputstring As String * 12          'Declare a string variable here


Do
Akey = Waitkey()
If Akey = 13 Then Goto Thanks                  'On enter key goto thanks
   Inputstring = Inputstring + Chr(akey)              'Assign the string
Loop

Thanks:
Print "Thank you " ; Inputstring ; " !"             'Notice what ; does

Wait 1
Print
Print "Take a look at the program code and try to understand"
Print "how this program works. Also press F1 at the statements"
Print
Print "If you understand everything continue to the next experiment"

End
```

ASCII

As you could have seen in the previous example we use the PRINT statement to send something to the UART. Actually we do not send just text. We send ASCII characters. ASCII means American Standard Code for Information Interchange. Basically ASCII is a list of 127 characters.

ASCII Table (Incomplete)

Decimal	Hex	Binary	Value	
000	000	00000000	NUL	(Null char.)
008	008	00001000	BS	(Backspace)
009	009	00001001	HT	(Horizontal Tab)
010	00A	00001010	LF	(Line Feed)
012	00C	00001100	FF	(Form Feed)
013	00D	00001101	CR	(Carriage Return)
048	030	00110000	0	
049	031	00110001	1	
052	034	00110100	4	

```
065     041    01000001        A
066     042    01000010        B
067     043    01000011        C
```

You can find a complete ASCII table here

CARRIAGE RETURN (CR) AND LINE FEED (LF)

In the previous example you can also see that a second print statement always prints the printed text to the following line. This is caused by the fact that the print statement always adds the CR and LF characters.

Basically if we state:
Print "ABC"
We send 65 66 67 13 10 to the UART. (In binary format)

The carriage return character (13) returns the cursor back to column position 0 of the current line. The line feed (10) moves the cursor to the next line.

Print "ABC" ;
When we type a semicolon (;) at the end of the line...
Bascom does not send a carriage return/line feed, so you can print another text after the ABC on the same line.

Print "ABC" ; Chr(13) ;
This would send only ABC CR. The next print would overwrite the ABC.

OVERVIEW

Here are some other commands that you can use for UART communications:

Waitkey()
Waitkey will until a character is received in the serial buffer.

Ischarwaiting()
Isrcharwaiting returns 1 when a character is waiting in the hardware UART buffer.

Inkey()
Inkey returns the ASCII value of the first character in the serial input buffer.

Print
Sends a variable or non-variable string to the UART

ANOTHER EXAMPLE

This example shows how to use Ischarwaiting to test if there is a key pressed. And if there is, read to a variable.

```
'Print "Press B key to start"
Dim Serialcharwaiting As Byte, Serialchar As Byte

Serialcharwaiting = Ischarwaiting()     'Check if B or b pressed then goto If
Serialcharwaiting = 1 Then
   Serialchar = Inkey()
   If Serialchar = 66 Or Serialchar = 98 Then
      Goto MyRoutine
   End If
End If

Goto Main
```

```
Myroutine:
'Statements

Main:
'Statements
End
```

BUFFERING SERIAL DATA

If you wish to send and receive data at high speed, you need to use serial input and serial output buffers. This buffering is implemented in BASCOM-AVR and can only be used for hardware UART's.

To configure a UART to use buffers, you need to use the Config statement.

```
Config Serialout = Buffered , Size = 20
```

and/or

```
Config Serialin = Buffered , Size = 20
```

More information can be found in BASCOM-Help. Search topic = "config serialin". There is also a sample program "RS232BUFFER.BAS" in the samples folder if you wish a demonstration of the buffering.

SOFTWARE UART

The previous examples used the hardware UART. That means the compiler uses the internal UART registers and internal hardware (RxD(0) and TxD(0)) of the AVR. If you don't have a hardware UART you can also use a software UART.

The Bascom compiler makes it easy to "create" additional UART's. Bascom creates software UART's on virtually every port pin.

Remember that a software UART is not as robust as a hardware UART, thus you can get timing problems if you have lots of interrupts in your program.

For this example we use microcontroller pins portc.1 and portc.2.
Connect portc.1 to TxD and portc.2 to RxD see the schematic above.

Change the $regfile and program this example:

```
$regfile = "m88def.dat"
$crystal = 8000000
$baud = 19200

Dim B As Byte
Waitms 100

'Open a TRANSMIT channel for output
Open "comc.1:19200,8,n,1" For Output As #1
Print #1 , "serial output"

'Now open a RECEIVE channel for input
Open "comc.2:19200,8,n,1" For Input As #2
'Since there is no relation between the input and output pin
'there is NO ECHO while keys are typed

Print #1 , "Press any alpha numerical key"

'With INKEY() we can check if there is data available
'To use it with the software UART you must provide the channel
Do
   'Store in byte
   B = Inkey(#2)
```

```
   'When the value > 0 we got something
   If B > 0 Then
      Print #1 , Chr(b)                          'Print the character
   End If
Loop
Close #2                                          'Close the channels
Close #1

End
```

After you have programmed the controller and you connected the serial cable, open the terminal emulator by clicking on in Bascom.
You should see the program asking for an alphanumerical input, and it should print the input back to the terminal.

Using the I²C protocol

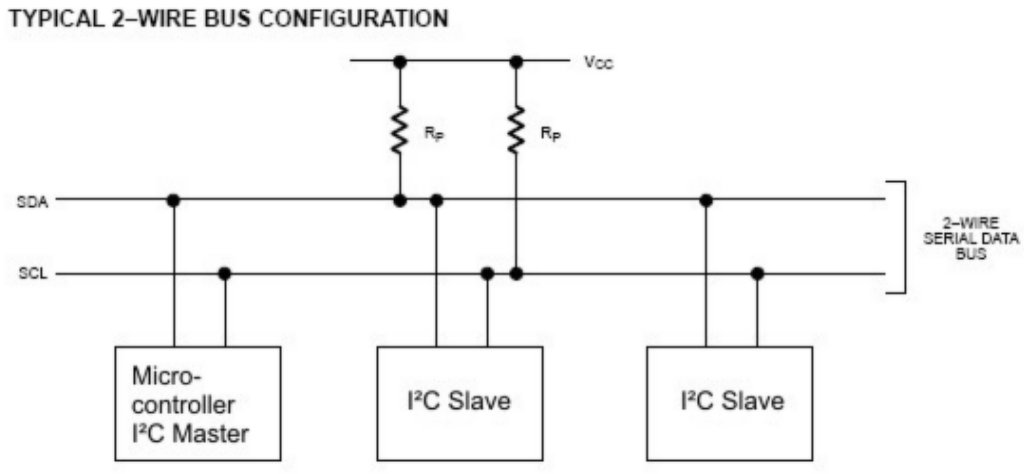
I²C bus

I²C bus is an abbreviation for Inter Integrated Circuit bus. It is also known as IIC and I2C.

I²C is a serial and synchronous bus protocol. In standard applic ations hardware and timing are often the same. The way data is treated on the I²C bus is to be defined by the manufacturer of the I²C master and slave chips.

In a simple I²C system there can only be one master, but multiple slaves. The difference between master and slave is that the master generates the clock pulse. The master also defines when communication should occur. For bus timing it is important that the slowest slave should still be able to follow the master's clock. In other words the bus is as fast as the slowest slave.

A typical hardware configuration is shown in the figure below:

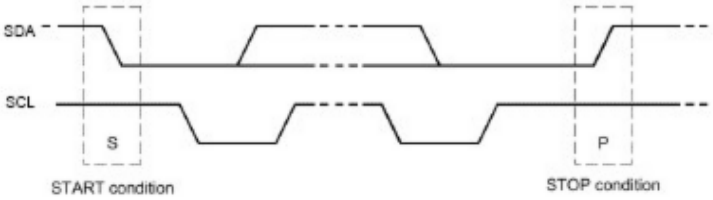


Note that more slave chips can be connec ted to the SDA and SCL lines, norm ally Rp has a value of 1kOHM. The clock generated by the m aster is called Serial CLock (SCL) and the data is called Serial DAta (SDA).

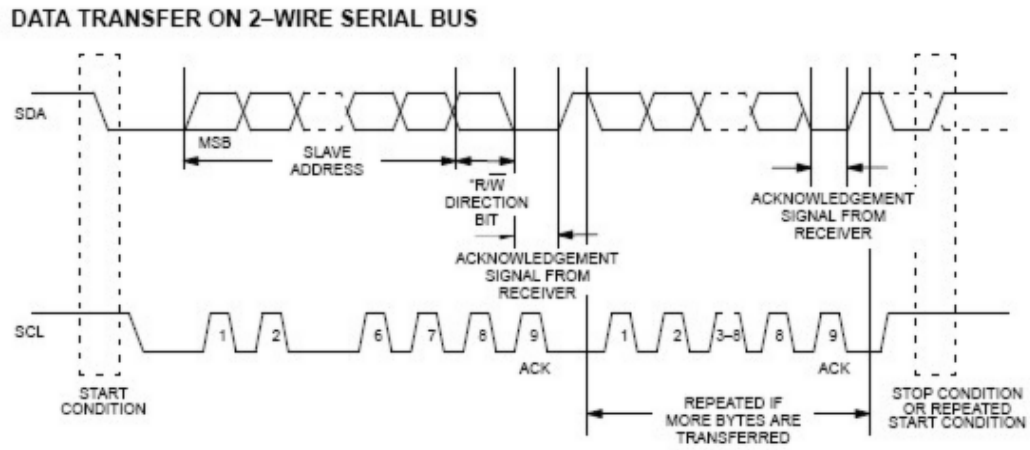
In most applications the microcontroller is the I²C Master. Slave c hips can be Real Time Clocks and Temperature sensors. For example the DS1307 and the DS1624 from www.maxim-ic.com. Of coarse you can also create your own slaves. In that c ase there is

microcontroller to microcontroller communication.

LOGIC BUS LEVELS AND CONDITIONS



Data can only occur after the master generates a **start condition.** A start condition is a high-to-low transition of
the SDA line while SCL remains high. After each data transfer a **stop condition** is generated. A stop condition is a low-to-high transition of the SDA line while SCL remains high.



As said a data transfer can occur after a **start condition** of the master. The length of data sent over I²C is always 8 bit this includes a read/write direction bit, so you can effectively send 7 bits every time.
The most significant bit MSB is always passed first on the bus.

If the master writes to the bus the R/W bit = 0 and if the master reads the R/W bit = 1.

After the R/W bit the master should generate one clock period for an acknowledgement ACK.

Each receiving chip that is addressed is obliged to generate an acknowledge after the reception of each byte. A chip that acknowledges must pull down the SDA line during the acknowledge clock pulse in such a way that the SDA line is stable LOW during the HIGH period of the acknowledge related clock pulse.

After an acknowledge there can be a stop condition, if the master wishes to leave the bus idle. Or a repeated start condition. A repeated start is the same as a start condition.

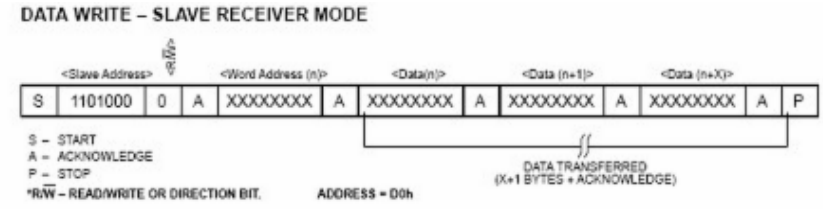
When the master reads from a slave it should acknowledge after each byte received. There are two reasons for the master not to acknowledge. The master sends a not acknowledge if data was not received correctly or if the master wishes the stop receiving.

In other words if the master wishes to stop receiving, it sends a not acknowledge after the last received byte.

The master can stop any communication on the bus **at any time** by sending a stop condition.

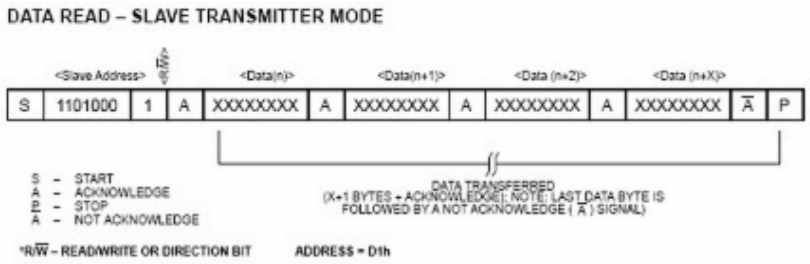
BUS ADRESSING

Let's say we have a slave chip with the address "1101000" and that the master wishes to write to that slave, the slave would then be in receiver mode, like this:



You can see here that the master always generates the start condition, then the master sends the address of the slave and a "0" for R/W. After that the master sends a command or word address. The function of that command or word address can be found in the datasheet of the slave addressed.

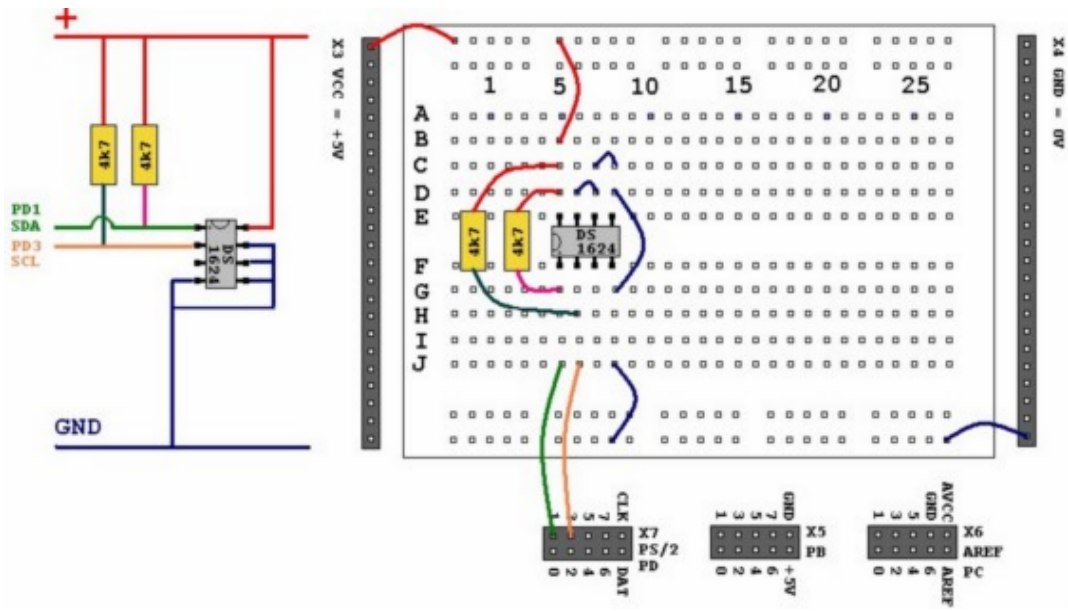
After that the master can send the data desired and stop the transfer with a stop condition.



Again the start condition and the slave address, only this time the master sends "1" for the R/W bit. The slave can then begin to send after the acknowledge. If the master wishes to stop receiving it should send a not acknowledge.

EXAMPLE

This example shows you how to setup and read the temperature from a DS1624 temperature sensor.
Connect the DS1624 like this:



Then program this sample into your microcontroller and connect your microcontroller to the serial port of your PC.

```
$regfile = "m88def.dat"                    'Define the chip you use
$crystal = 8000000                         'Define speed
$baud = 19200                              'Define UART BAUD rate


'Declare RAM for temperature storage
Dim I2ctemp As Byte                        'Storage for the temperature


'Configure pins we want to use for the I²C bus
Config Scl = Portd.1                       'Is serial clock SCL
Config Sda = Portd.3                       'Is serial data SDA



'Declare constants - I2C chip addresses
Const Ds1624wr = &B10010000                'DS1624 Sensor write
Const Ds1624rd = &B10010001                'DS1624 Sensor read

'This section initializes the DS1624
   I2cstart                                'Sends start condition
   I2cwbyte Ds1624wr                       'Sends the address

'byte with r/w 0

'Access the CONFIG register (&HAC address byte)
   I2cwbyte &HAC
'Set continuous conversion  (&H00 command byte)
   I2cwbyte &H00
   I2cstop                                 'Sends stop condition
   Waitms 25          'We have to wait some time after a stop

   I2cstart
   I2cwbyte Ds1624wr
'Start conversion (&HEE command byte)
   I2cwbyte &HEE
   I2cstop
   Waitms 25
'End of initialization
```

```
Print                                'Print empty line


Do

   'Get the current temperature
   I2cstart
   I2cwbyte Ds1624wr
   I2cwbyte &HAA      'Read temperature (&HAA command byte)
   I2cstart
   I2cwbyte Ds1624rd  'The chip will give register contents
'Temperature is stored as 12,5 but the ,5 first
   I2crbyte I2ctemp
'So you'll have to read twice... first the ,5
   I2crbyte I2ctemp , Nack
'And then the 12... we don't store the ,5
   I2cstop
                                                              'That's why we
read twice.

'We give NACK if the last byte is read

   'Finally we print
Print "Temperature: " ; Str(i2ctemp) ; " degrees" ; Chr(13);

   Waitms 25

Loop
End
```

You should be able to read the temperature in your terminal emulator.
Note that the used command bytes in this example can be found in DS1624 temperature sensor datasheet.

OVERVIEW

ConfigSda = Portx.x
Configures a port pin for use as serial data SDA.

ConfigScl = Portx.x
Configures a port pin for use as serial clock SCL.

I2cstart
Sends the start condition.

I2cstop
Sends the stop condition.

I2cwbyte
Writes one byte to an I²Cslave.

I2crbyte
Reads one byte from an I²Cslave.

I2csend
Writes a number of bytes to an I²Cslave.

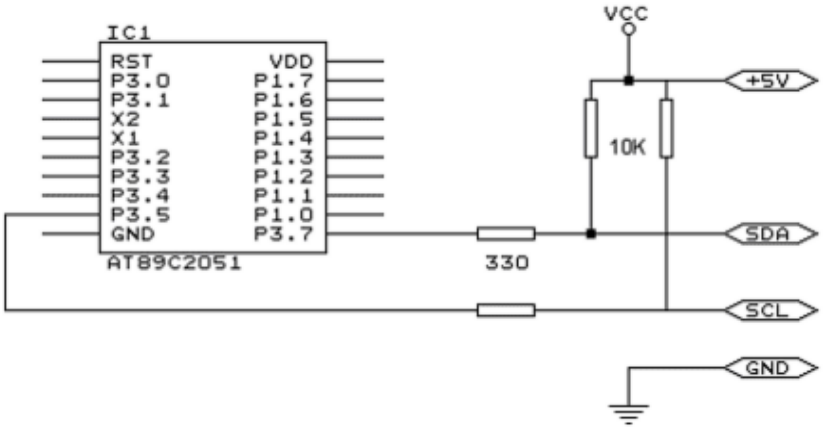
I2creceive
Reads a number of bytes from an I²Cslave.

Practice

The design below shows how to implement an I2C-bus. The circuit shown is for the 8051 micro the AT89C2051 which is pin compatible with the AT90S2313. It also works for the AVR.

R1 and R2 are 330 ohm resistors.
R3 and R4 are 10 kilo-ohm resistors. For 5V, 4K7 is a good value in combination with AVR chips.

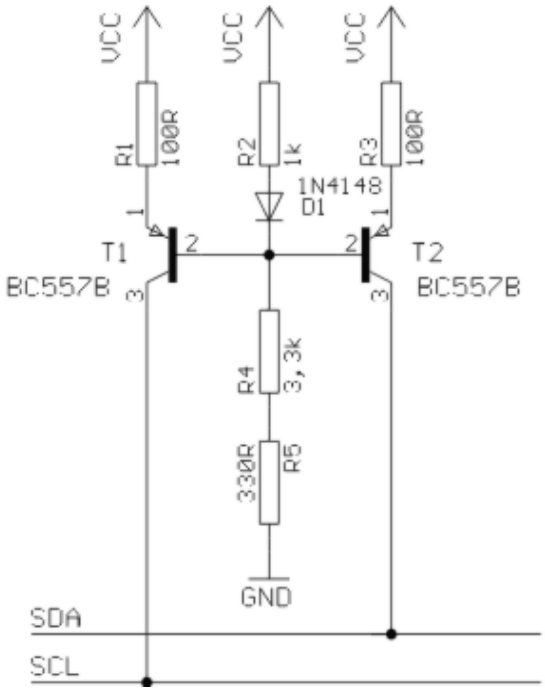
You can select which port pins you want to use for the I2C interface with the compiler settings.



The following information was submitted by Detlef Queck.

Many people have problems over and over with I2C(TWI) Termination. Use 4,7k or 10 k pullup? How long can the SCL, SDA line be when used with pullups etc, etc.

You can simplify this confusing problem. Here is a Schematic for an active Termination of I2C and TWI. We have used this Schematic for over 10 years, and have had no problems with it. The I2C (TWI) lines can be up to 80cm (400KHz) without any problem when the Terminator is at the end of the lines.



Using the 1 WIRE protocol

The 1-wire protocol was invented by Dallas Semiconductors and needs only 1 wire for two-way communication. You also need power and ground of course.

This topic is written by Göte Haluza. He tested the new 1-wire search routines and is building a weather station.

Dallas Semiconductor (DS) 1-wire. This is a brief description of DS 1-wire bus when used in combination with BASCOM. For more detailed explanations about the 1-wire bus, please go to http://www.maxim-ic.com. Using BASCOM makes the world a lot easier. This paper will approach the subject from a "BASCOM-user-point-of-view".

1-wire-net is a serial communication protocol, used by DS devices. The bus could be implemented in two basic ways :

With 2 wires, then DQ and ground is used on the device. Power is supplied on the DQ line, which is +5V, and used to charge a capacitor in the DS device. This power is used by the device for its internal needs during communication, which makes DQ go low for short periods of time. This bus is called the 1-wire bus.

With 3 wires, when +5V is supplied to the VDD line of the device, and DQ + ground as above. This bus is called the 2-wire bus.

So, the ground line is "not counted" by DS. But hereafter we use DS naming conventions.

How it works. (1-wire)

The normal state of the bus is DQ=high. Through DQ the device gets its power, and performs the tasks it is designed for.

When the host (your micro controller (uC)) wants something to happen with the 1-wire bus, it issues a reset-command. That is a very simple electric function that happens then; the DQ goes active low for a time (480uS on original DS 1-wire bus). This put the DS-devices in reset mode; then (they) send a presence pulse, and then (they) listen to the host.

The presence pulse is simply an active low, this time issued by the device(s).

Now, the host cannot know what is on the bus, it is only aware of that at least 1 DS device is attached on the bus.

All communication on the 1-wire bus is initialized by the host, and issued by time-slots of active-low on a normally high line (DQ), issued by the device, which is sending at the moment. The devices(s) internal capacitor supplies its power needs during the low-time.

How do you work with 1-wire-bus

Thereafter, you can read a device, and write to it. If you know you only have 1 sensor attached, or if you want to address all sensors, you can start with a "Skip Rom" - command. This means; take no notice about the IDs of the sensors - skip that part of the communication.

When you made a 1-wire-reset, all devices of the bus are listening. If you chose to address only one of them, the rest of them will not listen again before you have made a new 1-wire-reset on the bus.

I do not describe BASCOM commands in this text - they are pretty much self-explanatory. But the uC has to write the commands to the bus - and thereafter read the answer. What you have to write as a command depends on devices you are using - and what you want to do with it. Every DS chip has a datasheet, which you can find at http://www.dalsemi.com/datasheets/pdfindex.html. There you can find out all about the actual devices command structure.

There are some things to have in mind when deciding which of the bus-types to use.

The commands, from BASCOM, are the same in both cases. So this is not a problem.

The +5V power-supply on the VDD when using a 2-wire bus has to be from a separate power supply, according to DS. But it still works with taking the power from the same source as for the processor, directly on the stabilizing transistor. I have not got it to work taking power directly from the processor pin.

Some devices consume some more power during special operations. The DS1820 consumes a lot of power during the operation "Convert Temperature". Because the sensors knows how they are powered (it is also possible to get this information from the devices) some operations, as "Convert T" takes different amount of time for the sensor to execute. The command "Convert T" as example, takes ~200mS on 2-wire, but ~700mS on 1-wire. This has to be considered during programming.

And that power also has to be supplied somehow.

If you use 2-wire, you don't have to read further in this part. You can do simultaneously "Convert T" on all the devices you attach on the bus. And save time. This command is the most power-consuming command, possible to execute on several devices, I am aware of.

If you use 1-wire, there are things to think about. It is about not consuming more power than you feed. And how to feed power? That depends on the devices (their consumption) and what you are doing with them (their consumption in a specific operation).

Short, not-so-accurate description of power needs, not reflecting on cable lengths.

Only the processor pin as power supplier, will work < 5 sensors. (AVR, 1-wire-functions use an internal pull-up. 8051 not yet tested). Don't even think of simultaneous commands on multiple sensors.

With +5V through a 4K7 resistor, to the DQ-line, 70 sensors are tested. But, take care, cause issuing "Convert T" simultaneously, would cause that to give false readings. About ~15 sensors is the maximum amount of usable devices, which simultaneously performs some action. This approach DS refers to as "pull-up resistor".

With this in mind, a bus with up to 70 devices has been successfully powered this way.

The resistor mentioned, 4K7, could be of smaller value. DS says minimum 1K5, I have tested down to 500 ohm - below that the bus is not usable any more. (AVR). Lowering the resistor feeds more power - and makes the bus more noise resistant. But, the resistor minimum value is naturally also depending on the uC-pin electric capabilities. Stay at 4K7 - which is standard recommendation.

DS recommends yet another approach, called "strong pull-up" which (short) works via a MOS-FET transistor, feeding the DQ lines with enough power, still on 1-wire, during power-consuming tasks. This is not tested, but should naturally work. Because this functionality is really a limited one; BASCOM has no special support for that. But anyway, we tell you about it, just in case you wonder. Strong pull-up has to use one uC pin extra - to drive the MOS-FET.

Cable lengths (this section is only for some limitation understanding)

For short runs up to 30 meters, cable selection for use on the 1-Wire bus is less critical. Even flat modular phone cable works with limited numbers of 1-Wire devices. However, the longer the 1-Wire bus, the more pronounced cable effects become, and therefore greater importance is placed on cable selection.

For longer distances, DS recommends twisted-pair-cable (CAT5).

DS standard examples show 100 meters cable lengths, so they say, that's no problem. They also show examples with 300m cabling, and I think I have seen something with 600-meter bus (but I cant find it again).

Noise and CRC

The longer cable and the noisier environment, the more false readings will be made. The devices are equipped with a CRC-generator - the LSByte of the sending is always a checksum. Look in program examples to learn how to re-calculate this checksum in your uC. AND, if you notice that there are false readings - do something about your cables. (Shield, lower resistor)

Transfer speed

On the original 1-wire bus, DS says the transfer speed is about 14Kbits /second. And, if that was not enough, some devices has an overdrive option. That multiplies the speed by 10. This is issued by making the communication-time-slots smaller (from 60 uS to 6uS) which naturally will make the devices more sensitive, and CRC-error will probably occur more often. But, if that is not an issue, ~140Kbit is a reachable speed to the devices. So, whatever you thought before, it is FAST.

The BASCOM scanning of the bus is finds about 50 devices / second , and reading a specific sensors value to a uC should be about 13 devices / second.

Topology
Of the 1w-net - that is an issue we will not cover so much. Star-net, bus-net? It seems like you can mix that. It is a bus-net, but not so sensitive about that.

The benefit of the 1-wire bus
Each device is individual - and you can communicate with it over the media of 2 wires. Still, you can address one individual device, if you like. Get its value. There are 64 ^ 2 unique identifications-numbers.

Naturally, if lot of cables are unwanted, this is a big benefit. And you only occupy 1 processor pin.

DS supplies with different types of devices, which all are made for interfacing an uC - directly. No extra hardware. There are sensors, so you can get knowledge about the real world, and there are also potentiometers and relays, so you can do something about it. On the very same bus.

And the Ibutton approach from DS (ever heard of it?) is based on 1wire technology. Maybe something to pick up.

BASCOM let you use an uC with 1wire-devices so easy, that (since now) that also has to count as a benefit - maybe one of the largest. ;-)

The disadvantages of the 1-wire bus
So far as I know, DS is the only manufacturer of sensors for the bus. Some people think their devices are expensive. And, until now, it was really difficult to communicate with the devices. Particularly when using the benefit of several devices on one bus. Still some people say that the 1w-bus is slow - but I don't think so.

Göte Haluza
System engineer

Using the SPI protocol

General description of the SPI

The SPI allows high-speed synchronous data transfer between the AVR and peripheral devices or between several AVR devices. On most parts the SPI has a second purpose where it is used for In System Programming (ISP).

The interconnection between two SPI devices always happens between a master device and a slave device. Compared to some peripheral devices like sensors which can only run in slave mode, the SPI of the AVR can be configured for both master and slave mode.

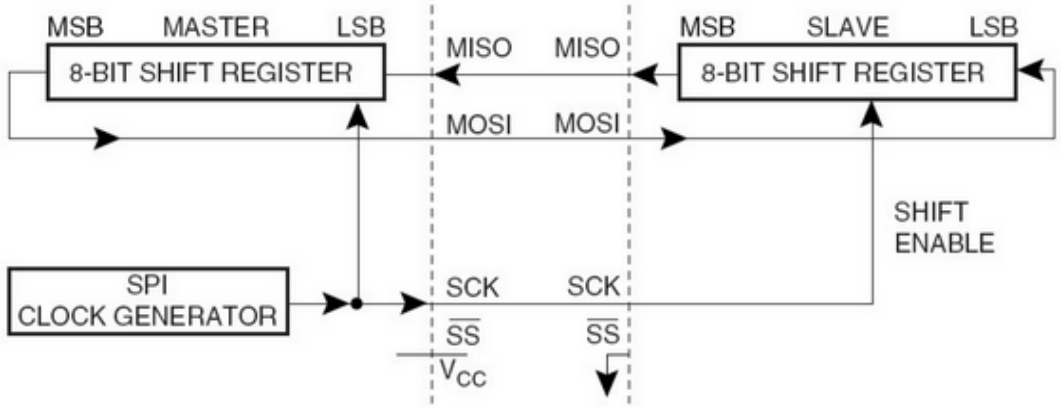
The mode the AVR is running in is specified by the settings of the master bit (MSTR) in the SPI control register (SPCR).

Special considerations about the /SS pin have to be taken into account. This will be described later in the section "Multi Slave Systems - /SS pin Functionality".

The master is the active part in this system and has to provide the clock signal a serial data transmission is based on. The slave is not capable of generating the clock signal and thus can not get active on its own.

The slave just sends and receives data if the master generates the necessary clock signal. The master however generates the clock signal only while sending data. That means that the master has to send data to the slave to read data from the slave.

Figure 61. SPI Master-Slave Interconnection



Data transmission between Master and Slave

The interaction between a master and a slave AVR is shown in Figure 1. Two identical SPI units are displayed. The left unit is configured as master while the right unit is configured as slave. The MISO, MOSI and SCK lines are connected with the corresponding lines of the other part.

The mode in which a part is running determines if they are input or output signal lines. Because a bit is shifted from the master to the slave and from the slave to the master simultaneously in one clock cycle both 8-bit shift registers can be considered as one 16-bit circular shift register. This means that after eight SCK clock pulses the data between master and slave will be exchanged.

The system is single buffered in the transmit direction and double buffered in the receive direction. This influences the data handling in the following ways:

1. New bytes to be sent can not be written to the data register (SPDR) / shift register before the entire shift cycle is completed.
2. Received bytes are written to the Receive Buffer immediately after the transmission is completed.
3. The Receive Buffer has to be read before the next transmission is completed or data will be lost.
4. Reading the SPDR will return the data of the Receive Buffer.

After a transfer is completed the SPI Interrupt Flag (SPIF) will be set in the SPI Status Register (SPSR). This will cause the corresponding interrupt to be executed if this interrupt and the global interrupts are enabled. Setting the SPI Interrupt Enable (SPIE) bit in the SPCR enables the interrupt of the SPI while setting the I bit in the SREG enables the global interrupts.

Pins of the SPI

The SPI consists of four different signal lines. These lines are the shift clock (SCK), the Master Out Slave In line (MOSI), the Master In Slave Out line (MISO) and the active low Slave Select line (/SS). When the SPI is enabled, the data direction of the MOSI, MISO, SCK and /SS pins are overridden according to the following table.

Table 1. SPI Pin Overrides

Pin Direction Overrides	Master SPI Mode Direction Overrides	Slave SPI Modes
MOSI	User Defined	Input
MISO	Input	User Defined
SCK	User Defined	Input
SS	User Defined	Input

This table shows that just the input pins are automatically configured. The output pins have to be initialized manually by software. The reason for this is to avoid damages e.g. through driver contention.

Multi Slave Systems - /SS pin Functionality

The Slave Select (/SS) pin plays a central role in the SPI configuration. Depending on the mode the part is running in and the configuration of this pin, it can be used to activate or deactivate the devices. The /SS pin can be compared with a chip select pin which has some extra features. In master mode, the /SS pin must be held high to ensure master SPI operation if this pin is configured as an input pin. A low level will switch the SPI into slave mode and the hardware of the SPI will perform the following actions:

1. The master bit (MSTR) in the SPI Control Register (SPCR) is cleared and the SPI system becomes a slave. The direction of the pins will be switched according to Table 1.

2. The SPI Interrupt Flag (SPIF) in the SPI Status Register (SPSR) will be set. If the SPI interrupt and the global interrupts are enabled the interrupt routine will be executed. This can be useful in systems with more than one master to avoid that two masters are accessing the SPI bus at the same time. If the /SS pin is configured as output pin it can be used as a general purpose output pin which does not affect the SPI system.

Note: In cases where the AVR is configured for master mode and it can not be ensured that the /SS pin will stay high between two transmissions, the status of the MSTR bit has to be checked before a new byte is written. Once the MSTR bit has been cleared by a low level on the /SS line, it must be set by the application to re-enable SPI master mode.

In slave mode the /SS pin is always an input. When /SS is held low, the SPI is activated and MISO becomes output if configured so by the user. All other pins are inputs. When /SS is driven high, all pins are inputs, and the SPI is passive, which means that it will not receive incoming data.

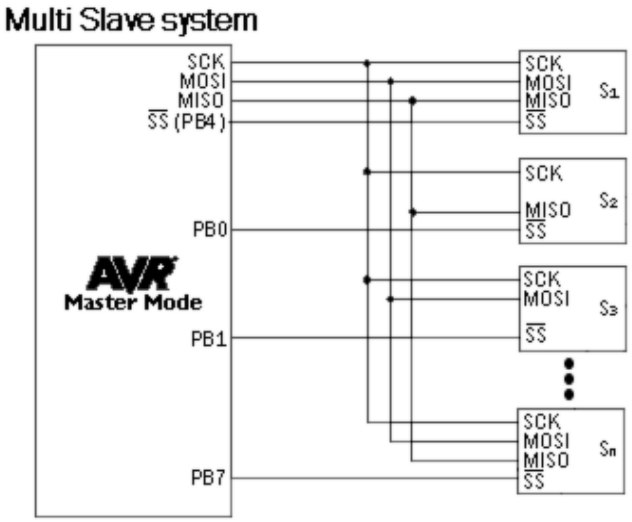
Table 2 shows an overview of the /SS Pin Functionality.

Note: In slave mode, the SPI logic will be reset once the /SS pin is brought high. If the /SS pin is brought high during a transmission, the SPI will stop sending and receiving immediately and both data received and data sent must be considered as lost.

TABLE 2. Overview of SS pin.

Mode	/SS Config	/SS Pin level	Description
Slave	Always input	High	Slave deactivated
		Low	Slave activated
Master	Input	High	Master activated
		Low	Master deactivated
	Output	High	Master activated
		Low	

As shown in Table 2, the /SS pin in slave mode is always an input pin. A low level activates the SPI of the device while a high level causes its deactivation. A Single Master Multiple Slave System with an AVR configured in master mode and /SS configured as output pin is shown in Figure 2. The amount of slaves, which can be connected to this AVR is only limited by the number of I/O pins to generate the slave select signals.



The ability to connect several devices to the same SPI-bus is based on the fact that only one master and only one slave is active at the same time. The MISO, MOSI and SCK lines of all the other slaves are tristated (configured as input pins of a high impedance with no pull up resistors enabled). A false implementation (e.g. if two slaves are activated at the same time) can cause a driver contention which can lead to a CMOS latchup state and must be avoided. Resistances of 1 to 10 k ohms in series with the pins of the SPI can be used to prevent the system from latching up. However this affects the maximum usable data rate, depending on the loading capacitance on the SPI pins.

Unidirectional SPI devices require just the clock line and one of the data lines. If the device is using the MISO line or the MOSI line depends on its purpose. Simple sensors for instance are just sending data (see S2 in Figure 2), while an external DAC usually just receives data (see S3 in Figure 2).

SPI Timing

The SPI has four modes of operation, 0 through 3. These modes essentially control the way data is clocked in or out of an SPI device. The configuration is done by two bits in the SPI control register (SPCR). The clock polarity is specified by the CPOL control bit, which selects an active high or active low clock. The clock phase (CPHA) control bit selects one of the two fundamentally different transfer formats. To ensure a proper communication between master and slave both devices have to run in the same mode. This can require a reconfiguration of

the master to match the requirements of different peripheral slaves.

The settings of CPOL and CPHA specify the different SPI modes, shown in Table 3. Because this is no standard and specified different in other literature, the configuration of the SPI has to be done carefully.

Table 3. SPI Mode configuration

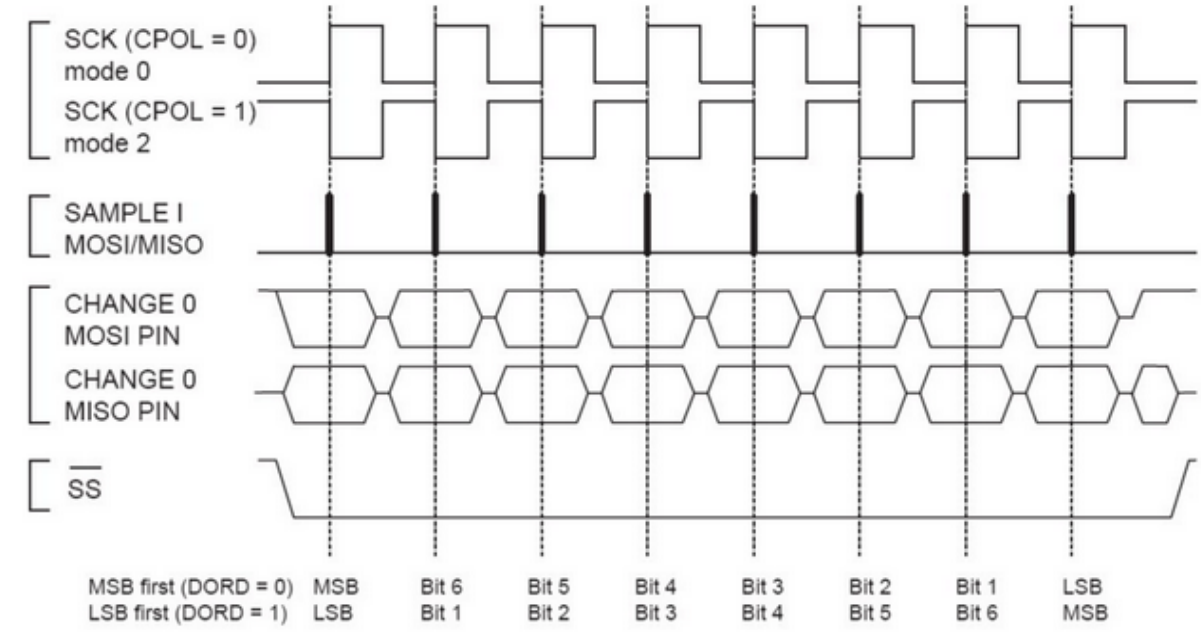
SPI Mode	CPOL	CPHA	Shift SCK edge	Capture SCK edge
0	0	0	Falling	Rising
1	0	1	Rising	Falling
2	1	0	Rising	Falling
3	1	1	Falling	Rising

The clock polarity has no significant effect on the transfer format. Switching this bit causes the clock signal to be inverted (active high becomes active low and idle low becomes idle high). The settings of the clock phase, how-ever, selects one of the two different transfer timings, which are described closer in the next two chapters. Since the MOSI and MISO lines of the master and the slave are directly connected to each other, the diagrams show the timing of both devices, master and slave. The /SS line is
the slave select input of the slave. The /SS pin of the master is not shown in the diagrams. It has to be inactive by a high level on this pin (if configured as input pin) or by configuring it as an output pin.

A.) CPHA = 0 and CPOL = 0 (Mode 0) and CPHA = 0 and CPOL = 1 (Mode 1)

The timing of a SPI transfer where CPHA is zero is shown in Figure 3. Two wave forms are shown for the SCK signal -one for CPOL equals zero and another for CPOL equals one.

Figure 62. SPI Transfer Format with CPHA = 0



When the SPI is configured as a slave, the transmission starts with the falling edge of the /SS line. This activates the SPI of the slave and the MSB of the byte stored in its data register (SPDR) is output on the MISO line. The actual transfer is started by a software write to the SPDR of the master. This causes the clock signal to be generated. In cases where the CPHA

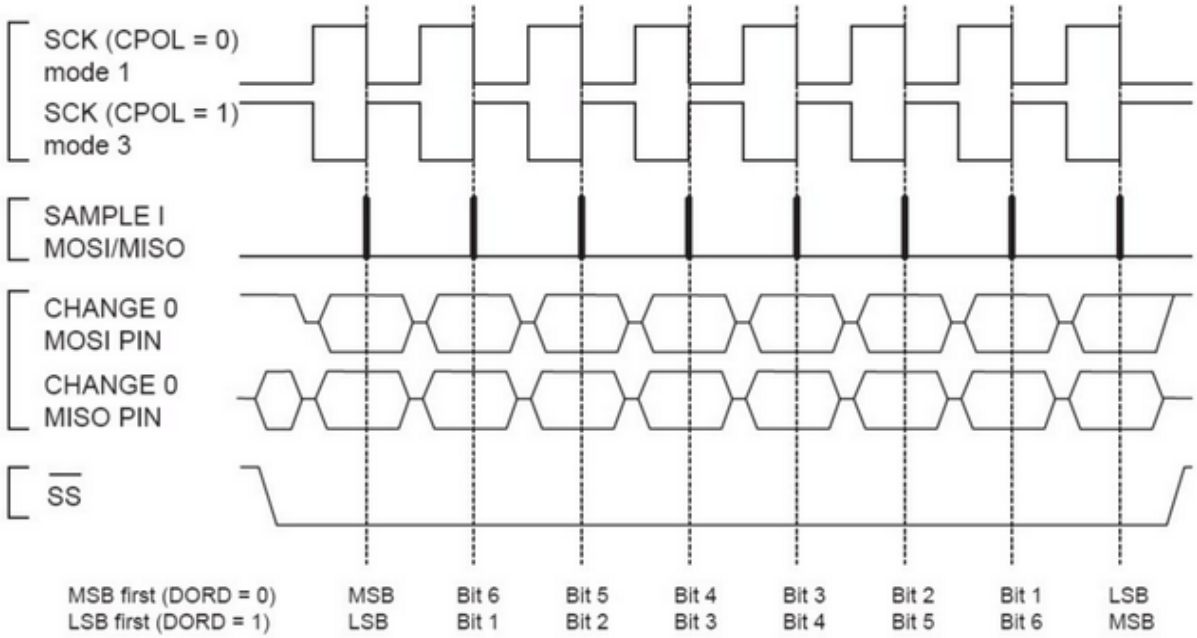
equals zero, the SCK signal remains zero for the first half of the first SCK cycle. This ensures that the data is stable on the input lines of both the master and the slave. The data on the input lines is read with the edge of the SCK line from its inactive to its active state (rising edge if CPOL equals zero and falling edge if CPOL equals one). The edge of the SCK line from its active to its inactive state (falling edge if CPOL equals zero and rising edge if CPOL equals one) causes the data to be shifted one bit further so that the next bit is output on the MOSI and MISO lines.

After eight clock pulses the transmission is completed. In both the master and the slave device the SPI interrupt flag (SPIF) is set and the received byte is transferred to the receive buffer.

B.) CPHA = 1 and CPOL = 0 (Mode 2) and CPHA = 1 and CPOL = 1 (Mode 3)

The timing of a SPI transfer where CPHA is one is shown in Figure 4. Two wave forms are shown for the SCK signal -one for CPOL equals zero and another for CPOL equals one.

Figure 63. SPI Transfer Format with CPHA = 1



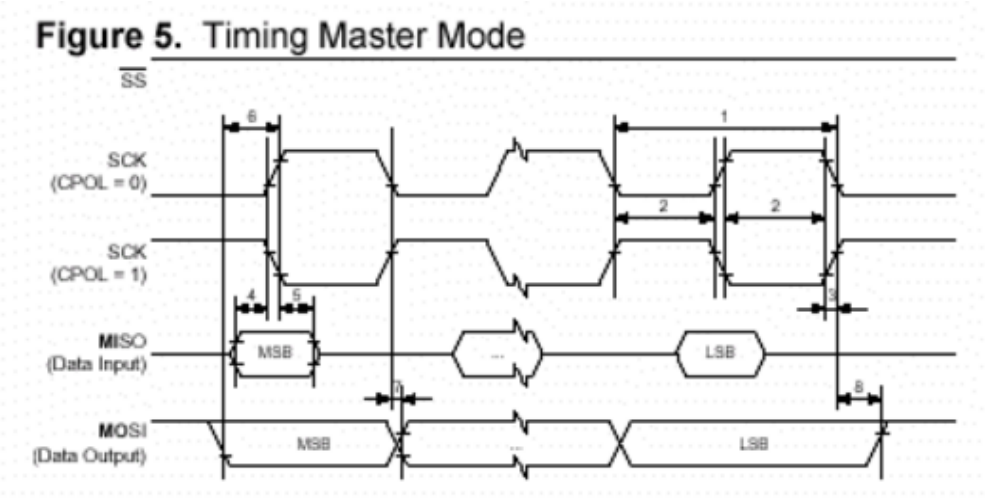
Like in the previous cases the falling edge of the /SS lines selects and activates the slave. Compared to the previous cases, where CPHA equals zero, the transmission is not started and the MSB is not output by the slave at this stage. The actual transfer is started by a software write to the SPDR of the master what causes the clock signal to be generated. The first edge of the SCK signal from its inactive to its active state (rising edge if CPOL equals zero and falling edge if CPOL equals one) causes both the master and the slave to output the MSB of the byte in the SPDR.

As shown in Figure 4, there is no delay of half a SCK-cycle like in Mode 0 and 1. The SCK line changes its level immediately at the beginning of the first SCK-cycle. The data on the input lines is read with the edge of the SCK line from its active to its inactive state (falling edge if CPOL equals zero and rising edge if CPOL equals one).

After eight clock pulses the transmission is completed. In both the master and the slave device the SPI interrupt flag (SPIF) is set and the received byte is transferred to the receive buffer.

Considerations for high speed transmissions

Parts which run at higher system clock frequencies and SPI modules capable of running at speed grades up to half the system clock require a more specific timing to match the needs of both the sender and receiver. The following two diagrams show the timing of the AVR in master and in slave mode for the SPI Modes 0 and 1. The exact values of the displayed times vary between the different pars and are not an issue in this application note. However the functionality of all parts is in principle the same so that the following considerations apply to all parts.



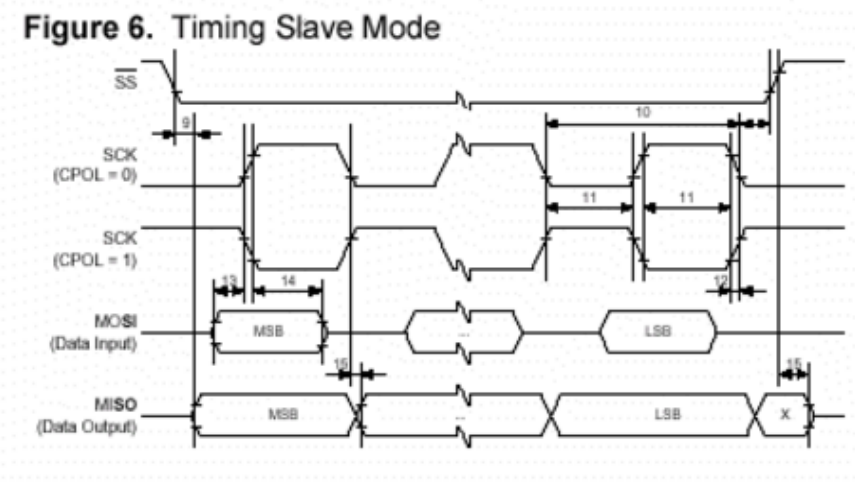
The minimum timing of the clock signal is given by the times "1" and "2". The value "1" specifies the SCK period while the value "2" specifies the high / low times of the clock signal. The maximum rise and fall time of the SCK signal is specified by the time "3". These are the first timings of the AVR to check if they match the requirements of the slave.

The Setup time "4" and Hold time "5" are important times because they specify the requirements the AVR has on the interface of the slave. These times determine how long before the clock edge the slave has to have valid output data ready and how long after the clock edge this data has to be valid.

If the Setup and Hold time are long enough the slave suits to the requirements of the AVR but does the AVR suit to the requirements of the slave?

The time "6" (Out to SCK) specifies the minimum time the AVR has valid output data ready before the clock edge occurs. This time can be compared to the Setup time "4" of the slave.

The time "7" (SCK to Out) specifies the maximum time after which the AVR outputs the next data bit while the time "8" (SCK to Out high) the minimum time specifies during which the last data bit is valid on the MOSI line after the SCK was set back to its idle state.



In principle the timings are the same in slave mode like previously described in master mode. Because of the switching of the roles between master and slave the requirements on the timing are inverted as well. The minimum times of the master mode are now maximum times and vice versa.

SPI Transmission Conflicts

A write collision occurs if the SPDR is written while a transfer is in progress. Since this register is just single buffered in the transmit direction, writing to SPDR causes data to be written directly into the SPI shift register. Because this write operation would corrupt the data of the current transfer, a write-collision error in generated by setting the WCOL bit in the SPSR. The write operation will not be executed in this case and the transfer continues undisturbed. A write collision is generally a slave error because a slave has no control over when a master will initiate a transfer. A master, however, knows when a transfer is in progress. Thus a master should not generate write collision errors, although the SPI logic can detect these errors in a master as well as in a slave mode.

When you set the SPI option from the Options, Compiler, SPI menu SPCR will be set to 01010100 which means ; enable SPI, master mode, CPOL = 1

When you want to control the various options with the hardware SPI you can use the CONFIG SPI statement.

Power Up

At power up all ports are in Tri-state and can serve as input pins.

When you want to use the ports (pins) as output, you must set the data direction first with the statement : CONFIG PORTB = OUTPUT

Individual bits can also be set to be used as input or output.

For example : DDRB = &B00001111 , will set a value of 15 to the data direction register of PORTB.

PORTB.0 to PORTB.3 (the lower 4 bits) can be used as outputs because they are set high. The upper four bits (PORTB.4 to PORTB.7), can be used for input because they are set low.

You can also set the direction of a port pin with the statement :

CONFIG PINB.0 = OUTPUT | INPUT

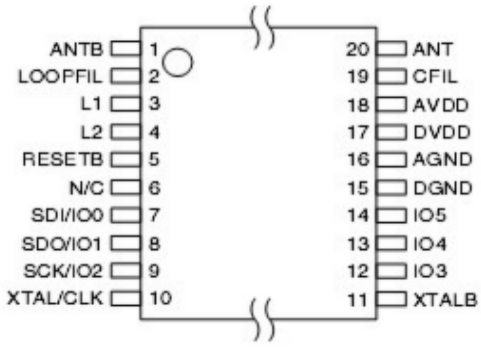
The internal RAM is cleared at power up or when a reset occurs. Use $NORAMCLEAR to disable this feature.

You may use $INITMICRO to set a port level and direction immediately on startup.

Chips

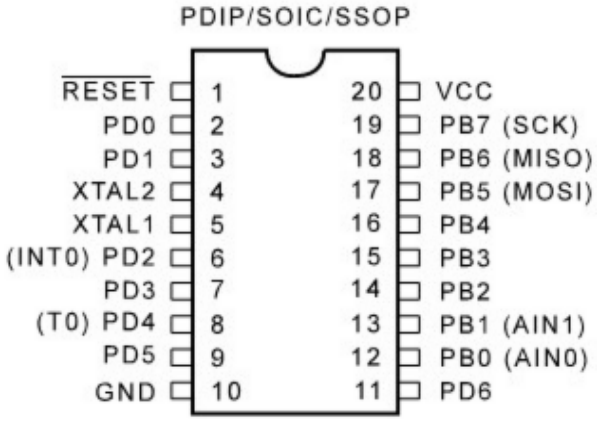
AT86RF401

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



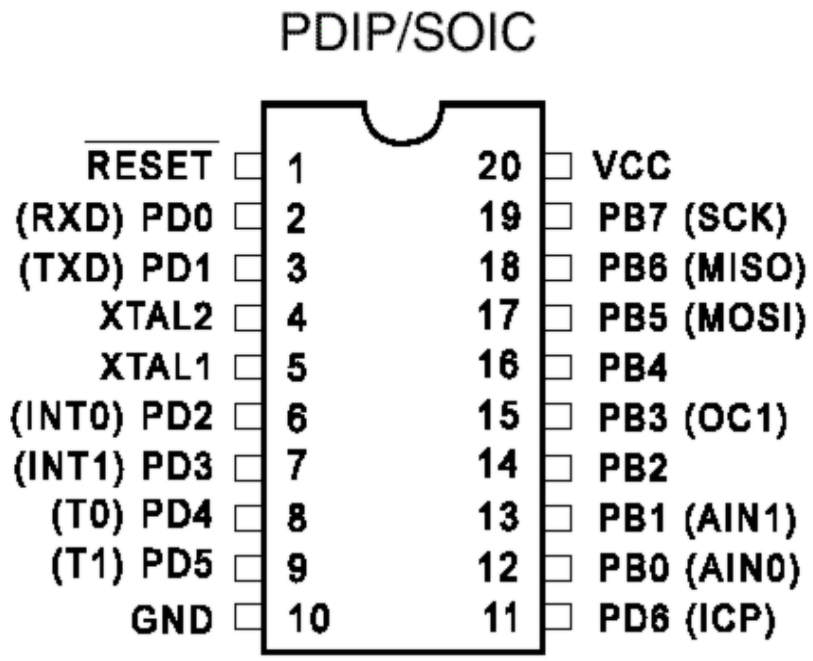
AT90S1200

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



AT90S2313

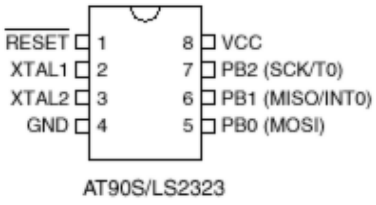
This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



The ATTiny2313 should be used for new designs.

AT90S2323

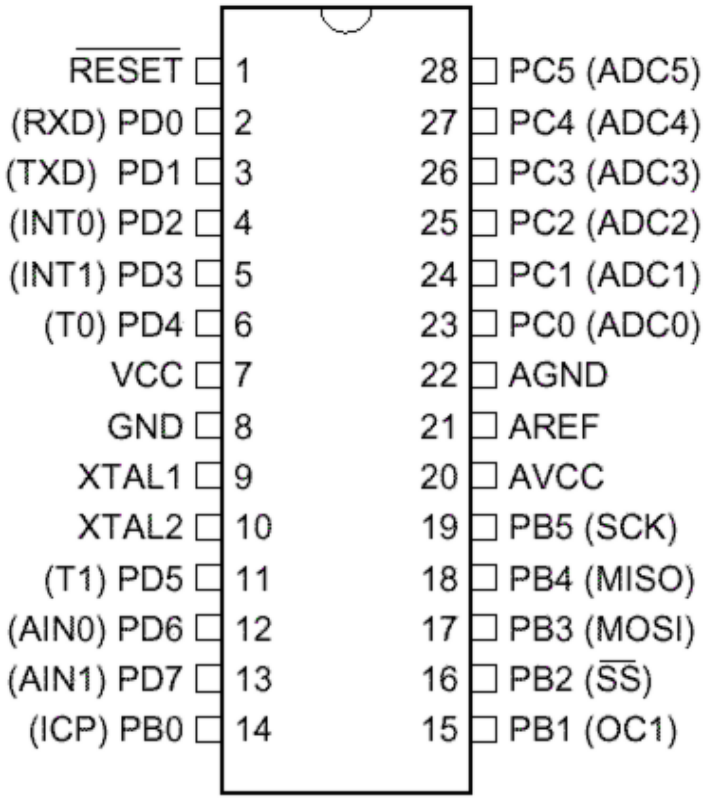
This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



AT90S/LS2323

AT90S2333

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



AT90S2343

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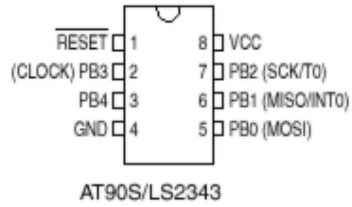


AT90S/LS2343

[tip from Martin Verschuren]

When using the AT90S2343 with BASCOM-AVR 1.11.6.4 and the STK200. Programming must be done with jumper ext-clk.

The BASCOM build in programmer will detect a Tiny22, which seems to have the same ID string as the 2343 (Atmel source) so no wonder.

By using the internal clock RCEN=0, then the jumper of the STK200 must be on int.clk after programming.

Don't leave this away, some AT90S2343 will not correctly startup.

In your own project notice that you have to pullup the clk pin(2) at power up else it won't work. (I just looked for it for a day to get this problem solved:-)

Note : the at90s2343 and tiny22 have the same chip ID. In BASCOM you need to choose the tiny22 even if you use the 2343.

I note from MCS : only the AT23LS43-1 has the internal oscillator programmed by default! All other 2343 chips need an external clock signal. Tip: use a AT90S2313 and connect X2 to the clock input of the 2343.

[tip from David Chambers]

Using the AT90S2343 with BASCOM 1.11.7.3 the DT006 hardware there are no problems with programming the chip ie no special jumper conditions to enable programming. However it is best to remove links connecting ports to the DT006 LED's before programming. If access to PB3 and PB4 is desired then jumpers J11 & J12 must be installed with pins 2 and 3 linked in both cases. Note that PB3 and PB4 are each connected to a momentary pushbutton on the DT006 board. These can be used to check contact closure functions, so bear this in mind when writing code for contact monitoring.

The current ATMEL data sheet specifies that all versions –1, -4 and –10 are supplied with a fuse bit set for the internal clock that operates at approximately 1Mhz. If using the internal clock make sure to enter 1000000 under Options\Complier\Communication\frequency.

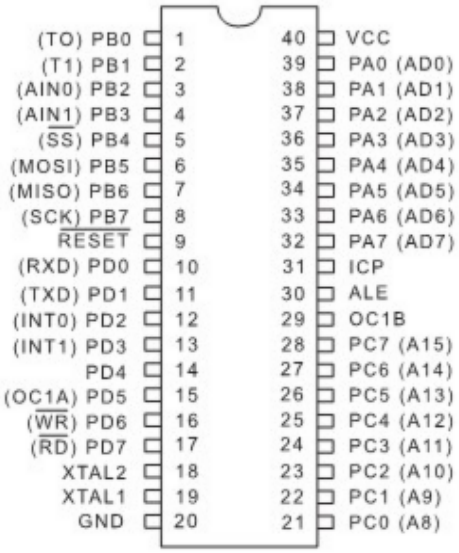
A great little chip with minimal external components. Only the resistor and capacitor required for RESET during power up.

Note that the LED's on the DT006 are not connected to the same programmed port pins when changing the chip type. This is because the special functions assigned ports varies between the 8pin, 20 pin and 28 pin products eg the MOSI, MISI and SCK functions are assigned to PB0, PB1 and PB2 for an 8 pin processor and PB5, PB6 and PB7 for a 20 pin processor. The result is that for a given program the LED's that respond are different.

AT90S4414

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.

PDIP



AT90S4433

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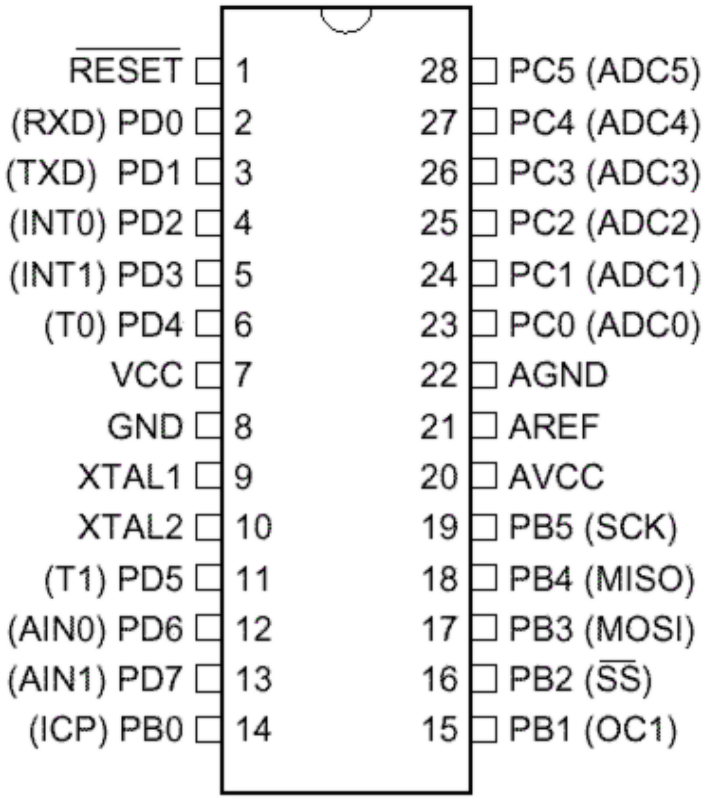

AT90S4434

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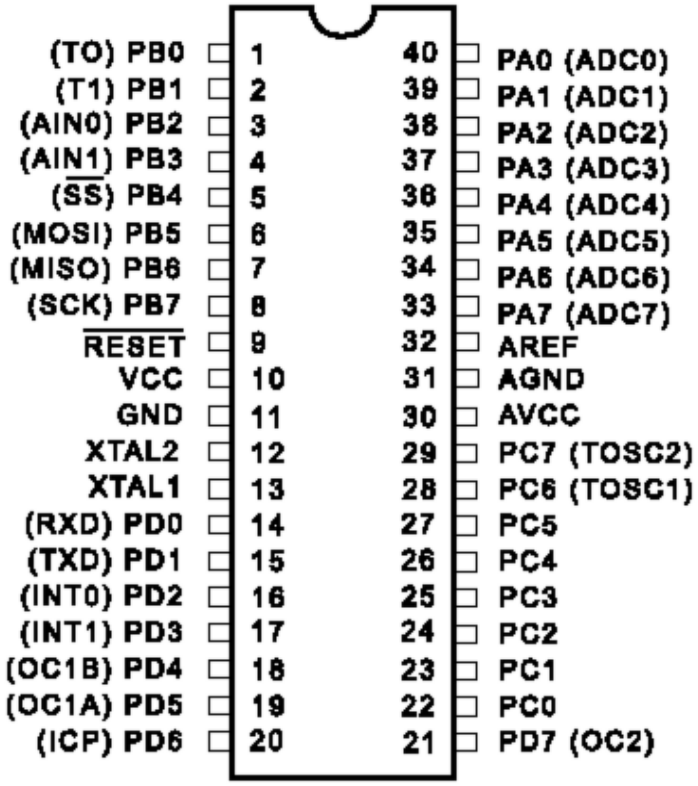
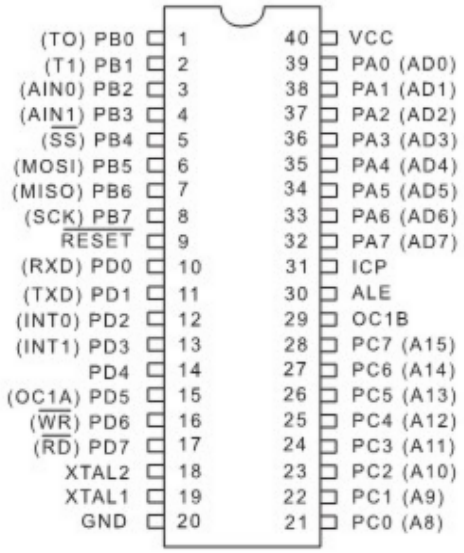


AT90S8515

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.

PDIP



AT90S8535

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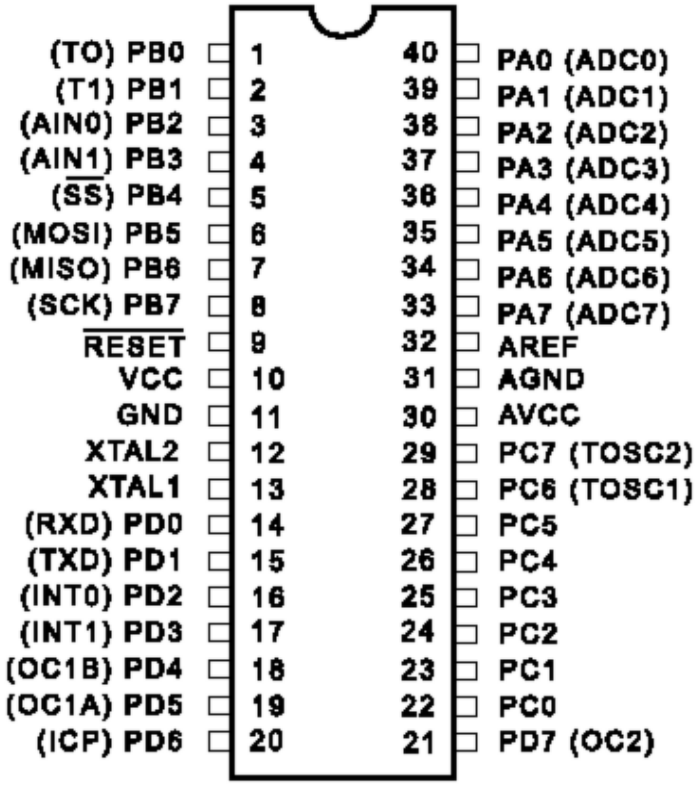

AT90CAN128

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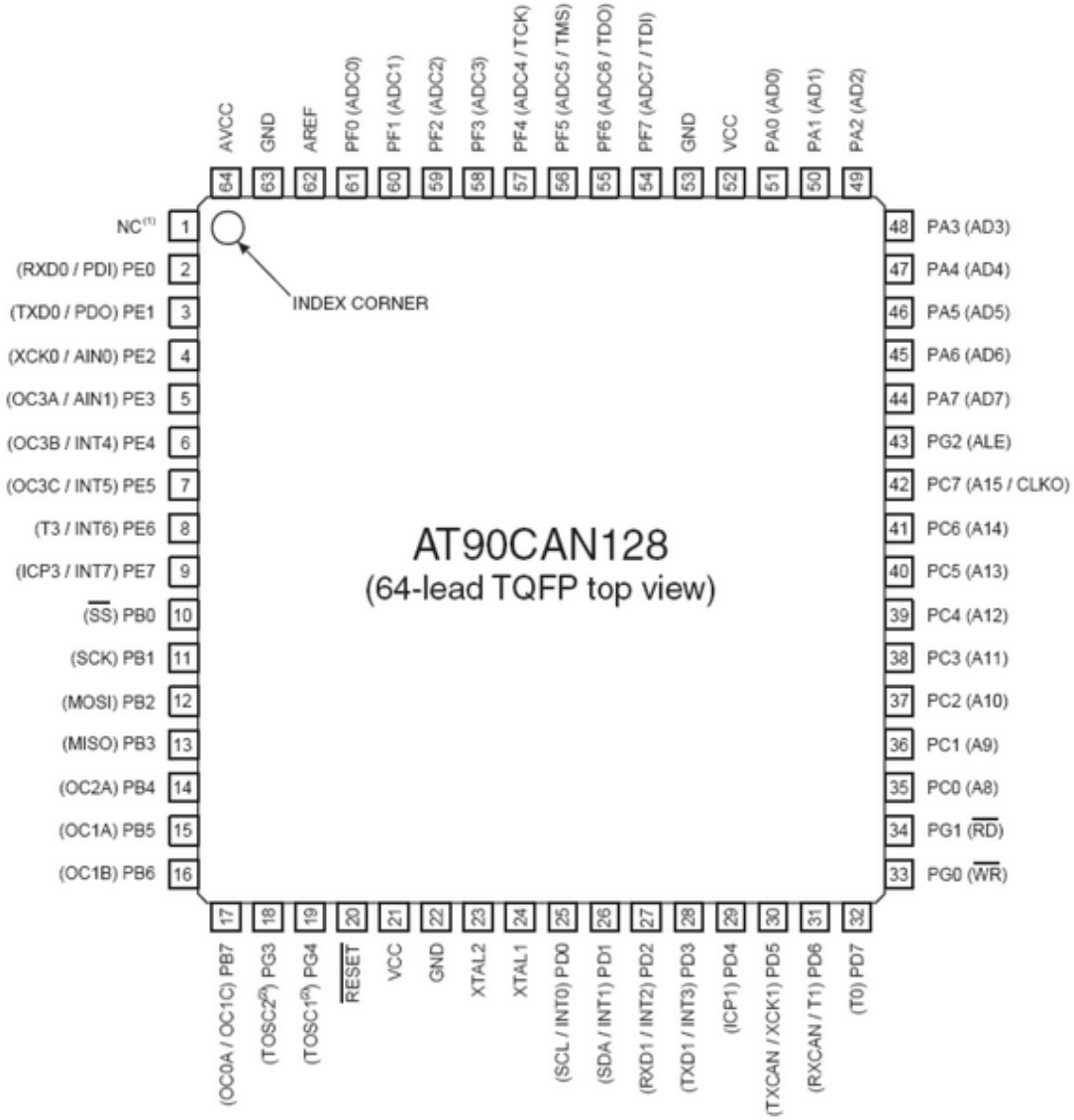

ATtiny22

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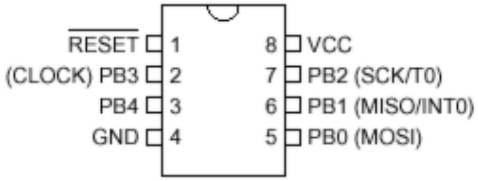

ATtiny12

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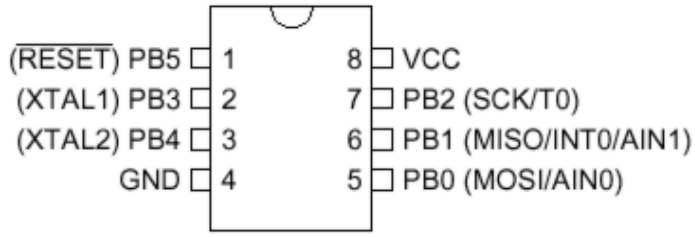

ATtiny13

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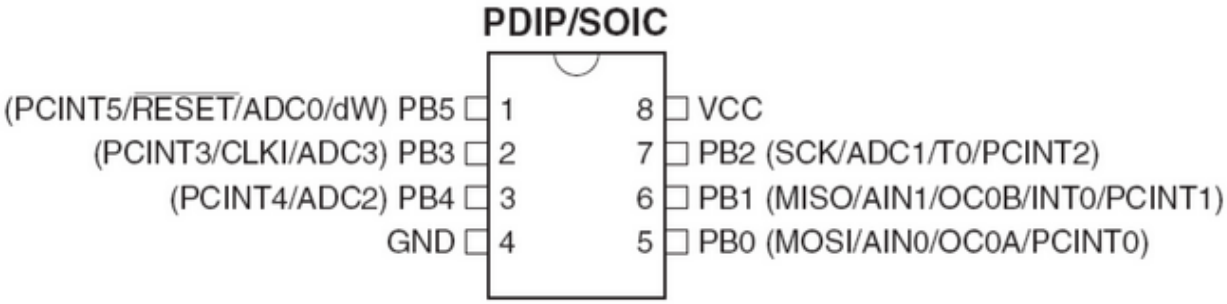

ATtiny15

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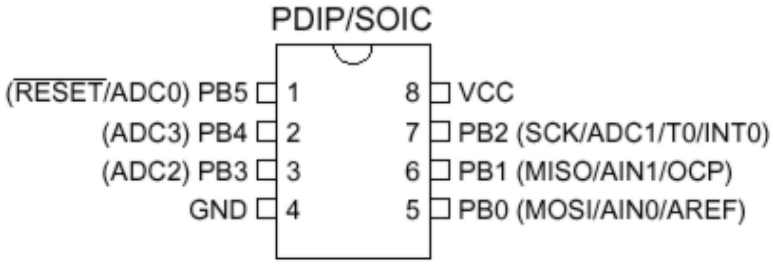

ATtiny25

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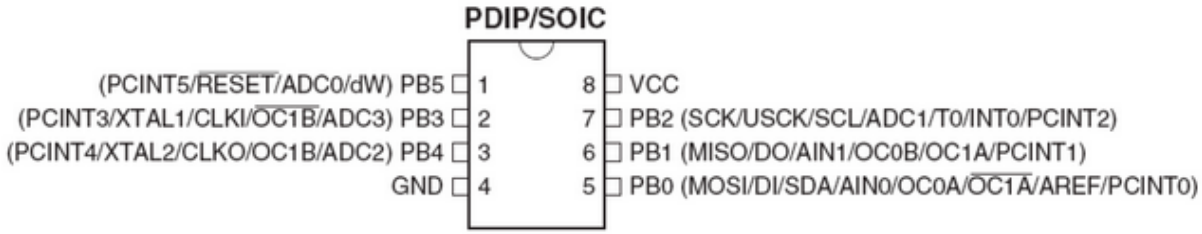

ATtiny45

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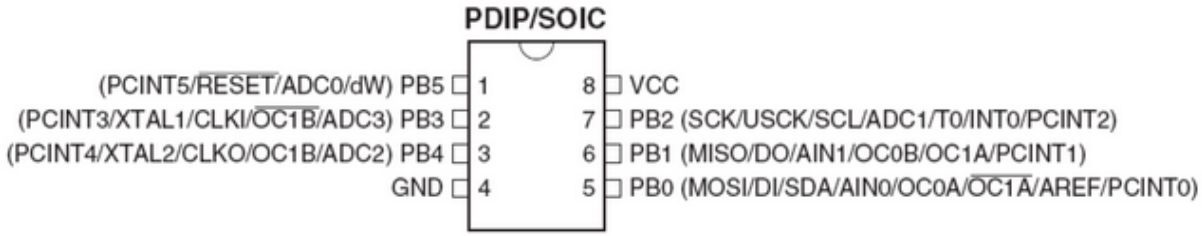

ATtiny85

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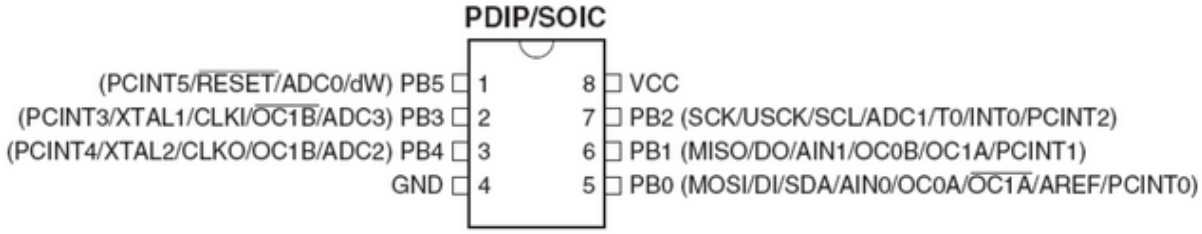

ATtiny26

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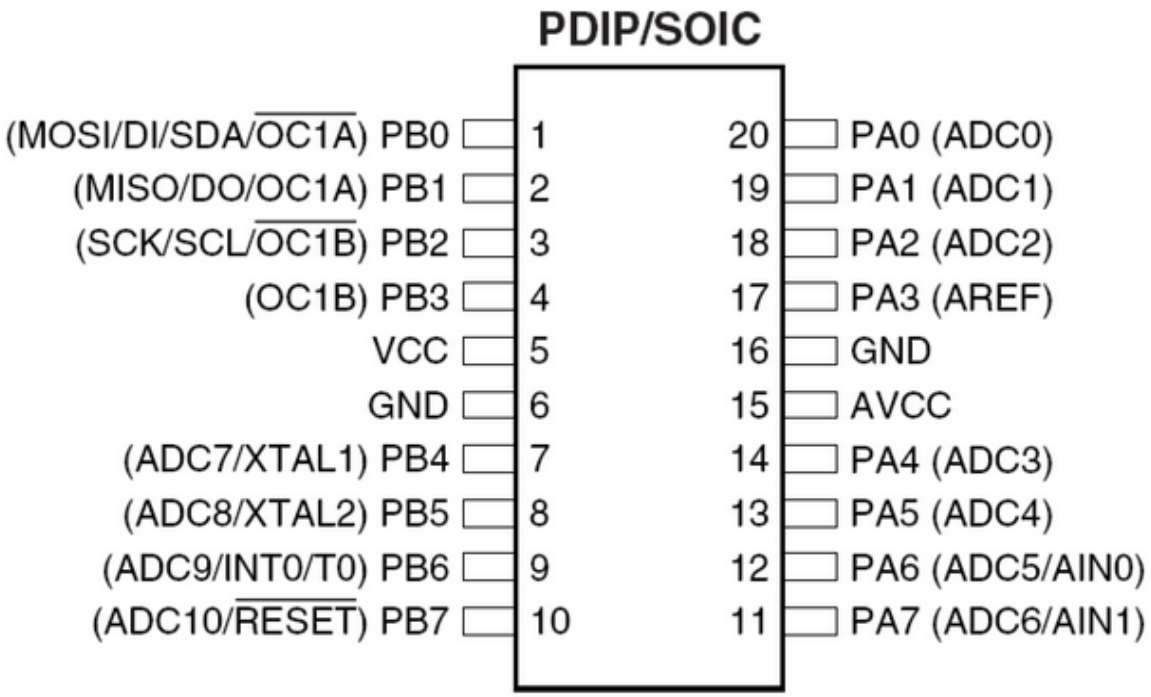
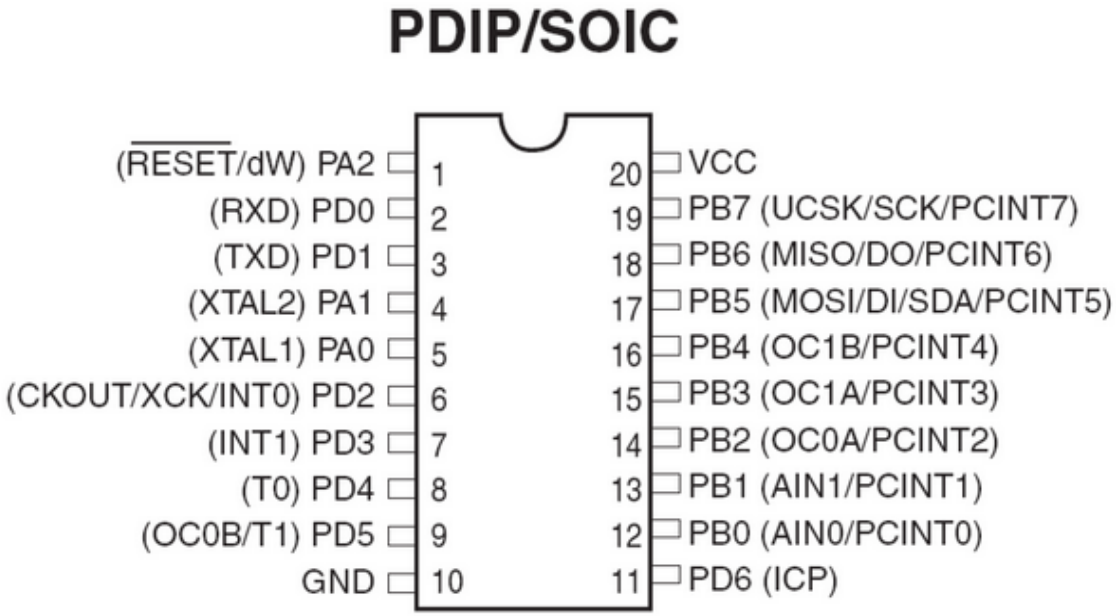


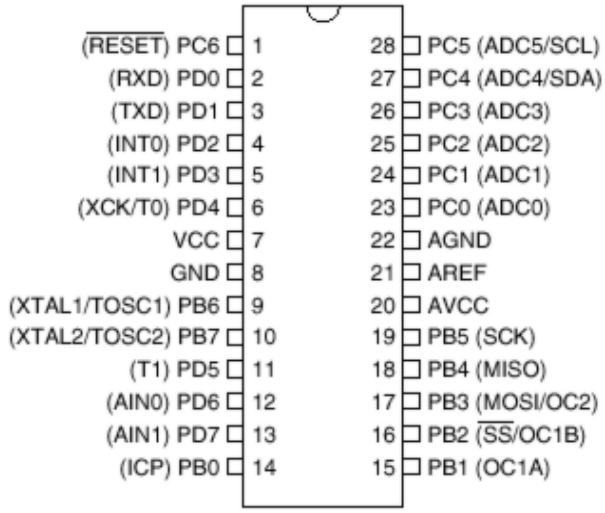
ATtiny2313

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



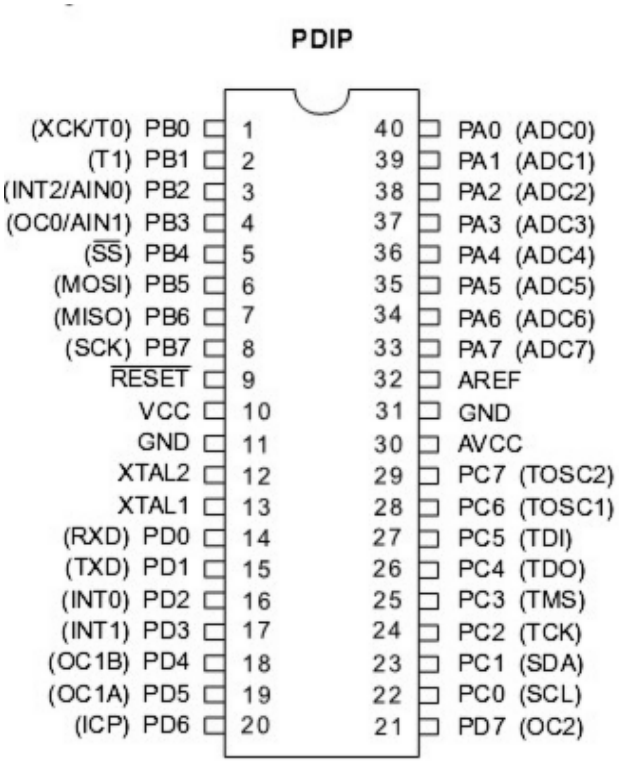
ATMEGA8

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



ATMEGA16

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



ATMEGA32

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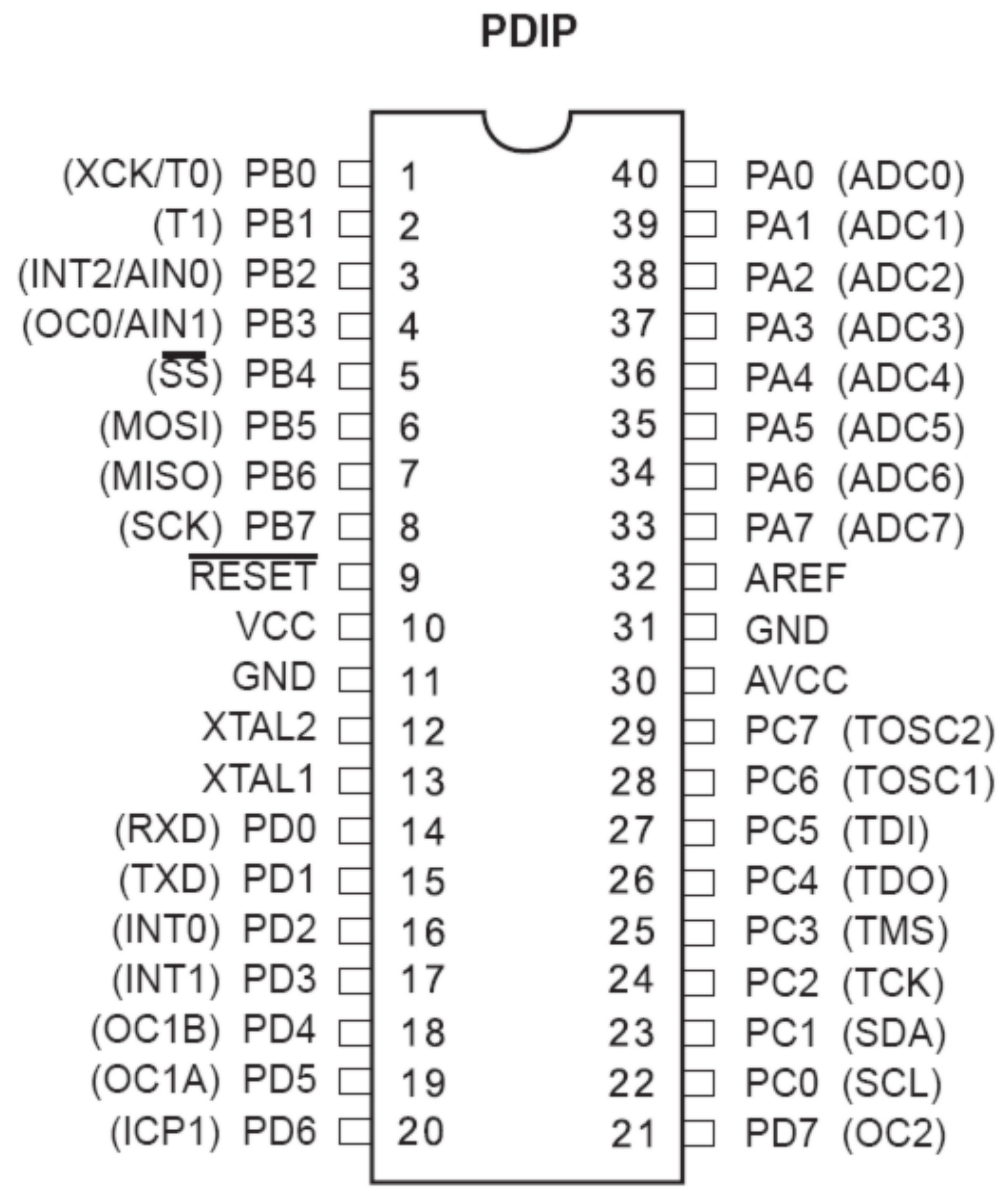

ATMEGA48

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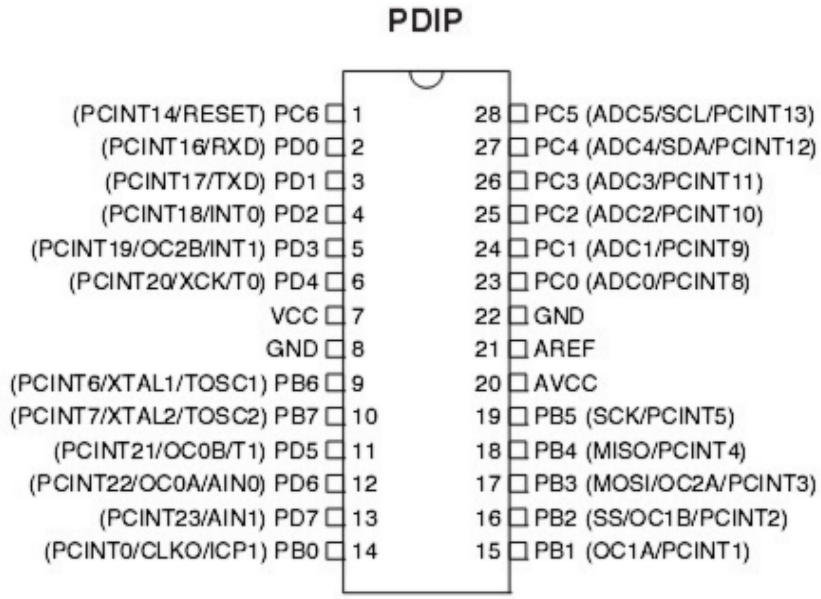

ATMEGA88

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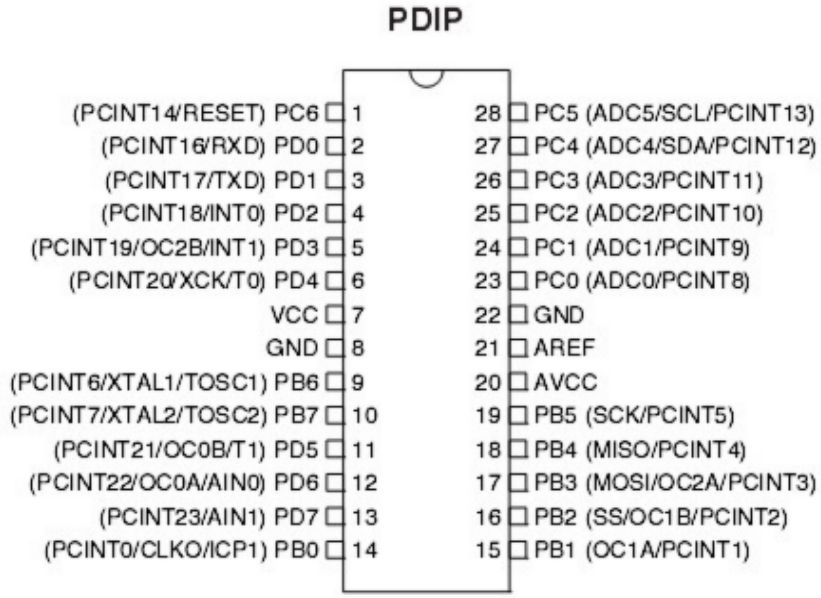

ATMEGA168

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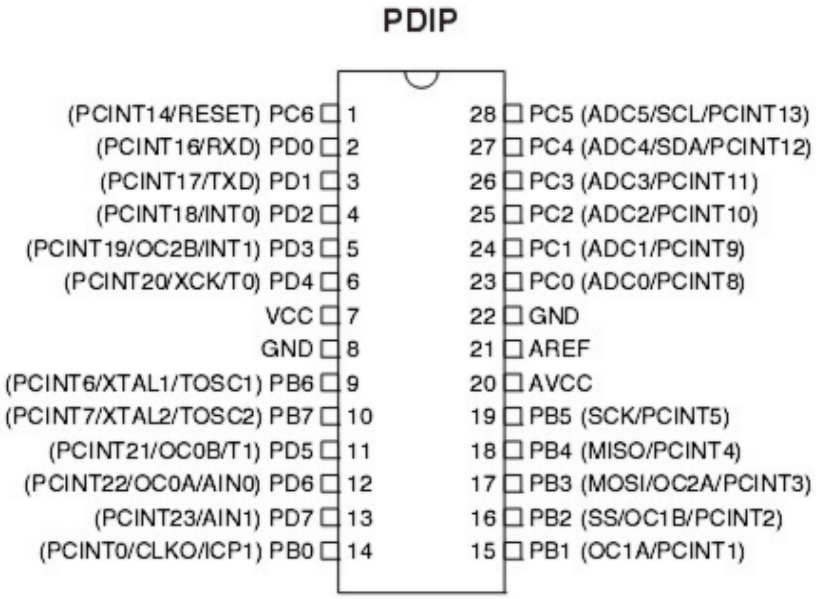
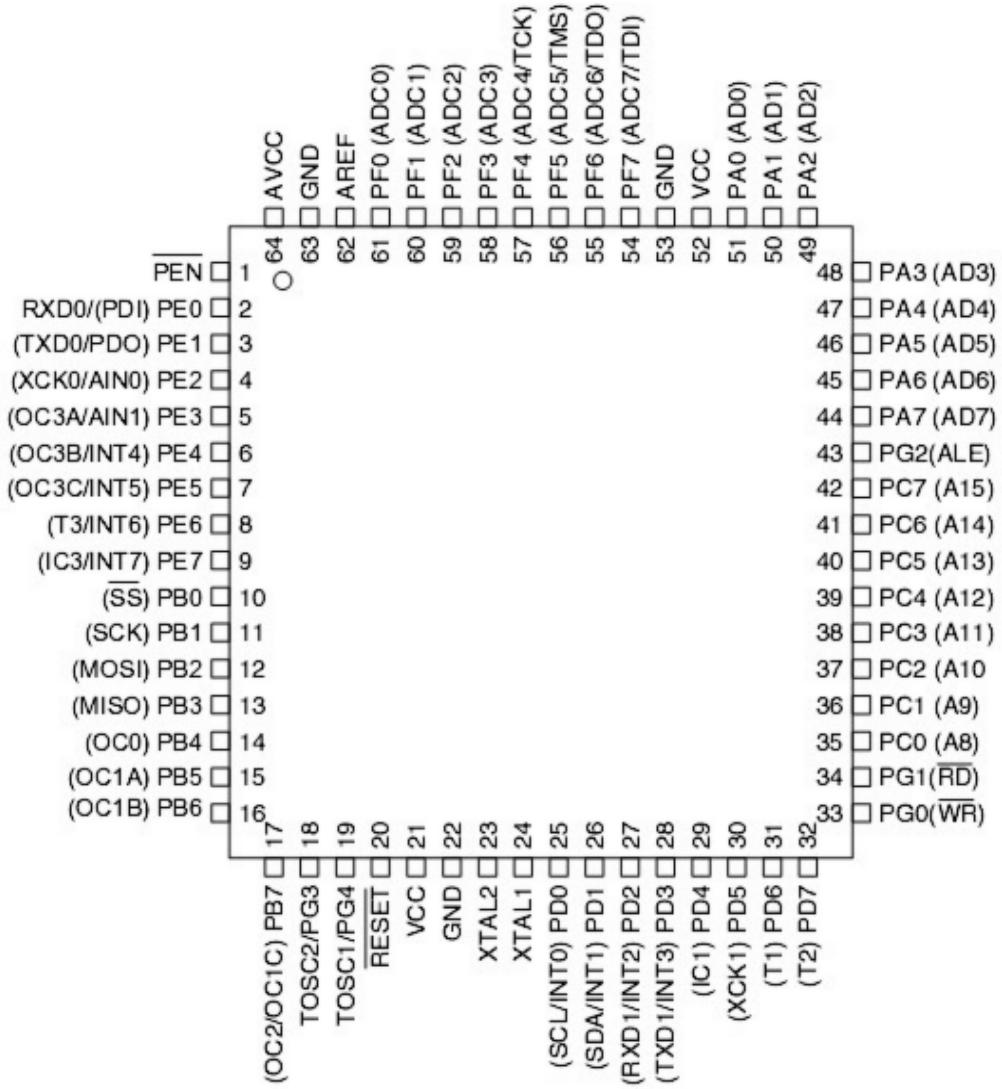


ATMEGA64

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.

Figure 1. Pinout ATmega64



ATMEGA103

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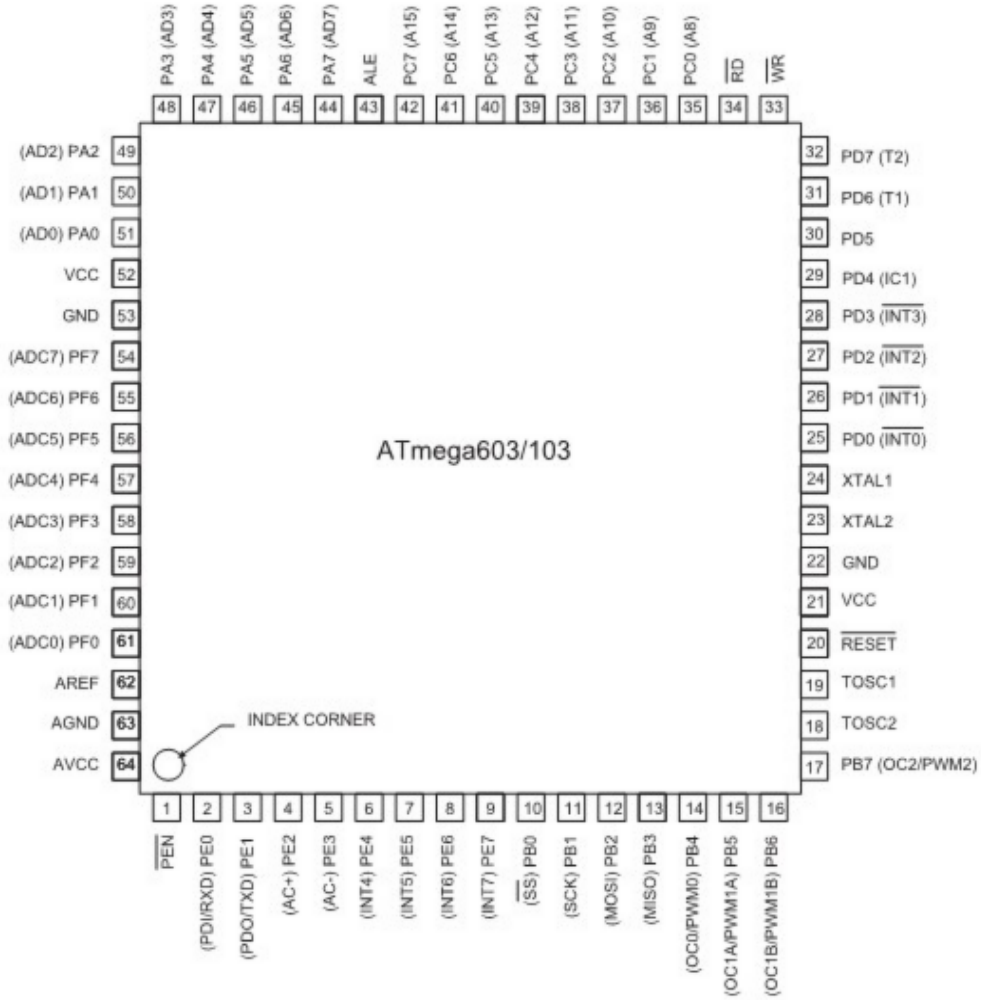

ATMEGA128

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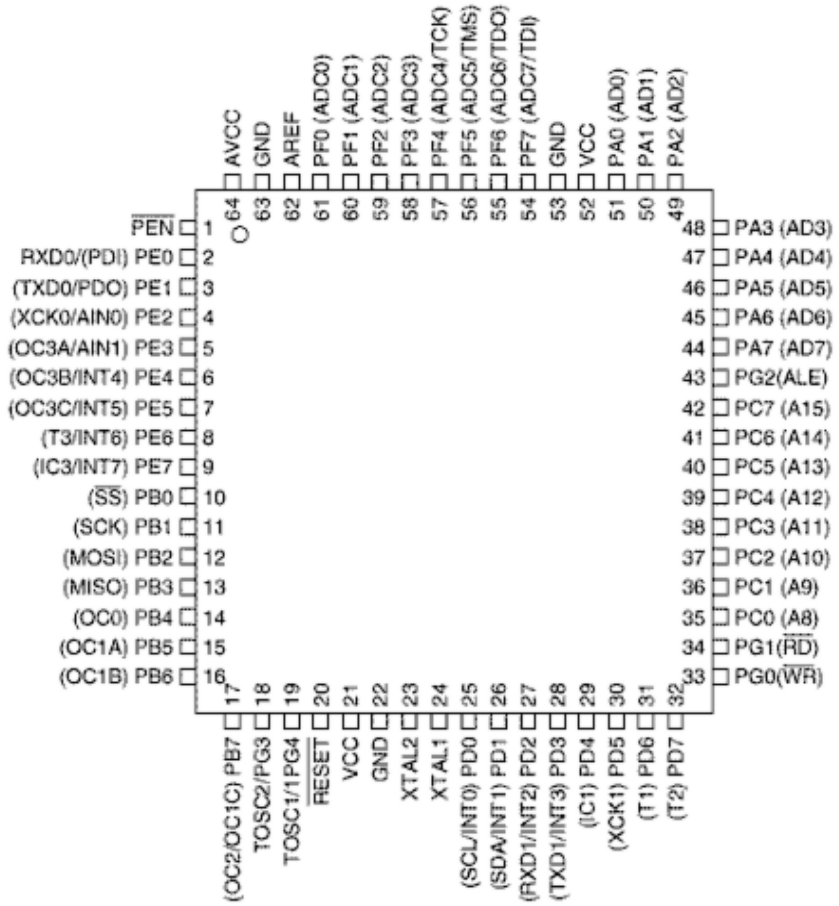
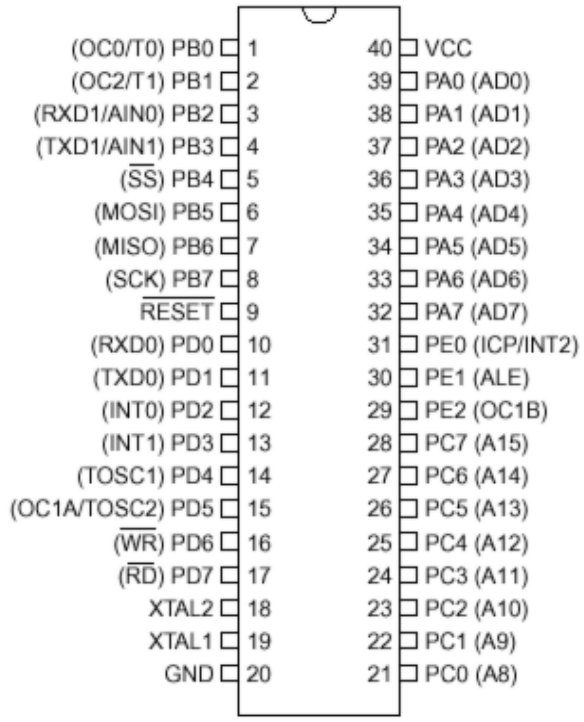


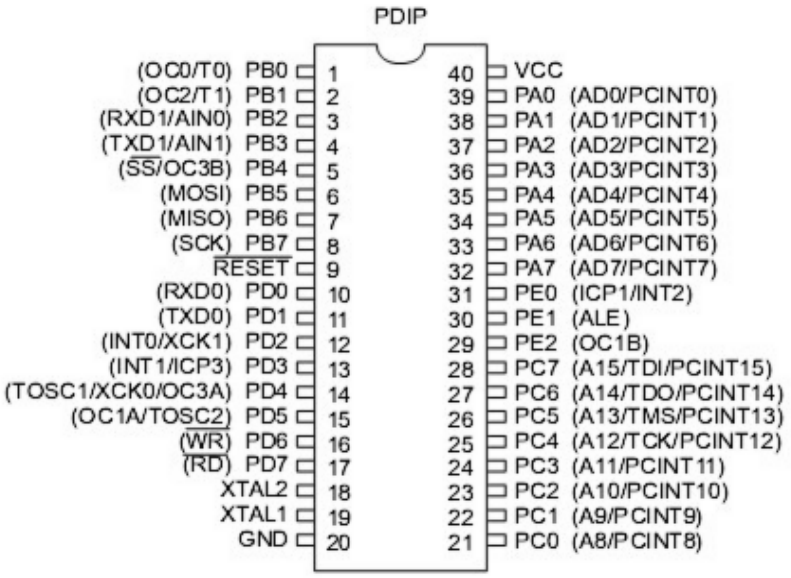
ATMEGA161

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



ATMEGA162

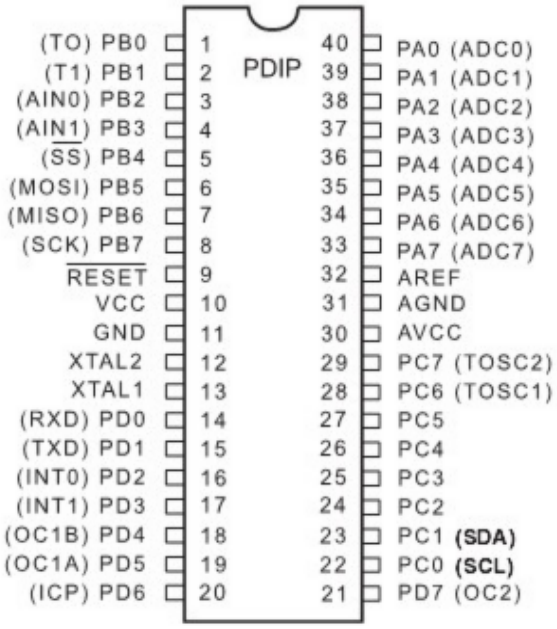
This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



The M162 has a clock-16 divider enabled by default. See the M162.bas sample file

ATMEGA163

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



The M163 by default uses the internal clock running at 1 MHz

When you have problems with timing set the right fuse bit A987= 0101. This will solve this problem.

I have just found a small difference in PortB when using the Mega163 in place of a 8535. The difference is in regard to PortB.4 - PortB.7 when not used as a SPI

interface. The four upper bits of PortB are shared with the hardware SPI unit.

If the SPI is configured in SLAVE mode (DEFAULT) the MOSI , SCK , /SS

Are configured as inputs, Regardless of the DDRB setting !

The /SS (slave select) pin also has restrictions on it when using it as a general input.- see data sheet ATmega163 - p57.

This sample allows you to use the upper nibble of PortB as outputs.

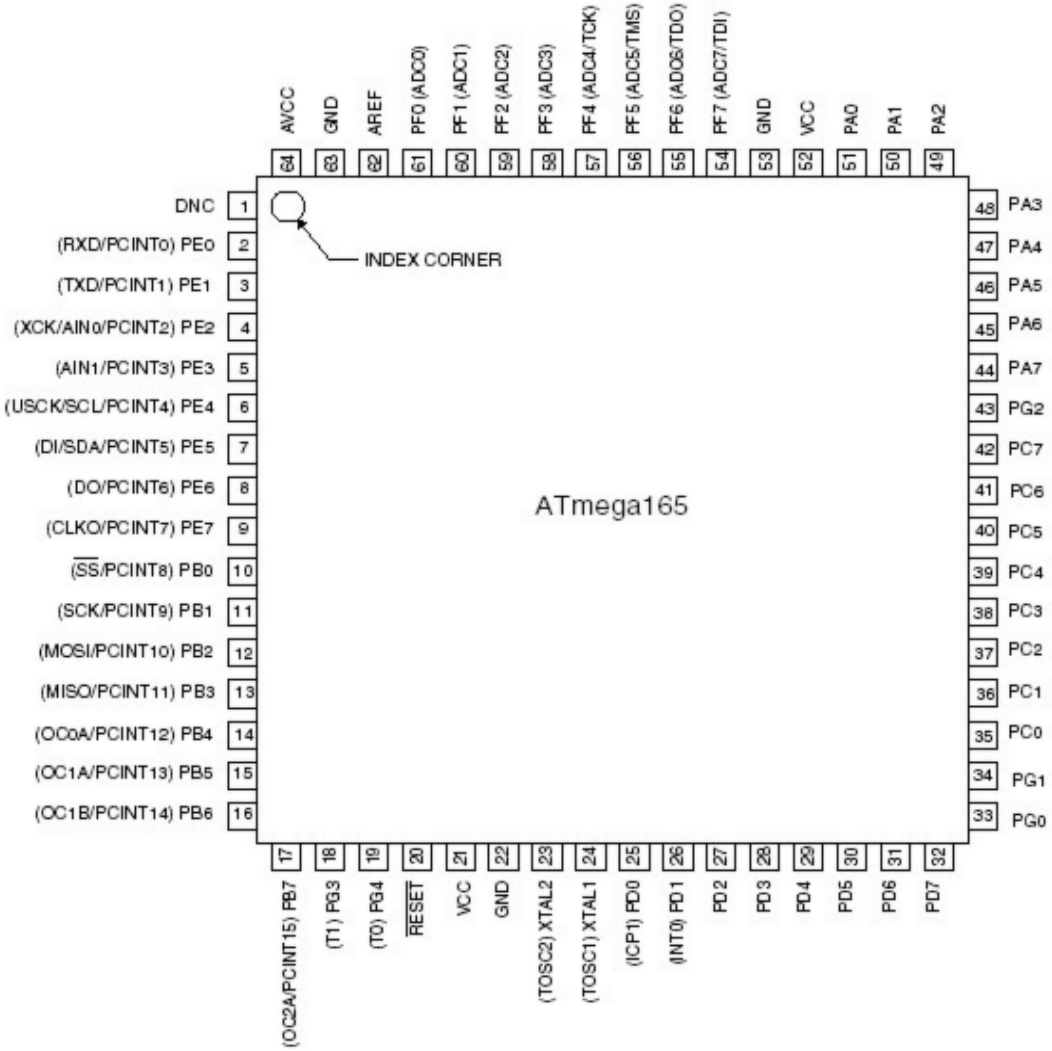
```
Portb = &B0000_0000

DDRB = &B1111_0000 'set upper bits for output.

Spcr = &B0001_0000 ' set SPI to Master and Disable.
```

If The SPCR register is not set for Master, you cannot set the pins for

Output.

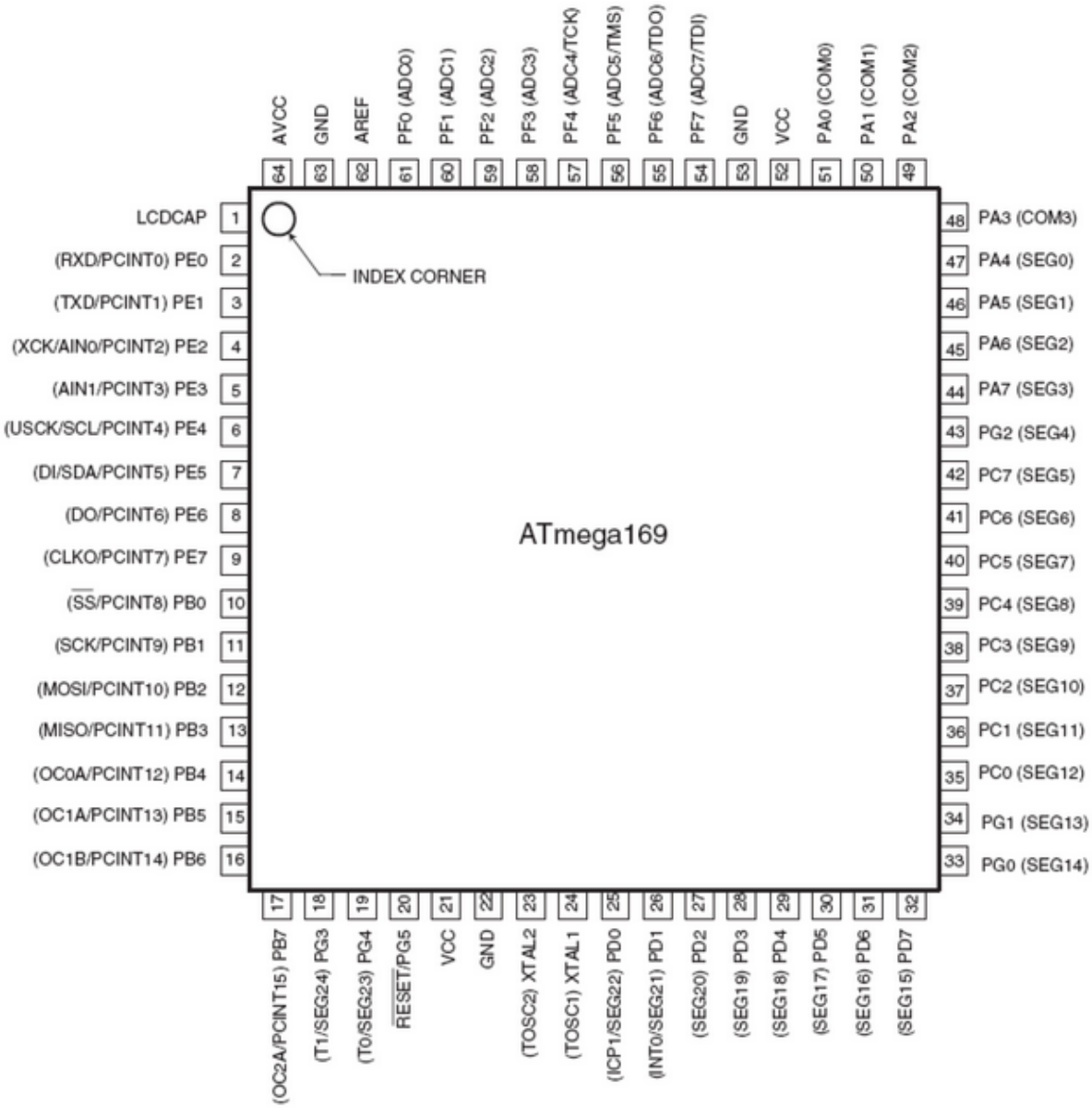
ATMEGA165

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



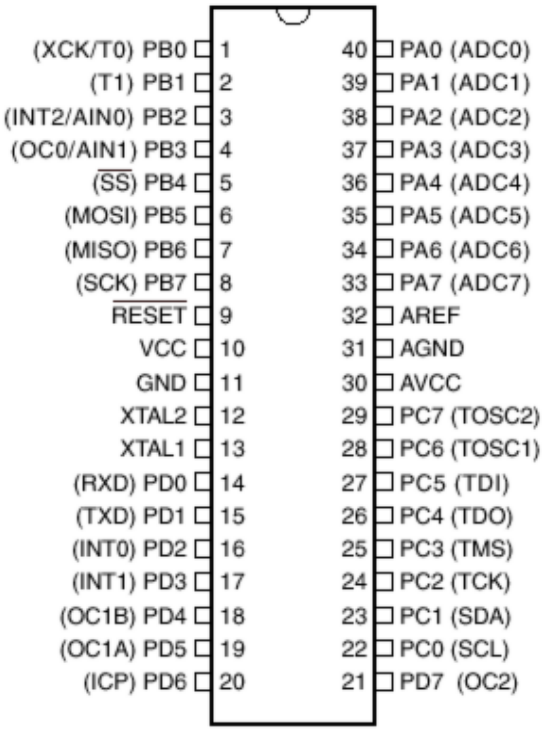
ATMEGA169

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



ATMEGA323

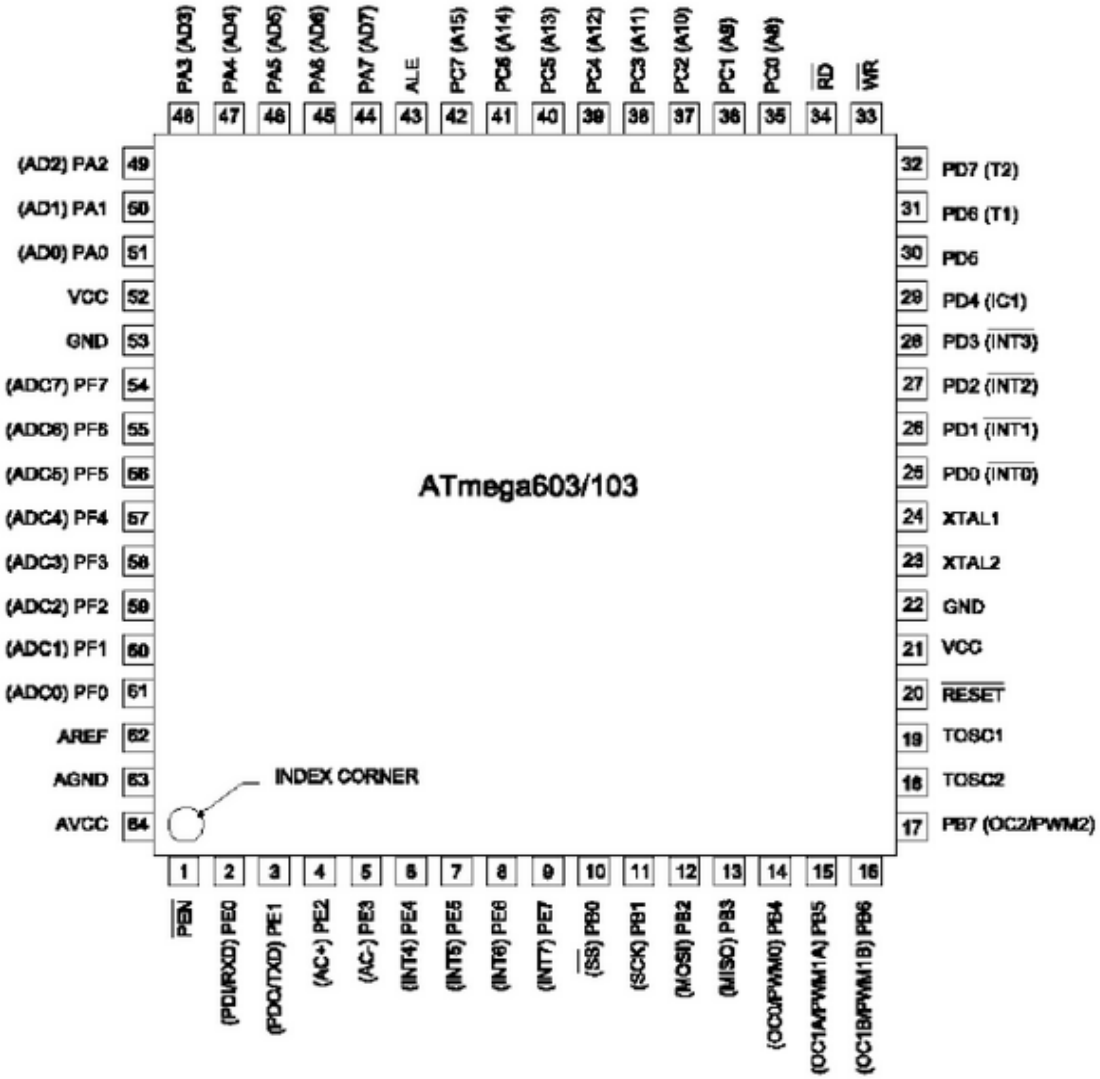
This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



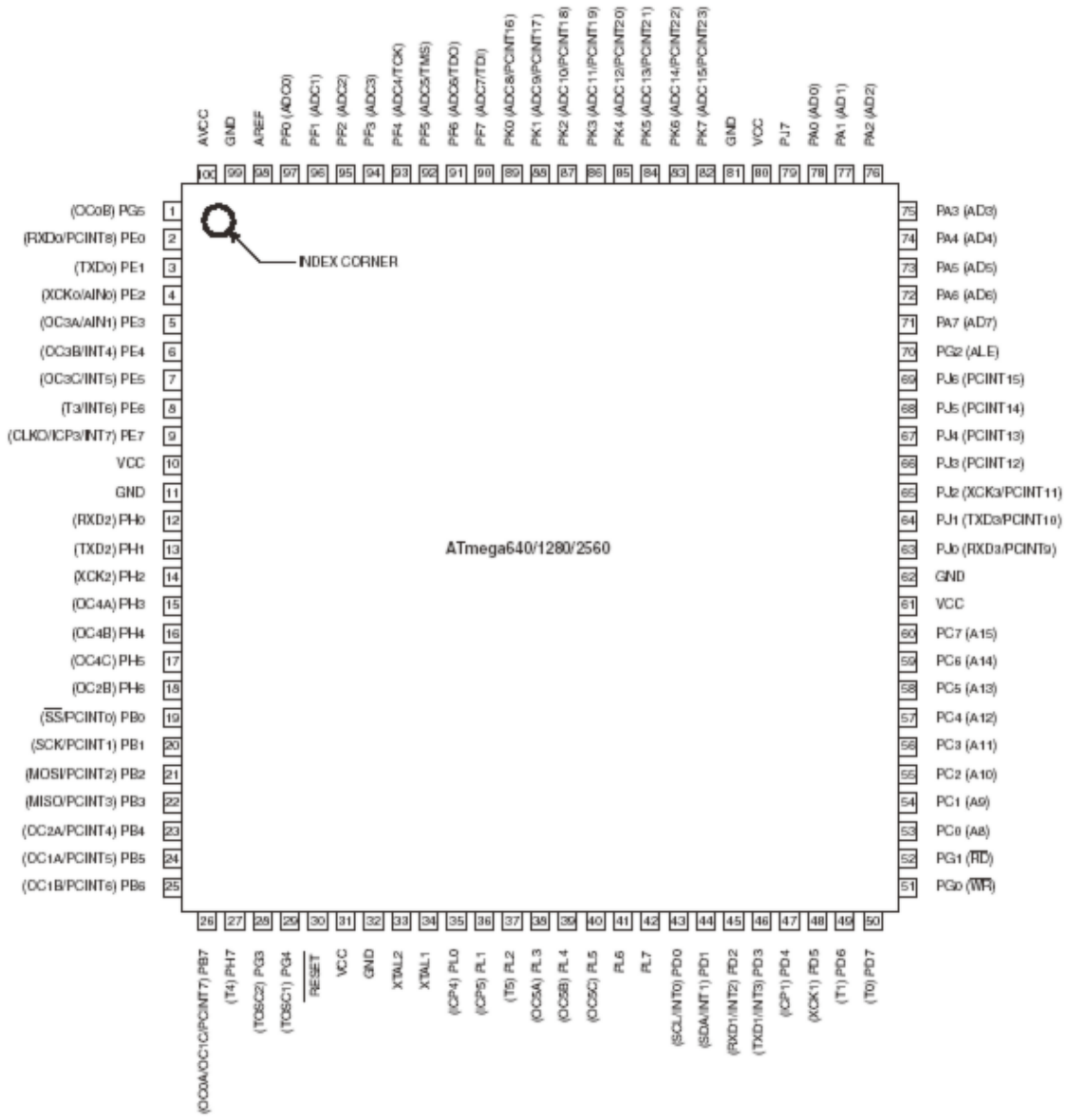
The JTAG interface is enabled by default. This means that portC.2-portC.5 pins can not be used. Program the JTAG fuse bit to disable the JTAG interface.

ATMEGA603

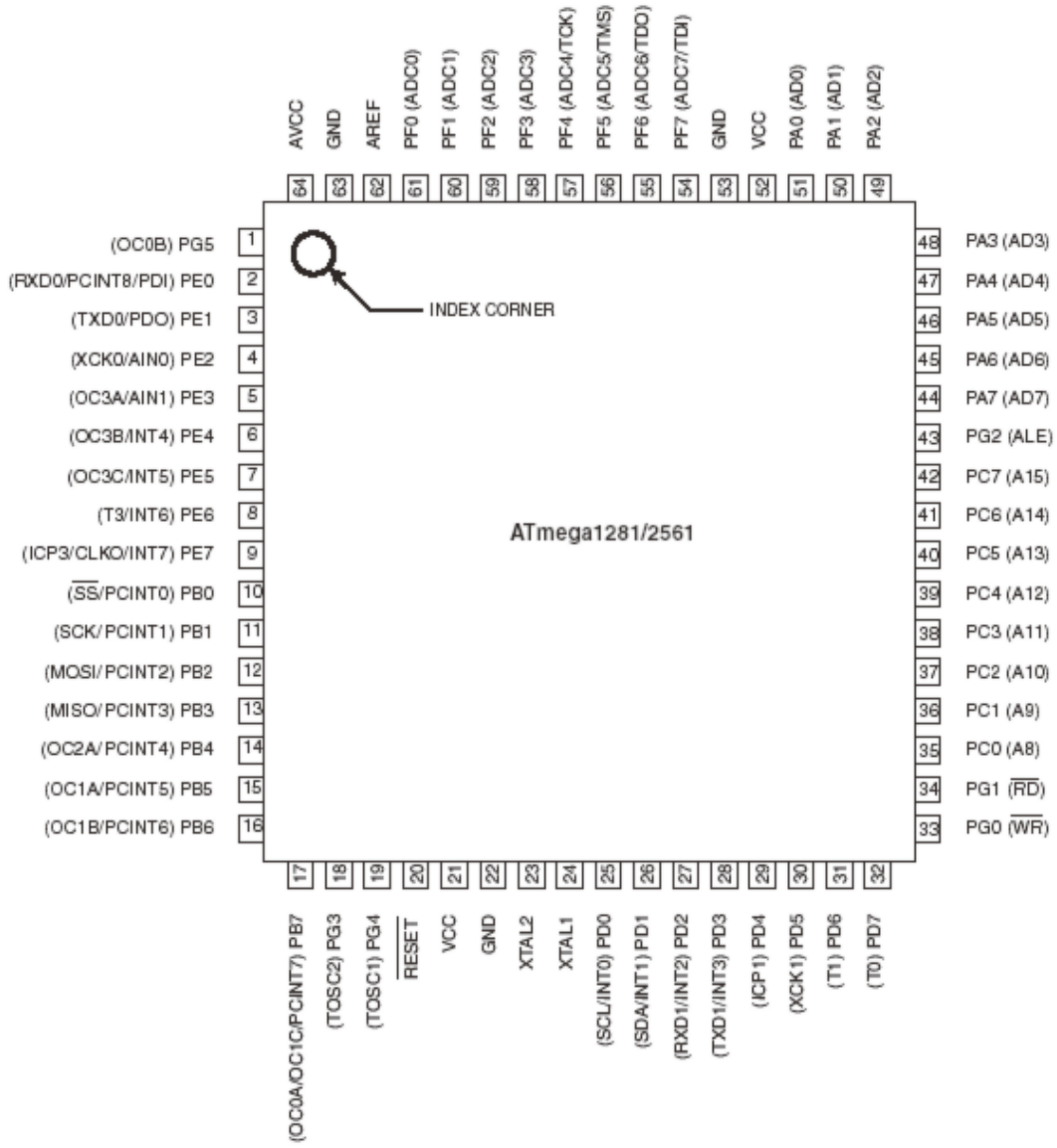
This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.


PA3 (AD3) 48
PA4 (AD4) 47
PA5 (AD5) 46
PA6 (AD6) 45
PA7 (AD7) 44
ALE 43
PC7 (A15) 42
PC6 (A14) 41
PC5 (A13) 40
PC4 (A12) 39
PC3 (A11) 38
PC2 (A10) 37
PC1 (A9) 36
PC0 (A8) 35
RD 34
WR 33
(AD2) PA2 49
(AD1) PA1 50
(AD0) PA0 51
VCC 52
GND 53
(ADC7) PF7 54
(ADC6) PF6 55
(ADC5) PF5 56
(ADC4) PF4 57
(ADC3) PF3 58
(ADC2) PF2 59
(ADC1) PF1 60
(ADC0) PF0 61
AREF 62
AGND 63
AVCC 64
ATmega603/103
INDEX CORNER
32 PD7 (T2)
31 PD6 (T1)
30 PD5
29 PD4 (IC1)
28 PD3 (INT3)
27 PD2 (INT2)
26 PD1 (INT1)
25 PD0 (INT0)
24 XTAL1
23 XTAL2
22 GND
21 VCC
20 RESET
19 TOSC1
18 TOSC2
17 PB7 (OC2/PWM2)
1 PEN
2 (PDI/RXD) PE0
3 (PDO/TXD) PE1
4 (AC+) PE2
5 (AC-) PE3
6 (INT4) PE4
7 (INT5) PE5
8 (INT6) PE6
9 (INT7) PE7
10 (SS) PB0
11 (SCK) PB1
12 (MOSI) PB2
13 (MISO) PB3
14 (OC0/PWM0) PB4
15 (OC1A/PWM1A) PB5
16 (OC1B/PWM1B) PB6

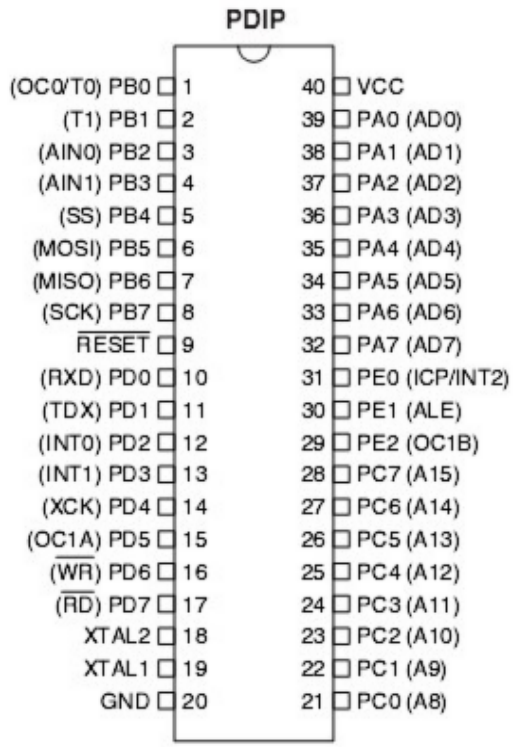
ATMEGA2560


AVCC
GND
AREF
PF0 (ADC0)
PF1 (ADC1)
PF2 (ADC2)
PF3 (ADC3)
PF4 (ADC4/TCK)
PF5 (ADC5/TMS)
PF6 (ADC6/TDO)
PF7 (ADC7/TDI)
PK0 (ADC8/PCINT16)
PK1 (ADC9/PCINT17)
PK2 (ADC10/PCINT18)
PK3 (ADC11/PCINT19)
PK4 (ADC12/PCINT20)
PK5 (ADC13/PCINT21)
PK6 (ADC14/PCINT22)
PK7 (ADC15/PCINT23)
GND
VCC
PJ7
PA0 (AD0)
PA1 (AD1)
PA2 (AD2)
100 99 98 97 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 80 79 78 77 76
(OC0B) PG5 1
(RXD0/PCINT8) PE0 2
(TXD0) PE1 3
(XCK0/AIN0) PE2 4
(OC3A/AIN1) PE3 5
(OC3B/INT4) PE4 6
(OC3C/INT5) PE5 7
(T3/INT6) PE6 8
(CLKO/ICP3/INT7) PE7 9
VCC 10
GND 11
(RXD2) PH0 12
(TXD2) PH1 13
(XCK2) PH2 14
(OC4A) PH3 15
(OC4B) PH4 16
(OC4C) PH5 17
(OC2B) PH6 18
(SS/PCINT0) PB0 19
(SCK/PCINT1) PB1 20
(MOSI/PCINT2) PB2 21
(MISO/PCINT3) PB3 22
(OC2A/PCINT4) PB4 23
(OC1A/PCINT5) PB5 24
(OC1B/PCINT6) PB6 25
INDEX CORNER
ATmega640/1280/2560
75 PA3 (AD3)
74 PA4 (AD4)
73 PA5 (AD5)
72 PA6 (AD6)
71 PA7 (AD7)
70 PG2 (ALE)
69 PJ6 (PCINT15)
68 PJ5 (PCINT14)
67 PJ4 (PCINT13)
66 PJ3 (PCINT12)
65 PJ2 (XCK3/PCINT11)
64 PJ1 (TXD3/PCINT10)
63 PJ0 (RXD3/PCINT9)
62 GND
61 VCC
60 PC7 (A15)
59 PC6 (A14)
58 PC5 (A13)
57 PC4 (A12)
56 PC3 (A11)
55 PC2 (A10)
54 PC1 (A9)
53 PC0 (A8)
52 PG1 (RD)
51 PG0 (WR)
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
(OC0A/OC1C/PCINT7) PB7
(T4) PH7
(TOSC2) PG3
(TOSC1) PG4
RESET
VCC
GND
XTAL2
XTAL1
(ICP4) PL0
(ICP5) PL1
(T5) PL2
(OC5A) PL3
(OC5B) PL4
(OC5C) PL5
PL6
PL7
(SCL/INT0) PD0
(SDA/INT1) PD1
(RXD1/INT2) PD2
(TXD1/INT3) PD3
(ICP1) PD4
(XCK1) PD5
(T1) PD6
(T0) PD7

ATMEGA2561

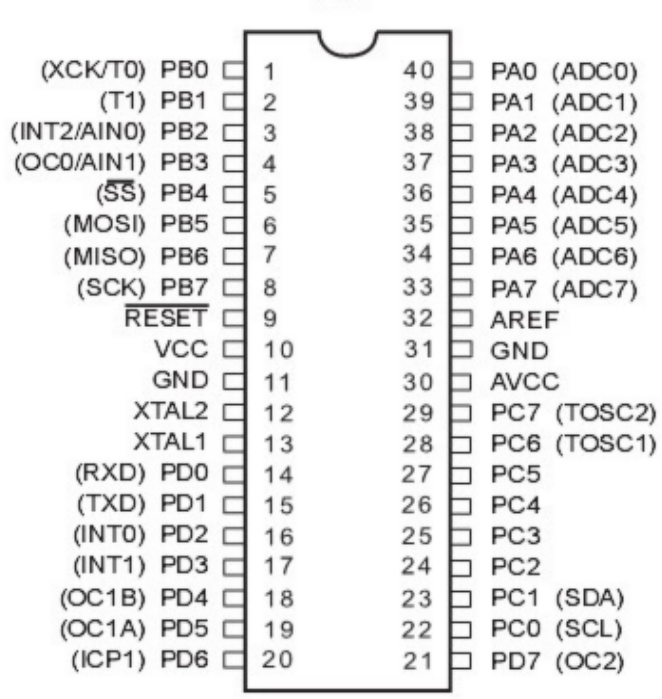

AVCC 64
GND 63
AREF 62
PF0 (ADC0) 61
PF1 (ADC1) 60
PF2 (ADC2) 59
PF3 (ADC3) 58
PF4 (ADC4/TCK) 57
PF5 (ADC5/TMS) 56
PF6 (ADC6/TDO) 55
PF7 (ADC7/TDI) 54
GND 53
VCC 52
PA0 (AD0) 51
PA1 (AD1) 50
PA2 (AD2) 49
(OC0B) PG5 1
(RXD0/PCINT8/PDI) PE0 2
(TXD0/PDO) PE1 3
(XCK0/AIN0) PE2 4
(OC3A/AIN1) PE3 5
(OC3B/INT4) PE4 6
(OC3C/INT5) PE5 7
(T3/INT6) PE6 8
(ICP3/CLKO/INT7) PE7 9
(SS/PCINT0) PB0 10
(SCK/PCINT1) PB1 11
(MOSI/PCINT2) PB2 12
(MISO/PCINT3) PB3 13
(OC2A/PCINT4) PB4 14
(OC1A/PCINT5) PB5 15
(OC1B/PCINT6) PB6 16
INDEX CORNER
ATmega1281/2561
48 PA3 (AD3)
47 PA4 (AD4)
46 PA5 (AD5)
45 PA6 (AD6)
44 PA7 (AD7)
43 PG2 (ALE)
42 PC7 (A15)
41 PC6 (A14)
40 PC5 (A13)
39 PC4 (A12)
38 PC3 (A11)
37 PC2 (A10)
36 PC1 (A9)
35 PC0 (A8)
34 PG1 (RD)
33 PG0 (WR)
17 (OC0A/OC1C/PCINT7) PB7
18 (TOSC2) PG3
19 (TOSC1) PG4
20 RESET
21 VCC
22 GND
23 XTAL2
24 XTAL1
25 (SCL/INT0) PD0
26 (SDA/INT1) PD1
27 (RXD1/INT2) PD2
28 (TXD1/INT3) PD3
29 (ICP1) PD4
30 (XCK1) PD5
31 (T1) PD6
32 (T0) PD7

ATMEGA8515



ATMEGA8535

This page is intended to show the outline of the chip and to provide additional information that might not be clear from the datasheet.



BASCOM Language Fundamentals

Changes compared to BASCOM-8051

The design goal was to make BASCOM-AVR compatible with BASCOM-8051.

For the AVR compiler some statements had to be removed.
New statements were also added. And some statements were changed.

They need specific attention, but the changes to the syntax will be made available to BASCOM-8051 too in the future.

Statements that were removed

STATEMENT	DESCRIPTION
$LARGE	Not needed anymore.
$ROMSTART	Code always starts at address 0 for the AVR. Added again in 1.11.6.2
$LCDHEX	Use LCD Hex(var) instead.
$NOINIT	Not needed anymore. Added in 1.11.6.2
$NOSP	Not needed anymore
$NOBREAK	Can't be used anymore because there is no object code that can be used for it.
$OBJ	Removed.
BREAK	Can't be used anymore because there is no object code that can be used for it.
PRIORITY	AVR does no allow setting priority of interrupts
PRINTHEX	You can use Print Hex(var) now
LCDHEX	You can use Lcd Hex(var) now

Statements that were added

STATEMENT	DESCRIPTION
FUNCTION	You can define your own user FUNCTIONS.
LOCAL	You can have LOCAL variables in SUB routines or FUNCTIONS.
^	New math statement. Var = 2 ^ 3 will return 2*2*2
SHIFT	Because ROTATE was changed, I added the SHIFT statement. SHIFT works just like ROTATE, but when shifted left, the LS BIT is cleared and the carry doesn't go to the LS BIT.
LTRIM	LTRIM, trims the leftmost spaces of a string.
RTRIM	RTRIM, trims the rightmost spaces of a string.
TRIM	TRIM, trims both the leftmost and rightmost spaces of a string.

Statements that behave differently

STATEMENT	DESCRIPTION
ROTATE	Rotate now behaves like the ASM rotate, this means that the carry will go to the most significant bit of a variable or the least significant bit of a variable.
CONST	String were added to the CONST statement. I also changed it to be compatible with QB.

DECLARE	BYVAL has been added since real subprograms are now supported.
DIM	You can now specify the location in memory of the variable. Dim v as byte AT 100, will use memory location 100.

Language Fundamentals

Characters from the BASCOM character set are put together to form labels, keywords, variables and operators.

These in turn are combined to form the statements that make up a program.

This chapter describes the character set and the format of BASCOM program lines. In particular, it discusses:

- The specific characters in the character set and the special meanings of some characters.
- The format of a line in a BASCOM program.
- Line labels.
- Program line length.

Character Set

The BASCOM BASIC character set consists of alphabetic characters, numeric characters, and special characters.
The alphabetic characters in BASCOM are the uppercase letters (A-Z) and lowercase letters (a-z) of the alphabet.

The BASCOM numeric characters are the digits 0-9.
The letters A-H can be used as parts of hexadecimal numbers.
The following characters have special meanings in BASCOM statements and expressions:

Character	Name
ENTER	Terminates input of a line
	Blank (or space)
'	Single quotation mark (apostrophe)
*	Asterisks (multiplication symbol)
+	Plus sign
,	Comma
-	Minus sign
.	Period (decimal point)
/	Slash (division symbol) will be handled as \
:	Colon
"	Double quotation mark
;	Semicolon
<	Less than
=	Equal sign (assignment symbol or relational operator)

>	Greater than
\	Backslash (integer/word division symbol)
^	Exponent

The BASCOM program line

BASCOM program lines have the following syntax:

[[line-identifier]] [[statement]] [[:statement]] ... [[comment]]

Using Line Identifiers

BASCOM support one type of line-identifier; alphanumeric line labels:

An alphabetic line label may be any combination of from 1 to 32 letters and digits, starting with a letter and ending with a colon.
BASCOM keywords are not permitted.

The following are valid alphanumeric line labels:

Alpha:
ScreenSUB:
Test3A:

Case is not significant. The following line labels are equivalent:

alpha:
Alpha:
ALPHA:

Line labels may begin in any column, as long as they are the first characters other than blanks on the line.
Blanks are not allowed between an alphabetic label and the colon following it.
A line can have only one label. When there is a label on the line, no other identifiers may be used on the same line. So the label is the sole identifier on a line.

BASCOM Statements

A BASCOM statement is either "executable" or " non-executable".
An executable statement advances the flow of a programs logic by telling the program what to do next.
Non executable statement perform tasks such as allocating storage for variables, declaring and defining variable types.

The following BASCOM statements are examples of non-executable statements:

- REM or (starts a comment)
- DIM

A "comment" is a non-executable statement used to clarify a programs operation and purpose.
A comment is introduced by the REM statement or a single quote character(').

The following lines are equivalent:

PRINT " Quantity remaining" : REM Print report label.
PRINT " Quantity remaining" ' Print report label.

More than one BASCOM statement can be placed on a line, but colons(:) must separate statements, as illustrated below.

FOR I = 1 TO 5 : PRINT " Gday, mate." : NEXT I

BASCOM LineLength

If you enter your programs using the built-in editor, you are not limited to any line length, although it is advised to shorten your lines to 80 characters for clarity.

Data Types

Every variable in BASCOM has a data type that determines what can be stored in the variable. The next section summarizes the elementary data types.

Elementary Data Types

- Bit (1/8 byte). A bit can hold only the value 0 or 1. A group of 8 bits is called a byte.
- Byte (1 byte). Bytes are stores as unsigned 8-bit binary numbers ranging in value from 0 to 255.
- Integer (two bytes). Integers are stored as signed sixteen-bit binary numbers ranging in value from -32,768 to +32,767.
- Word (two bytes). Words are stored as unsigned sixteen-bit binary numbers ranging in value from 0 to 65535.
- Long (four bytes). Longs are stored as signed 32-bit binary numbers ranging in value from -2147483648 to 2147483647.
- Single. Singles are stored as signed 32 bit binary numbers. Ranging in value from 1.5 x 10^–45 to 3.4 x 10^38
- Double. Doubles are stored as signed 64 bit binary numbers. Ranging in value from 5.0 x 10^–324 to 1.7 x 10^308
- String (up to 254 bytes). Strings are stored as bytes and are terminated with a 0-byte. A string dimensioned with a length of 10 bytes will occupy 11 bytes.

Variables can be stored internal (default) , external or in EEPROM.

Variables

A variable is a name that refers to an object--a particular number.
A numeric variable, can be assigned only a numeric value (either integer, byte, long, single or bit).
The following list shows some examples of variable assignments:

- A constant value:
  A = 5
  C = 1.1

- The value of another numeric variable:
  abc = def

k = g

- The value obtained by combining other variables, constants, and operators: Temp = a + 5
  Temp = C + 5

- The value obtained by calling a function:
  Temp = Asc(S)

Variable Names

A BASCOM variable name may contain up to 32 characters.
The characters allowed in a variable name are letters and numbers.
The first character in a variable name must be a letter.

A variable name cannot be a reserved word, but embedded reserved words are allowed.
For example, the following statement is illegal because AND is a reserved word.

AND = 8

However, the following statement is legal:

ToAND = 8

Reserved words include all BASCOM commands, statements, function names, internal registers and operator names.
(see BASCOM Reserved Words , for a complete list of reserved words).

You can specify a hexadecimal or binary number with the prefix &H or &B.
a = &HA , a = &B1010 and a = 10 are all the same.

Before assigning a variable, you must tell the compiler about it with the DIM statement.
Dim b1 As Bit, I as Integer, k as Byte , s As String * 10

The STRING type needs an additional parameter to specify the length.

You can also use DEFINT, DEFBIT, DEFBYTE ,DEFWORD ,DEFLNG or DEFSNG.

For example,DEFINT c tells the compiler that all variables that are not dimensioned and that are beginning with the character c are of the Integer type.

Expressions and Operators

This chapter discusses how to combine, modify, compare, or get information about expressions by using the operators available in BASCOM.

Anytime you do a calculation you are using expressions and operators.

This chapter describes how expressions are formed and concludes by describing the following kind of operators:

- Arithmetic operators, used to perform calculations.
- Relational operators, used to compare numeric or string values.
- Logical operators, used to test conditions or manipulate individual bits.
- Functional operators, used to supplement simple operators.

Expressions and Operators

An expression can be a numeric constant, a variable, or a single value obtained by combining constants, variables, and other expressions with operators.

Operators perform mathematical or logical operations on values.
The operators provided by BASCOM can be divided into four categories, as follows:

1. Arithmetic
2. Relational
3. Logical
4. Functional

Arithmetic

Arithmetic operators are +, - , * , \, / and ^.

- Integer
  Integer division is denoted by the backslash (\).
  Example: Z = X \ Y

- Modulo Arithmetic
  Modulo arithmetic is denoted by the modulus operator MOD.
  Modulo arithmetic provides the remainder, rather than the quotient, of an integer division.

  Example: X = 10 \ 4 : remainder = 10 MOD 4

- Overflow and division by zero
  Division by zero, produces an error.
  At the moment no message is produced, so you have to make sure yourself that this won't happen.

Relational Operators

Relational operators are used to compare two values as shown in the table below.
The result can be used to make a decision regarding program flow.

Operator	Relation Tested	Expression
=	Equality	X = Y
<>	Inequality	X <> Y
<	Less than	X < Y
>	Greater than	X > Y
<=	Less than or equal to	X <= Y
>=	Greater than or equal to	X >= Y

Logical Operators

Logical operators perform tests on relations, bit manipulations, or Boolean operators.

There four operators in BASCOM are :

Operator	Meaning
NOT	Logical complement
AND	Conjunction
OR	Disjunction
XOR	Exclusive or

It is possible to use logical operators to test bytes for a particular bit pattern.
For example the AND operator can be used to mask all but one of the bits of a status byte, while OR can be used to merge two bytes to create a particular binary value.

Example

```
A = 63 And 19
PRINT A
A = 10 Or 9
PRINT A
```

Output

```
19
11
```

Floating point SINGLE (4 BYTE)(ASM code used is supplied by Jack Tidwell)
Single numbers conforming to the IEEE binary floating point standard.
An eight bit exponent and 24 bit mantissa are supported.
Using four bytes the format is shown below:

31 30_____23 22_____0

s exponent mantissa

The exponent is biased by 128. Above 128 are positive exponents and below are negative. The sign bit is 0 for positive numbers and 1 for negative. The mantissa is stored in hidden bit normalized format so that 24 bits of precision can be obtained.

All mathematical operations are supported by the single.
You can also convert a single to an integer or word or vise versa:

```
Dim I as Integer, S as Single

S = 100.1 'assign the single
I = S  'will convert the single to an integer
```

Here is a fragment from the Microsoft knowledge base about FP:

Floating-point mathematics is a complex topic that confuses many programmers. The tutorial below should help you recognize programming situations where floating-point errors are likely to occur and how to avoid them. It should also allow you to recognize cases that are caused by inherent floating-point math limitations as opposed to actual compiler bugs.

Decimal and Binary Number Systems

Normally, we count things in base 10. The base is completely arbitrary. The only reason that people have traditionally used base 10 is that they have 10 fingers, which have made handy counting tools.

The number 532.25 in decimal (base 10) means the following:

(5 * 10^2) + (3 * 10^1) + (2 * 10^0) + (2 * 10^-1) + (5 * 10^-2)

500 + 30 + 2 + 2/10 + 5/100

_____

= 532.25

In the binary number system (base 2), each column represents a power of 2 instead of 10. For example, the number 101.01 means the following:
(1 * 2^2) + (0 * 2^1) + (1 * 2^0) + (0 * 2^-1) + (1 * 2^-2)
4 + 0 + 1 + 0 + 1/4

_____
= 5.25 Decimal

How Integers Are Represented in PCs

Because there is no fractional part to an integer, its machine representation is much simpler than it is for floating-point values. Normal integers on personal computers (PCs) are 2 bytes (16 bits) long with the most significant bit indicating the sign. Long integers are 4 bytes long.

Positive values are straightforward binary numbers. For example:

1 Decimal = 1 Binary
2 Decimal = 10 Binary
22 Decimal = 10110 Binary, etc.

However, negative integers are represented using the two's complement scheme. To get the two's complement representation for a negative number, take the binary representation for the number's absolute value and then flip all the bits and add 1. For example:

4 Decimal = 0000 0000 0000 0100

1111 1111 1111 1011 Flip the Bits

-4 = 1111 1111 1111 1100 Add 1

Note that adding any combination of two's complement numbers together

using ordinary binary arithmetic produces the correct result.

Floating-Point Complications

Every decimal integer can be exactly represented by a binary integer; however, this is not true for fractional numbers. In fact, every number that is irrational in base 10 will also be irrational in any system with a base smaller than 10.

For binary, in particular, only fractional numbers that can be represented in the form p/q, where q is an integer power of 2, can be expressed exactly, with a finite number of bits.

Even common decimal fractions, such as decimal 0.0001, cannot be represented exactly in binary. (0.0001 is a repeating binary fraction with a period of 104 bits!)

This explains why a simple example, such as the following

```
SUM = 0
FOR I% = 1 TO 10000
  SUM = SUM + 0.0001
NEXT I%
PRINT SUM ' Theoretically = 1.0.
```

will PRINT 1.000054 as output. The small error in representing 0.0001
in binary propagates to the sum.

For the same reason, you should always be very cautious when making comparisons on real numbers. The following example illustrates a common programming error:

```
item1# = 69.82#
item2# = 69.20# + 0.62#
IF item1# = item2# then print "Equality!"
```

This will NOT PRINT "Equality!" because 69.82 cannot be represented exactly in binary, which causes the value that results from the assignment to be SLIGHTLY different (in binary) than the value that is generated from the expression. In practice, you should always code such comparisons in such a way as to allow for some tolerance.

General Floating-Point Concepts

It is very important to realize that any binary floating-point system can represent only a finite number of floating-point values in exact form. All other values must be approximated by the closest represent able value. The IEEE standard specifies the method for rounding values to the "closest" represent able value. BASCOM supports the standard and rounds according to the IEEE rules.

Also, keep in mind that the numbers that can be represented in IEEE are spread out over a very wide range. You can imagine them on a number line. There is a high density of represent able numbers near 1.0 and -1.0 but fewer and fewer as you go towards 0 or infinity.

The goal of the IEEE standard, which is designed for engineering calculations, is to maximize accuracy (to get as close as possible to the actual number). Precision refers to the number of digits that you can represent. The IEEE standard attempts to balance the number of bits dedicated to the exponent with the number of bits used for the fractional part of the number, to keep both accuracy and precision within acceptable limits.

IEEE Details

Floating-point numbers are represented in the following form, where [exponent] is the binary exponent:

X = Fraction * 2^(exponent - bias)

[Fraction] is the normalized fractional part of the number, normalized because the exponent is adjusted so that the leading bit is always a 1. This way, it does not have to be stored, and you get one more bit of precision. This is why there is an implied bit. You can think of this like scientific notation, where you manipulate the exponent to have one digit to the left of the decimal point, except in binary, you can always manipulate the exponent so that the first bit is a 1, since there are only 1s and 0s.

[bias] is the bias value used to avoid having to store negative exponents.

The bias for single-precision numbers is 127 and 1023 (decimal) for double-precision numbers.

The values equal to all 0's and all 1's (binary) are reserved for representing special cases. There are other special cases as well, that indicate various error conditions.

Single-Precision Examples

2 = 1 * 2^1 = 0100 0000 0000 0000 ... 0000 0000 = 4000 0000 hex

Note the sign bit is zero, and the stored exponent is 128, or

100 0000 0 in binary, which is 127 plus 1. The stored mantissa is

(1.) 000 0000 ... 0000 0000, which has an implied leading 1 and

binary point, so the actual mantissa is 1.

-2 = -1 * 2^1 = 1100 0000 0000 0000 ... 0000 0000 = C000 0000 hex

Same as +2 except that the sign bit is set. This is true for all

IEEE format floating-point numbers.

4 = 1 * 2^2 = 0100 0000 1000 0000 ... 0000 0000 = 4080 0000 hex

Same mantissa, exponent increases by one (biased value is 129, or

100 0000 1 in binary.

6 = 1.5 * 2^2 = 0100 0000 1100 0000 ... 0000 0000 = 40C0 0000 hex

Same exponent, mantissa is larger by half -- it's

(1.) 100 0000 ... 0000 0000, which, since this is a binary fraction, is 1-1/2 (the values of the fractional digits are 1/2, 1/4, 1/8, etc.).

1 = 1 * 2^0 = 0011 1111 1000 0000 ... 0000 0000 = 3F80 0000 hex

Same exponent as other powers of 2, mantissa is one less than

2 at 127, or 011 1111 1 in binary.

.75 = 1.5 * 2^-1 = 0011 1111 0100 0000 ... 0000 0000 = 3F40 0000 hex

The biased exponent is 126, 011 1111 0 in binary, and the mantissa

is (1.) 100 0000 ... 0000 0000, which is 1-1/2.

2.5 = 1.25 * 2^1 = 0100 0000 0010 0000 ... 0000 0000 = 4020 0000 hex

Exactly the same as 2 except that the bit which represents 1/4 is

set in the mantissa.

0.1 = 1.6 * 2^-4 = 0011 1101 1100 1100 ... 1100 1101 = 3DCC CCCD hex

1/10 is a repeating fraction in binary. The mantissa is just shy of 1.6, and the biased exponent says that 1.6 is to be divided by 16 (it is 011 1101 1 in binary, which is 123 n decimal). The true exponent is 123 - 127 = -4, which means that the factor by which to multiply is 2**-4 = 1/16. Note that the stored mantissa is rounded up in the last bit. This is an attempt to represent the unrepresentable number as accurately as possible. (The reason that 1/10 and 1/100 are not exactly representable in binary is similar to the way that 1/3 is not exactly representable in decimal.)

0 = 1.0 * 2^-128 = all zeros -- a special case.

Other Common Floating-Point Errors

The following are common floating-point errors:

1. Round-off error

This error results when all of the bits in a binary number cannot be used in a calculation.

Example: Adding 0.0001 to 0.9900 (Single Precision)

Decimal 0.0001 will be represented as:

(1.)10100011011011100010111 * 2^(-14+Bias) (13 Leading 0s in Binary!)

0.9900 will be represented as:

(1.)11111010111000010100011 * 2^(-1+Bias)

Now to actually add these numbers, the decimal (binary) points must be aligned. For this they must be Unnormalized. Here is the resulting addition:

.00000000000000011010001101 * 2^0 <- Only 11 of 23 Bits retained

+.11111101011100001010011 * 2^0

_____

.11111101011101110011000 * 2^0

This is called a round-off error because some computers round when shifting for addition. Others simply truncate. Round-off errors are important to consider whenever you are adding or multiplying two very different values.

2. Subtracting two almost equal values

.1235
-.1234
_____
.0001

This will be normalized. Note that although the original numbers each had four significant digits, the result has only one significant digit.

3. Overflow and underflow

This occurs when the result is too large or too small to be represented by the data type.

4. Quantizing error

This occurs with those numbers that cannot be represented in exact form by the floating-point standard.

Rounding

When a Long is assigned to a single, the number is rounded according to the rules of the IEEE committee.

For explanation: 1.500000 is exact the middle between 1.00000 and 2.000000. If x.500000 is always rounded up, than there is trend for higher values than the average of all numbers. So their rule says, half time to round up and half time to round down, if value behind LSB is exact ..500000000.

The rule is, round this .500000000000 to next even number, that means if LSB is 1 (half time) to round up, so the LSB is going to 0 (=even), if LSB is 0 (other half time) to round down, that means no rounding.

This rounding method is best since the absolute error is 0.

You can override the default IEEE rounding method by specifying the $LIB LONG2FLOAT.LBX library which rounds up to the next number. This is the method used up to 1.11.7.4 of the compiler.

Double

The double is essential the same as a single. Except the double consist of 8 bytes instead of

4. The exponent is 11 bits leaving 52 bits for the mantissa.

Arrays

An array is a set of sequentially indexed elements having the same type. Each element of an array has a unique index number that identifies it. Changes made to an element of an array do not affect the other elements.

The index must be a numeric constant, a byte, an integer, word or long.
The maximum number of elements is 65535.
The first element of an array is always one. This means that elements are 1-based.

Arrays can be used on each place where a 'normal' variable is expected.

Example:

```
'create an array named a, with 10 elements (1 to 10)
Dim A(10) As Byte
'create an integer
Dim C As Integer
'now fill the array
For C = 1 To 10
'assign array element
A(c)= C
' print it
Print A(c)
Next
'you can add an offset to the index too
C = 0
A(c + 1)= 100
Print A(c + 1)
End
```

Strings

A string is used to store text. A string must be dimensioned with the length specified.

DIM S as STRING * 5

Will create a string that can store a text with a maximum length of 5 bytes.
The space used is 6 bytes because a string is terminated with a null byte.

To assign the string:
s = "abcd"

To insert special characters into the string :
s= "AB{027}cd"

The {ascii} will insert the ASCII value into the string.

The number of digits must be 3. s = "{27} will assign "{27}" to the string instead of escape character 27!

Casting

In BASCOM-AVR when you perform operations on variables they all must be of the same data type.
long = long1 * long2 ' for example

The assigned variables data type determines what kind of math is performed.
For example when you assign a long, long math will be used.

If you try to store the result of a LONG into a byte, only the LSB of the LONG will be stored into the BYTE.
Byte = LONG

When LONG = 256 , it will not fit into a BYTE. The result will be 256 AND 255 = 0.

Of course you are free to use different data types. The correct result is only guaranteed when you are using data types of the same kind or that result always can fit into the target data type.

When you use strings, the same rules apply. But there is one exception:

Dim b as Byte

b = 123 ' ok this is normal

b = "A" ' b = 65

When the target is a byte and the source variable is a string constant denoted by "", the ASCII value will be stored in the byte. This works also for tests :

IF b = "A" then ' when b = 65

END IF

This is different compared to QB/VB where you can not assign a string to a byte variable.

SINGLE CONVERSION

When you want to convert a SINGLE into a byte, word, integer or long the compiler will automatic convert the values when the source string is of the SINGLE data type.

integer = single

You can also convert a byte, word, integer or long into a SINGLE by assigning this variable to a SINGLE.

single = long

Mixing ASM and BASIC

BASCOM allows you to mix BASIC with assembly.
This can be very useful in some situations when you need full control of the generated code.

Almost all assembly mnemonics are recognized by the compiler. The exceptions are : SUB, SWAP, CALL and OUT. These are BASIC reserved words and have priority over the ASM mnemonics. To use these mnemonics precede them with the ! - sign.

For example :

```
Dim a As Byte At &H60 'A is stored at location &H60
Ldi R27 , $00   'Load R27 with MSB of address
Ldi R26 , $60   'Load R26 with LSB of address
Ld R1, X   'load memory location $60 into R1
!SWAP R1   'swap nibbles
```

As you can see the SWAP mnemonic is preceded by a **!** sign.

Another option is to use the assembler block directives:

```
$ASM
 Ldi R27 , $00   'Load R27 with MSB of address
 Ldi R26 , $60   'Load R26 with LSB of address
 Ld R1, X    'load memory location $60 into R1
 SWAP R1   'swap nibbles
$END ASM
```

A special assembler helper function is provided to load the address into the register X or Z. Y can may not be used because it is used as the soft stack pointer.

```
Dim A As Byte  'reserve space
LOADADR a, X  'load address of variable named A into register pair X
```

This has the same effect as :

```
Ldi R26 , $60 'for example !
Ldi R27, $00 'for example !
```

Some registers are used by BASCOM
R4 and R5 are used to point to the stack frame or the temp data storage
R6 is used to store some bit variables:
 R6 bit 0 = flag for integer/word conversion
 R6 bit 1 = temp bit space used for swapping bits
 R6 bit 2 = error bit (ERR variable)
 R6 bit 3 = show/noshow flag when using INPUT statement
R8 and R9 are used as a data pointer for the READ statement.

All other registers are used depending on the used statements.

To Load the address of a variable you must enclose them in brackets.

```
Dim B As Bit
Lds R16, {B} 'will replace {B} with the address of variable B
```

To refer to the bitnumber you must precede the variable name by BIT.

```
Sbrs R16 , BIT.B  'notice the point!
```

Since this was the first dimensioned bit the bit number is 7. Bits are stored in bytes and the first dimensioned bit goes in the LS bit.

To load an address of a label you must use :

```
LDI ZL, Low(lbl * 1)
LDI ZH , High(lbl * 1)
```

Where ZL = R30 and may be R24, R26, R28 or R30

And ZH = R31 and may be R25, R27, R29 or R31.

These are so called register pairs that form a pointer.

When you want to use the LPM instruction to retrieve data you must multiply the address with 2 since the AVR object code consist of words.

```
LDI ZL, Low(lbl * 2)
LDI ZH , High(lbl * 2)
LPM ; get data into R0
Lbl:
```

Atmel mnemonics must be used to program in assembly.
You can download the pdf from www.atmel.com that shows how the different mnemonics are used.

Some points of attention :
* All instructions that use a constant as a parameter only work on the upper 16 registers (r16-r31)
So LDI R15,12 WILL NOT WORK

* The instruction SBR register, K
will work with K from 0-255. So you can set multiple bits!

The instruction SBI port, K will work with K from 0-7 and will set only ONE bit in a IO-port register.

The same applies to the CBR and CBI instructions.

You can use constants too:

```
.equ myval = (10+2)/4
ldi r24,myval+2 '5
ldi r24,asc("A")+1 ; load with 66
```

Or in BASIC with CONST :

```
CONST Myval = (10+2) / 4
Ldi r24,myval
```

How to make your own libraries and call them from BASIC?
The files for this sample can be found as libdemo.bas in the SAMPLES dir and as mylib.lib in the LIB dir.

First determine the used parameters and their type.
Also consider if they are passed by reference or by value

For example the sub test has two parameters:
x which is passed by value (copy of the variable)
y which is passed by reference(address of the variable)

In both cases the address of the variable is put on the soft stack which is indexed by the Y pointer.

The first parameter (or a copy) is put on the soft stack first
To refer to the address you must use:

```
ldd r26 , y + 0
ldd r27 , y + 1
```

This loads the address into pointer X
The second parameter will also be put on the soft stack so :
The reference for the x variable will be changed :

To refer to the address of x you must use:

```
ldd r26 , y + 2
ldd r27 , y + 3
```

To refer to the last parameter y you must use

```
ldd r26 , y + 0
ldd r27 , y + 1
```

Write the sub routine as you are used too but include the name within brackets []

```
[test]
test:
ldd r26,y+2 ; load address of x
ldd r27,y+3
ld r24,x ; get value into r24
inc r24 ; value + 1
st x,r24 ; put back
ldd r26,y+0 ; address of y
ldd r27,y+1
st x,r24 ; store
ret ; ready
[end]
```

To write a function goes the same way.
A function returns a result so a function has one additional parameter.
It is generated automatic and it has the name of the function.
This way you can assign the result to the function name

For example:

Declare Function Test(byval x as byte , y as byte) as byte
A virtual variable will be created with the name of the function in this case test.
It will be pushed on the softstack with the Y-pointer.

To reference to the result or name of the function (test) the address will be:
y + 0 and y + 1
The first variable x will bring that to y + 2 and y + 3

And the third variable will cause that 3 parameters are saved on the soft stack

To reference to test you must use :
ldd r26 , y + 4
ldd r27 , y + 5

To reference variable x
ldd r26 , y + 2
ldd r27 , y + 3

And to reference variable y

ldd r26 , y + 0
ldd r27 , y + 1

When you use exit sub or exit function you also need to provide an additional label. It starts with sub_ and must be completed with the function / sub routine name. In our example:

sub_test:

LOCALS

When you use local variables thing become more complicated.

Each local variable address will be put on the soft stack too

When you use 1 local variable its address will become

ldd r26, y+0
ldd r27 , y + 1

All other parameters must be increased with 2 so the reference to y variable changes from

ldd r26 , y + 0 to ldd r26 , y + 2
ldd r27 , y + 1 to ldd r27 , y + 3

And of course also for the other variables.

When you have more local variables just add 2 for each.

Finally you save the file as a .lib file
Use the library manager to compile it into the lbx format.
The declare sub / function must be in the program where you use the sub / function.

The following is a copy of the libdemo.bas file :

```
'define the used library

$lib "mylib.lib"

'also define the used routines

$external Test

'this is needed so the parameters will be placed correct on the stack
```

```
Declare Sub Test(byval X As Byte , Y As Byte)


'reserve some space
Dim Z As Byte


'call our own sub routine
Call Test(1 , Z)

'z will be 2 in the used example
End
```

When you use ports in your library you must use .equ to specify the address:

```
.equ EEDR=$1d
In R24, EEDR
```

This way the library manager knows the address of the port during compile time.

As an alternative precede the mnemonic with a * so the code will not be compiled into the lib. The address of the register will be resolved at run time in that case.

This chapter is not intended to teach you ASM programming. But when you find a topic is missing to interface BASCOM with ASM send me an email.

Translation

In version 1.11.7.5 of the compiler some mnemonics are translated when there is a need for.

For example, SBIC will work only on normal PORT registers. This because the address may not be greater then 5 bits as 3 bits are used for the pin number(0-7).

SBIC worked well in the old AVR chips(AT90Sxxxx) but in the Mega128 where PORTG is on a high address, it will not work.

You always needs a normal register when you want to manipulate the bits of an external register.

For example :

```
LDS r23, PORTG ; get value of PORTG register
SBR r23,128 ; set bit 7
STS PORTG, R23
```

The mnemonics that are translated by the compiler are : IN, OUT, SBIC, SBIS, SBI and CBI.

The compiler will use register R23 for this. So make sure it is not used.

Assembler mnemonics

BASCOM supports the mnemonics as defined by Atmel.

The Assembler accepts mnemonic instructions from the instruction set.

A summary of the instruction set mnemonics and their parameters is given here. For a detailed description of the Instruction set, refer to the AVR Data Book.

Mnemonics	Operands	Description	Operation	Flags	Clock
ARITHMETIC AND LOGIC INSTRUCTIONS					
ADD	Rd, Rr	Add without Carry	Rd = Rd + Rr	Z,C,N,V, H	1
ADC	Rd, Rr	Add with Carry	Rd = Rd + Rr + C	Z,C,N,V, H	1
SUB	Rd, Rr	Subtract without Carry	Rd = Rd – Rr	Z,C,N,V, H	1
SUBI	Rd, K	Subtract Immediate	Rd = Rd – K	Z,C,N,V, H	1
SBC	Rd, Rr	Subtract with Carry	Rd = Rd - Rr - C	Z,C,N,V, H	1
SBCI	Rd, K	Subtract Immediate with Carry	Rd = Rd - K - C	Z,C,N,V, H	1
AND	Rd, Rr	Logical AND	Rd = Rd · Rr	Z,N,V	1
ANDI	Rd, K	Logical AND with Immediate	Rd = Rd · K	Z,N,V	1
OR	Rd, Rr	Logical OR	Rd = Rd v Rr	Z,N,V	1
ORI	Rd, K	Logical OR with Immediate	Rd = Rd v K	Z,N,V	1
EOR	Rd, Rr	Exclusive OR	Rd = Rd Å Rr	Z,N,V	1
COM	Rd	Ones Complement	Rd = $FF - Rd	Z,C,N,V	1
NEG	Rd	Twos Complement	Rd = $00 - Rd	Z,C,N,V, H	1
SBR	Rd,K	Set Bit(s) in Register	Rd = Rd v K	Z,N,V	1
CBR	Rd,K	Clear Bit(s) in Register	Rd = Rd · ($FFh - K)	Z,N,V	1
INC	Rd	Increment	Rd = Rd + 1	Z,N,V	1
DEC	Rd	Decrement	Rd = Rd - 1	Z,N,V	1
TST	Rd	Test for Zero or Minus	Rd = Rd · Rd	Z,N,V	1
CLR	Rd	Clear Register	Rd = Rd Å Rd	Z,N,V	1
SER	Rd	Set Register	Rd = $FF	None	1
ADIW Adiw r24, K6	Rdl, K6	Add Immediate to Word	Rdh:Rdl = Rdh:Rdl + K	Z,C,N,V, S	2
SBIW Sbiw R24,K6	Rdl, K6	Subtract Immediate from Word	Rdh:Rdl = Rdh:Rdl - K	Z,C,N,V, S	2
MUL	Rd,Rr	Multiply Unsigned	R1, R0 = Rd * Rr	C	2 *
BRANCH INSTRUCTIONS					
RJMP	K	Relative Jump	PC = PC + k + 1	None	2
IJMP		Indirect Jump to (Z)	PC = Z	None	2
JMP	K	Jump	PC = k	None	3
RCALL	K	Relative Call Subroutine	PC = PC + k + 1	None	3
ICALL		Indirect Call to (Z)	PC = Z	None	3
CALL	K	Call Subroutine	PC = k	None	4

RET		Subroutine Return	PC = STACK	None	4
RETI		Interrupt Return	PC = STACK	I	4
CPSE	Rd,Rr	Compare, Skip if Equal	if (Rd = Rr) PC = PC + 2 or 3	None	1 / 2
CP	Rd,Rr	Compare	Rd - Rr	Z,C,N,V, H,	1
CPC	Rd,Rr	Compare with Carry	Rd - Rr - C	Z,C,N,V, H	1
CPI	Rd,K	Compare with Immediate	Rd - K	Z,C,N,V, H	1
SBRC	Rr, b	Skip if Bit in Register Cleared	If (Rr(b)=0) PC = PC + 2 or 3	None	1 / 2
SBRS	Rr, b	Skip if Bit in Register Set	If (Rr(b)=1) PC = PC + 2 or 3	None	1 / 2
SBIC	P, b	Skip if Bit in I/O Register Cleared	If(I/O(P,b)=0) PC = PC + 2 or 3	None	2 / 3
SBIS	P, b	Skip if Bit in I/O Register Set	If(I/O(P,b)=1) PC = PC + 2 or 3	None	2 / 3
BRBS	s, k	Branch if Status Flag Set	if (SREG(s) = 1) then PC=PC+k + 1	None	1 / 2
BRBC	s, k	Branch if Status Flag Cleared	if (SREG(s) = 0) then PC=PC+k + 1	None	1 / 2
BREQ	K	Branch if Equal	if (Z = 1) then PC = PC + k + 1	None	1 / 2
BRNE	K	Branch if Not Equal	if (Z = 0) then PC = PC + k + 1	None	1 / 2
BRCS	K	Branch if Carry Set	if (C = 1) then PC = PC + k + 1	None	1 / 2
BRCC	K	Branch if Carry Cleared	if (C = 0) then PC = PC + k + 1	None	1 / 2
BRSH	K	Branch if Same or Higher	if (C = 0) then PC = PC + k + 1	None	1 / 2
BRLO	K	Branch if Lower	if (C = 1) then PC = PC + k + 1	None	1 / 2
BRMI	K	Branch if Minus	if (N = 1) then PC = PC + k + 1	None	1 / 2
BRPL	K	Branch if Plus	if (N = 0) then PC = PC + k + 1	None	1 / 2
BRGE	K	Branch if Greater or Equal, Signed	if (N V= 0) then PC = PC+ k + 1	None	1 / 2
BRLT	K	Branch if Less Than, Signed	if (N V= 1) then PC = PC + k + 1	None	1 / 2
BRHS	K	Branch if Half Carry Flag Set	if (H = 1) then PC = PC + k + 1	None	1 / 2
BRHC	K	Branch if Half Carry Flag Cleared	if (H = 0) then PC = PC + k + 1	None	1 / 2
BRTS	K	Branch if T Flag Set	if (T = 1) then PC = PC + k + 1	None	1 / 2
BRTC	K	Branch if T Flag Cleared	if (T = 0) then PC = PC + k + 1	None	1 / 2
BRVS	K	Branch if Overflow Flag is Set	if (V = 1) then PC = PC + k + 1	None	1 / 2

BRVC	K	Branch if Overflow Flag is Cleared	if (V = 0) then PC = PC + k + 1	None	1 / 2
BRIE	K	Branch if Interrupt Enabled	if (I = 1) then PC = PC + k + 1	None	1 / 2
BRID	K	Branch if Interrupt Disabled	if (I = 0) then PC = PC + k + 1	None	1 / 2
DATA TRANSFER INSTRUCTIONS					
MOV	Rd, Rr	Copy Register	Rd = Rr	None	1
LDI	Rd, K	Load Immediate	Rd = K	None	1
LDS	Rd, k	Load Direct	Rd = (k)	None	2
LD	Rd, X	Load Indirect	Rd = (X)	None	2
LD	Rd, X+	Load Indirect and Post-Increment	Rd = (X), X = X + 1	None	2
LD	Rd, -X	Load Indirect and Pre-Decrement	X = X - 1, Rd =(X)	None	2
LD	Rd, Y	Load Indirect	Rd = (Y)	None	2
LD	Rd, Y+	Load Indirect and Post-Increment	Rd = (Y), Y = Y + 1	None	2
LD	Rd, -Y	Load Indirect and Pre-Decrement	Y = Y - 1, Rd = (Y)	None	2
LDD	Rd,Y+q	Load Indirect with Displacement	Rd = (Y + q)	None	2
LD	Rd, Z	Load Indirect	Rd = (Z)	None	2
LD	Rd, Z+	Load Indirect and Post-Increment	Rd = (Z), Z = Z+1	None	2
LD	Rd, -Z	Load Indirect and Pre-Decrement	Z = Z - 1, Rd = (Z)	None	2
LDD	Rd, Z+q	Load Indirect with Displacement	Rd = (Z + q)	None	2
STS	k, Rr	Store Direct	(k) = Rr	None	2
ST	X, Rr	Store Indirect	(X) = Rr	None	2
ST	X+, Rr	Store Indirect and Post-Increment	(X) = Rr, X = X + 1	None	2
ST	-X, Rr	Store Indirect and Pre-Decrement	X = X - 1, (X) = Rr	None	2
ST	Y, Rr	Store Indirect	(Y) = Rr	None	2
ST	Y+, Rr	Store Indirect and Post-Increment	(Y) = Rr, Y = Y + 1	None	2
ST	-Y, Rr	Store Indirect and Pre-Decrement	Y = Y - 1, (Y) = Rr	None	2
STD	Y+q,Rr	Store Indirect with Displacement	(Y + q) = Rr	None	2
ST	Z, Rr	Store Indirect	(Z) = Rr	None	2
ST	Z+, Rr	Store Indirect and Post-Increment	(Z) = Rr, Z = Z + 1	None	2
ST	-Z, Rr	Store Indirect and Pre-Decrement	Z = Z - 1, (Z) = Rr	None	2
STD	Z+q,Rr	Store Indirect with Displacement	(Z + q) = Rr	None	2
LPM		Load Program Memory	R0 =(Z)	None	3

IN	Rd, P	In Port	Rd = P	None	1
OUT	P, Rr	Out Port	P = Rr	None	1
PUSH	Rr	Push Register on Stack	STACK = Rr	None	2
POP	Rd	Pop Register from Stack	Rd = STACK	None	2
BIT AND BIT-TEST INSTRUCTIONS					
LSL	Rd	Logical Shift Left	Rd(n+1) =Rd(n),Rd(0)= 0,C=Rd(7)	Z,C,N,V, H	1
LSR	Rd	Logical Shift Right	Rd(n) = Rd(n+1), Rd(7) =0, C=Rd(0)	Z,C,N,V	1
ROL	Rd	Rotate Left Through Carry	Rd(0) =C, Rd(n+1) =Rd(n),C=Rd(7)	Z,C,N,V, H	1
ROR	Rd	Rotate Right Through Carry	Rd(7) =C,Rd(n) =Rd(n+1),C¬Rd(0)	Z,C,N,V	1
ASR	Rd	Arithmetic Shift Right	Rd(n) = Rd(n+1), n=0..6	Z,C,N,V	1
SWAP	Rd	Swap Nibbles	Rd(3..0) « Rd(7..4)	None	1
BSET	S	Flag Set	SREG(s) = 1	SREG(s)	1
BCLR	S	Flag Clear	SREG(s) = 0	SREG(s)	1
SBI	P, b	Set Bit in I/O Register	I/O(P, b) = 1	None	2
CBI	P, b	Clear Bit in I/O Register	I/O(P, b) = 0	None	2
BST	Rr, b	Bit Store from Register to T	T = Rr(b)	T	1
BLD	Rd, b	Bit load from T to Register	Rd(b) = T	None	1
SEC		Set Carry	C = 1	C	1
CLC		Clear Carry	C = 0	C	1
SEN		Set Negative Flag	N = 1	N	1
CLN		Clear Negative Flag	N = 0	N	1
SEZ		Set Zero Flag	Z = 1	Z	1
CLZ		Clear Zero Flag	Z = 0	Z	1
SEI		Global Interrupt Enable	I = 1	I	1
CLI		Global Interrupt Disable	I = 0	I	1
SES		Set Signed Test Flag	S = 1	S	1
CLS		Clear Signed Test Flag	S = 0	S	1
SEV		Set Twos Complement Overflow	V = 1	V	1
CLV		Clear Twos Complement Overflow	V = 0	V	1
SET		Set T in SREG	T = 1	T	1
CLT		Clear T in SREG	T = 0	T	1
SHE		Set Half Carry Flag in SREG	H = 1	H	1
CLH		Clear Half Carry Flag in SREG	H = 0	H	1
NOP		No Operation		None	1
SLEEP		Sleep		None	1
WDR		Watchdog Reset		None	1

*) Not available in base-line microcontrollers

The Assembler is not case sensitive.

The operands have the following forms:

Rd: R0-R31 or R16-R31 (depending on instruction)
Rr: R0-R31
b: Constant (0-7)
s: Constant (0-7)
P: Constant (0-31/63)
K: Constant (0-255)
k: Constant, value range depending on instruction.
q: Constant (0-63)

Rdl: R24, R26, R28, R30. For ADIW and SBIW instructions

Reserved Words

The following table shows the reserved BASCOM statements or characters.

^
!
;
$BAUD , $BAUD1 , $BOOT , $CRYSTAL ,$DATA ,$DBG ,$DEFAULT , $END , $EEPROM , $EXTERNAL , $INCLUDE , $LCD , $LCDRS , $LCDPUTCTRL , $LCDPUTDATA , $LCDVFO , $LIB ,$MAP ,$REGFILE ,$SERIALINPUT ,$SERIALINPUT1, $SERIALINPUT2LCD , $SERIALOUTPUT , $SERIALOUTPUT1 ,
$TINY ,$WAITSTATE ,$XRAMSIZE , $XRAMSTART

1WRESET ,1WREAD ,1WWRITE

ACK ,ABS ,ALIAS ,AND ,ACOS ,AS , ASC , ASIN , AT , ATN, ATN2

BAUD, BCD , BIN , BIN2GRAY , BINVAL , BIT , BITWAIT , BLINK , BOOLEAN , BYTE , BYVAL

CALL , CAPTURE1 , CASE , CHECKSUM , CHR , CIRCLE , CLS , CLOSE , COMPARE1x , CONFIG , CONST , COS , COSH , COUNTER , COUNTERx ,
CPEEK , CPEEKH , CRC8 , CRC16 , CRC32 , CRYSTAL , CURSOR

DATA, DATE$, DBG , DEBOUNCE , DECR , DECLARE , DEFBIT , DEFBYTE , DEFLNG , DEFWORD , DEG2RAD , DEGSNG , DEFLCDCHAR, DEFINT ,
DEFWORD , DELAY , DIM , DISABLE , DISKSIZE , DISKFREESIZE , DISPLAY , DO , DOUBLE, DOWNTO , DTMFOUT

ELSE, ELSEIF, ENABLE, END, EOF, ERAM, ERASE, ERR, EXIT, EXP, EXTERNAL, FIX, FLUSH, FOR, FOURTH, FOURTHLINE, FREEFILE, FUNCTION

GATE, GET, GETADC, GETKBD, GETATKBD , GETRC5, GLCDDATA , GLCDCMD, GOSUB, GOTO, GRAY2BIN

HEXVAL,HIGH, HOME

I2CINIT, I2CRECEIVE, I2CSEND, I2CSTART, I2CSTOP, I2CRBYTE, I2CWBYTE, IDLE, IF , INCR

, INKEY , INP , INPUT , INPUTBIN , INPUTHEX ,
INT, INT0, INT1, INTEGER, INTERNAL, INSTR, IS, ISCHARWAITING

LCASE, LCD, LCDAT, LEFT, LEFT, LEN, LINE, LOAD, LOADLABEL, LOC , LOF , LOCAL, LOCATE,
LOG , LOG10 , LONG, LOOKUP, LOOKUPSTR,
LOOP, LTRIM, LOOKDOWN, LOW, LOWER, LOWERLINE

MAKEBCD, MAKEDEC, MAKEINT, MID, MIN, MAX, MOD, MODE

NACK, NEXT, NOBLINK, NOSAVE, NOT

OFF, ON, OR, OUT, OUTPUT

PEEK, POKE, PORTx, POWER, POWERDOWN, PRINT, PRINTBIN, PULSEOUT, PUT, PWM1x,
RAD2DEG, RC5SEND, RC6SEND, READ, READEEPROM
REM, RESET, RESTORE, RETURN, RIGHT, RIGHT, ROTATE, ROUND, RTRIM

SEEK, SELECT, SERIAL, SET, SERIN , SEROUT, SETFONT, SGN, SHIFT, SHIFTLCD,
SHIFTCURSOR,SHIFTIN , SHIFTOUT , SHOWPIC, SHOWPICE,
SIN, SINH , SONYSEND , SOUND , SPACE, SPC , SPIINIT , SPIIN , SPIMOVE , SPIOUT , START
, STEP , STR , STRING , STOP , SUB , SWAP , SQR

TAN , TANH , THEN , TIME$, THIRD , THIRDLINE , TIMERx , TO , TRIM

UCASE, UNTIL , UPPER , UPPERLINE

VAL, VARPTR

WAIT, WAITKEY, WAITMS , WAITUS , WATCHDOG , WRITEEEPROM , WEND , WHILE ,WORD

XOR, XRAM

Error Codes

The following table lists errors that can occur.

Error	Description
1	Unknown statement
2	Unknown structure EXIT statement
3	WHILE expected
4	No more space for IRAM BIT
5	No more space for BIT
6	. expected in filename
7	IF THEN expected
8	BASIC source file not found
9	Maximum 128 aliases allowed
10	Unknown LCD type
11	INPUT, OUTPUT, 0 or 1 expected
12	Unknown CONFIG parameter
13	CONST already specified
14	Only IRAM bytes supported
15	Wrong data type
16	Unknown Definition

17	9 parameters expected
18	BIT only allowed with IRAM or SRAM
19	STRING length expected (DIM S AS STRING * 12 ,for example)
20	Unknown DATA TYPE
21	Out of IRAM space
22	Out of SRAM space
23	Out of XRAM space
24	Out of EPROM space
25	Variable already dimensioned
26	AS expected
27	parameter expected
28	IF THEN expected
29	SELECT CASE expected
30	BIT's are GLOBAL and can not be erased
31	Invalid data type
32	Variable not dimensioned
33	GLOBAL variable can not be ERASED
34	Invalid number of parameters
35	3 parameters expected
36	THEN expected
37	Invalid comparison operator
38	Operation not possible on BITS
39	FOR expected
40	Variable can not be used with RESET
41	Variable can not be used with SET
42	Numeric parameter expected
43	File not found
44	2 variables expected
45	DO expected
46	Assignment error
47	UNTIL expected
50	Value doesn't fit into INTEGER
51	Value doesn't fit into WORD
52	Value doesn't fit into LONG
60	Duplicate label
61	Label not found
62	SUB or FUNCTION expected first
63	Integer or Long expected for ABS()
64	, expected
65	device was not OPEN
66	device already OPENED
68	channel expected
70	BAUD rate not possible
71	Different parameter type passed then declared
72	Getclass error. This is an internal error.
73	Printing this FUNCTION not yet supported
74	3 parameters expected

80	Code does not fit into target chip
81	Use HEX(var) instead of PRINTHEX
82	Use HEX(var) instead of LCDHEX
85	Unknown interrupt source
86	Invalid parameter for TIMER configuration
87	ALIAS already used
88	0 or 1 expected
89	Out of range : must be 1-4
90	Address out of bounds
91	INPUT, OUTPUT, BINARY, or RANDOM expected
92	LEFT or RIGHT expected
93	Variable not dimensioned
94	Too many bits specified
95	Falling or rising expected for edge
96	Prescale value must be 1,8,64,256 or 1024
97	SUB or FUNCTION must be DECLARED first
98	SET or RESET expected
99	TYPE expected
100	No array support for IRAM variables
101	Can't find HW-register
102	Error in internal routine
103	= expected
104	LoadReg error
105	StoreBit error
106	Unknown register
107	LoadnumValue error
108	Unknown directive in device file
109	= expected in include file for .EQU
110	Include file not found
111	SUB or FUNCTION not DECLARED
112	SUB/FUNCTION name expected
113	SUB/FUNCTION already DECLARED
114	LOCAL only allowed in SUB or FUNCTION
115	#channel expected
116	Invalid register file
117	Unknown interrupt
200	.DEF not found
201	Low Pointer register expected
202	.EQU not found, probably using functions that are not supported by the selected chip
203	Error in LD or LDD statement
204	Error in ST or STD statement
205	} expected
206	Library file not found
207	Library file already registered
210	Bit definition not found
211	External routine not found
212	LOW LEVEL, RISING or FALLING expected

213	String expected for assignment
214	Size of XRAM string 0
215	Unknown ASM mnemonic
216	CONST not defined
217	No arrays allowed with BIT/BOOLEAN data type
218	Register must be in range from R16-R31
219	INT0-INT3 are always low level triggered in the MEGA
220	Forward jump out of range
221	Backward jump out of range
222	Illegal character
223	* expected
224	Index out of range
225	() may not be used with constants
226	Numeric of string constant expected
227	SRAM start greater than SRAM end
228	DATA line must be placed after the END statement
229	End Sub or End Function expected
230	You can not write to a PIN register
231	TO expected
232	Not supported for the selected micro
233	READ only works for normal DATA lines, not for EPROM data
234	') block comment expected first
235	'(block comment expected first
236	Value does not fit into byte
238	Variable is not dimensioned as an array
239	Invalid code sequence because of AVR hardware bug
240	END FUNCTION expected
241	END SUB expected
242	Source variable does not match the target variable
243	Bit index out of range for supplied data type
244	Do not use the Y pointer
245	No arrays supported with IRAM variable
246	No more room for .DEF definitions
247	. expected
248	BYVAL should be used in declaration
249	ISR already defined
250	GOSUB expected
251	Label must be named SECTIC
252	Integer or Word expected
253	ERAM variable can not be used
254	Variable expected
255	Z or Z+ expected
256	Single expected
257	"" expected
258	SRAM string expected
259	- not allowed for a byte
260	Value larger than string length

261	Array expected
262	ON or OFF expected
263	Array index out of range
264	Use ECHO OFF and ECHO ON instead
265	offset expected in LDD or STD like Z+1
266	TIMER0, TIMER1 or TIMER2 expected
267	Numeric constant expected
268	Param must be in range from 0-3
269	END SELECT expected
270	Address already occupied
322	Data type not supported with statement
323	Label too long
324	Chip not supported by I2C slave library
325	Pre-scale value must be 1,8,32,128,256 or 1024
326	#ENDIF expected
327	Maximum size is 255
328	Not valid for SW UART
329	FileDateTime can only be assigned to a variable
330	Maximum value for OUT is &H3F
332	$END ASM expected
334	') blockcomment end expected
335	Use before DIM statements
336	Could not set specified CLOCK value
999	DEMO/BETA only supports 4096 bytes of code
9999	I hope you do not see this one.

Other error codes are internal ones. Please report them when you get them.

Newbie problems

When you are using the AVR without knowledge of the architecture you can experience some problems.

-I can not set a pin high or low
-I can not read the input on a pin

The AVR has 3 registers for each port. A port normally consists of 8 pins. A port is named with a letter from A-F.
All parts have PORTB.

When you want to set a single pin high or low you can use the SET and RESET statements. But before you use them the AVR chip must know in which direction you are going to use the pins.

Therefore there is a register named DDRx for each port. In our sample it is named DDRB. When you write a 0 to the bit position of the pin you can use the pin as an input. When you write a 1 you can use it as output.

After the direction bit is set you must use either the PORTx register to set a logic level or the PINx register to READ a pin level.

Yes the third register is the PINx register. In our sample, PINB.

For example :
DDRB = &B1111_0000 ' upper nibble is output, lower nibble is input
SET PORTB.7 'will set the MS bit to +5V
RESET PORTB.7 'will set MS bit to 0 V

To read a pin :
Print PINB.0 'will read LS bit and send it to the RS-232

You may also read from PORTx but it will return the value that was last written to it.

To read or write whole bytes use :
PORTB = 0 'write 0 to register making all pins low
PRINT PINB 'print input on pins

I want to write a special character but they are not printed correct:

Well this is not a newbie problem but I put it here so you could find it.
Some ASCII characters above 127 are interpreted wrong depending on country settings. To print the right value use : PRINT "Test{123}?"

The {xxx} will be replaced with the correct ascii character.

You must use 3 digits otherwise the compiler will think you want to print {12} for example. This should be {012}

My application was working but with a new micro it is slow and print funny

Most new micro's have an internal oscillator that is enabled by default. As it runs on 1 or 4 or 8 Mhz, this might be slower or faster then your external crystal. This results in slow operation.

As the baud rate is derived from the clock, it will also result in wrong baud rates.

Solution : change frequency with $crystal so the internal clock will be used.
Or change the fuse bits so the external xtal will be used.

Some bits on Port C are not working
Some chips have a JTAG interface. Disable it with the proper fusebit .

Tips and tricks

This section describes tips and tricks received from users.

Kyle Kronyak : Using all the RAM from an external RAM chip.

I have found a way to use the 607 bytes of external SRAM that are normally not available

when using hardware SRAM support with BASCOM-AVR. It's actually quite simple. Basically the user just has to disconnect A15 from /CE on the SRAM module, and tie /CE to ground. This makes the chip enabled all the time. Addresses 1-32768 will then be available! The reason is because normally when going above 32768, the A15 pin would go high, disabling the chip. When A15 is not connected to /CE, the chip is always enabled, and allows the address number to "roll over". Therefore address 32162 is actually 0, 32163 is actually 1, 32164 is actually 2, etc. I have only tested this on a 32k SRAM chip. It definitely won't work on a 64k chip, and I believe it already works on any chip below 32k without modification of the circuit.

Programming problems

- When you have unreliable results, use a shielded LPT cable

- The AVR chips have a bug, if the erase is not complete. It tend's to hang at some point. Sometimes although the system reports erased but blank check report "not empty". As per Atmel Data Errata You must drop the vcc by 0.5V (a diode 1N4148 in Series) if the erase is not happening. (Such Chip's are unreliable and hence can be used only if you are sure). This can happen after you have programmed the chip many times

-

ASCII chart

Decimal	Octal	Hex	Binary	Value
000	000	000	00000000	NUL (Null char.)
001	001	001	00000001	SOH (Start of Header)
002	002	002	00000010	STX (Start of Text)
003	003	003	00000011	ETX (End of Text)
004	004	004	00000100	EOT (End of Transmission)
005	005	005	00000101	ENQ (Enquiry)
006	006	006	00000110	ACK (Acknowledgment)
007	007	007	00000111	BEL (Bell)
008	010	008	00001000	BS (Backspace)
009	011	009	00001001	HT (Horizontal Tab)
010	012	00A	00001010	LF (Line Feed)
011	013	00B	00001011	VT (Vertical Tab)
012	014	00C	00001100	FF (Form Feed)
013	015	00D	00001101	CR (Carriage Return)
014	016	00E	00001110	SO (Shift Out)
015	017	00F	00001111	SI (Shift In)
016	020	010	00010000	DLE (Data Link Escape)
017	021	011	00010001	DC1 (XON) (Device Control 1)
018	022	012	00010010	DC2 (Device Control 2)
019	023	013	00010011	DC3 (XOFF)(Device Control 3)
020	024	014	00010100	DC4 (Device Control 4)
021	025	015	00010101	NAK (Negative Acknowledgement)
022	026	016	00010110	SYN (Synchronous Idle)
023	027	017	00010111	ETB (End of Trans. Block)
024	030	018	00011000	CAN (Cancel)
025	031	019	00011001	EM (End of Medium)
026	032	01A	00011010	SUB (Substitute)
027	033	01B	00011011	ESC (Escape)
028	034	01C	00011100	FS (File Separator)
029	035	01D	00011101	GS (Group Separator)

030	036	01E	00011110	RS	(Request to Send)(Record Separator)
031	037	01F	00011111	US	(Unit Separator)
032	040	020	00100000	SP	(Space)
033	041	021	00100001	!	(exclamation mark)
034	042	022	00100010	"	(double quote)
035	043	023	00100011	#	(number sign)
036	044	024	00100100	$	(dollar sign)
037	045	025	00100101	%	(percent)
038	046	026	00100110	&	(ampersand)
039	047	027	00100111	'	(single quote)
040	050	028	00101000	(	(left/opening parenthesis)
041	051	029	00101001	)	(right/closing parenthesis)
042	052	02A	00101010	*	(asterisk)
043	053	02B	00101011	+	(plus)
044	054	02C	00101100	,	(comma)
045	055	02D	00101101	-	(minus or dash)
046	056	02E	00101110	.	(dot)
047	057	02F	00101111	/	(forward slash)
048	060	030	00110000	0	
049	061	031	00110001	1	
050	062	032	00110010	2	
051	063	033	00110011	3	
052	064	034	00110100	4	
053	065	035	00110101	5	
054	066	036	00110110	6	
055	067	037	00110111	7	
056	070	038	00111000	8	
057	071	039	00111001	9	
058	072	03A	00111010	:	(colon)
059	073	03B	00111011	;	(semi-colon)
060	074	03C	00111100	<	(less than)
061	075	03D	00111101	=	(equal sign)
062	076	03E	00111110	>	(greater than)
063	077	03F	00111111	?	(question mark)
064	100	040	01000000	@	(AT symbol)
065	101	041	01000001	A	
066	102	042	01000010	B	
067	103	043	01000011	C	
068	104	044	01000100	D	
069	105	045	01000101	E	
070	106	046	01000110	F	
071	107	047	01000111	G	
072	110	048	01001000	H	
073	111	049	01001001	I	
074	112	04A	01001010	J	
075	113	04B	01001011	K	
076	114	04C	01001100	L	
077	115	04D	01001101	M	
078	116	04E	01001110	N	
079	117	04F	01001111	O	
080	120	050	01010000	P	
081	121	051	01010001	Q	
082	122	052	01010010	R	
083	123	053	01010011	S	
084	124	054	01010100	T	
085	125	055	01010101	U	
086	126	056	01010110	V	
087	127	057	01010111	W	
088	130	058	01011000	X	
089	131	059	01011001	Y	

090	132	05A	01011010	Z	
091	133	05B	01011011	[	(left/opening bracket)
092	134	05C	01011100	\	(back slash)
093	135	05D	01011101	]	(right/closing bracket)
094	136	05E	01011110	^	(caret/cirumflex)
095	137	05F	01011111	_	(underscore)
096	140	060	01100000	`	
097	141	061	01100001	a	
098	142	062	01100010	b	
099	143	063	01100011	c	
100	144	064	01100100	d	
101	145	065	01100101	e	
102	146	066	01100110	f	
103	147	067	01100111	g	
104	150	068	01101000	h	
105	151	069	01101001	i	
106	152	06A	01101010	j	
107	153	06B	01101011	k	
108	154	06C	01101100	l	
109	155	06D	01101101	m	
110	156	06E	01101110	n	
111	157	06F	01101111	o	
112	160	070	01110000	p	
113	161	071	01110001	q	
114	162	072	01110010	r	
115	163	073	01110011	s	
116	164	074	01110100	t	
117	165	075	01110101	u	
118	166	076	01110110	v	
119	167	077	01110111	w	
120	170	078	01111000	x	
121	171	079	01111001	y	
122	172	07A	01111010	z	
123	173	07B	01111011	{	(left/opening brace)
124	174	07C	01111100	|	(vertical bar)
125	175	07D	01111101	}	(right/closing brace)
126	176	07E	01111110	~	(tilde)
127	177	07F	01111111	DEL	(delete)

BASCOM Language Reference

$ASM

Action
Start of inline assembly code block.

Syntax
$ASM

Remarks
Use $ASM together with $END ASM to insert a block of assembler code in your BASIC code.
You can also precede each line with the ! sign.
Most ASM mnemonics can be used without the preceding ! too.

See also the chapter Mixing BASIC and Assembly and assembler mnemonics

Example
```
Dim C As Byte

Loadadr C , X 'load address of variable C into register X

$asm
  Ldi R24,1 ; load register R24 with the constant 1
  St X,R24  ; store 1 into variable c
$end Asm
Print C
End
```

$BAUD

Action
Instruct the compiler to override the baud rate setting from the options menu.

Syntax
$BAUD = var

Remarks

Var	The baud rate that you want to use. This must be a numeric constant.

The baud rate is selectable from the Compiler Settings. It is stored in a configuration file. The $BAUD directive overrides the setting from the Compiler Settings.

In the generated report, you can view which baud rate is actually generated. The generated baud rate does depend on the used micro and crystal.

When you simulate a program you will not notice any problems when the baud rate is not set to the value you expected. In real hardware a wrong baud rate can give weird results on the terminal emulator screen. For best results use a crystal that is a multiple of the baud rate.

See also
$CRYSTAL , BAUD

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Print "Hello"

'Now change the baud rate in a program
Baud = 9600
Print "Did you change the terminal emulator baud rate too?"
End
```

$BAUD1

Action
Instruct the compiler to set the baud rate for the second hardware UART.

Syntax
$BAUD1 = var

Remarks

Var	The baud rate that you want to use. This must be a numeric constant.

In the generated report, you can view which baud rate is actually generated.

When you simulate a program you will not notice any problems when the baud rate is not set to the value you expected. In real hardware a wrong baud rate can give weird results on the terminal emulator screen. For best results use a crystal that is a multiple of the baud rate.

Some AVR chips have 2 UARTS. For example the Mega161, Mega162, Mega103 and Mega128. There are several other's and some new chips even have 4 UARTS.

See also
$CRYSTAL , BAUD , $BAUD

Example

```
'-------------------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega162
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates BAUD1 directive and BAUD1 statement

'-------------------------------------------------------------------------------
-
$regfile = "M162def.dat"
$baud1 = 2400
$crystal= 14000000 ' 14 MHz crystal

Open "COM2:" For BINARY As #1

Print #1 , "Hello"
'Now change the baud rate in a program
Baud1 = 9600                                                    '
Print #1 , "Did you change the terminal emulator baud rate too?"
Close #1
End
```

$BGF

Action
Includes a BASCOM Graphic File.

Syntax
$BGF "file"

Remarks

file	The file name of the BGF file to include.

Use SHOWPIC to display the BGF file. $BGF only task is to store the picture into the compressed **B**ASCOM **G**raphics **F**ormat(BGF).

See also
SHOWPIC , PSET , CONFIG GRAPHLCD

Example

```
'-----------------------------------------------------------------
'                     (c) 1995-2005 MCS Electronics
'                  T6963C graphic display support demo
'-----------------------------------------------------------------

'The connections of the LCD used in this demo
'LCD pin                   connected to
' 1        GND             GND
 '2        GND             GND
 '3        +5V             +5V
 '4        -9V             -9V potmeter
 '5        /WR             PORTC.0
 '6        /RD             PORTC.1
 '7        /CE             PORTC.2
```

```
 '8        C/D             PORTC.3
 '9        NC              not conneted
 '10       RESET           PORTC.4
 '11-18    D0-D7            PA
 '19       FS              PORTC.5
 '20       NC              not connected

$crystal = 8000000

'First we define that we use a graphic LCD

Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'Clear the screen will both clear text and graph display
Cls
'Other options are :
' CLS TEXT   to clear only the text display
' CLS GRAPH  to clear only the graphical part

Cursor Off

Wait 1
'locate works like the normal LCD locate statement
' LOCATE LINE,COLUMN LINE can be 1-8 and column 0-30


Locate 1 , 1

'Show some text
Lcd "MCS Electronics"
'And some othe text on line 2
Locate 2 , 1 : Lcd "T6963c support"
Locate 3 , 1 : Lcd "12345678901234567890123456789012345678901234567890"

Wait 2

Cls Text
' draw a line using PSET X,Y, ON/OFF
' PSET on.off param is 0 to clear a pixel and any other value to turn it on
For X = 0 To 140
   Pset X , 20 , 255                                        ' set the pixel
Next

Wait 2


'Now it is time to show a picture
'SHOWPIC X,Y,label
'The label points to a label that holds the image data
Showpic 0 , 0 , Plaatje

Wait 2
Cls Text                                                    ' clear the text
End
```

```
'This label holds the mage data
Plaatje:
'$BGF will put the bitmap into the program at this location
$bgf "mcs.bgf"

'You could insert other picture data here
```

$BOOT

Action
Instruct the compiler to include boot loader support.

Syntax
$BOOT = address

Remarks

address	The boot loader address.

Some new AVR chips have a special boot section in the upper memory of the flash.
By setting some fuse bits you can select the code size of the boot section.
The code size also determines the address of the boot loader.

With the boot loader you can reprogram the chip when a certain condition occurs.
The sample checks a pin to see if a new program must be loaded.
When the pin is low there is a jump to the boot address.

The boot code must always be located at the end of your program.
It must be written in ASM since the boot loader may not access the application flash rom.
This because otherwise you could overwrite your running code!

The example is written for the M163. You can use the Upload file option of the terminal emulator to upload a new hex file. The terminal emulator must have the same baud rate as the chip. Under Options, Monitor, set the right upload speed and set a monitor delay of 20. Writing the flash take time so after every line a delay must be added while uploading a new file.

The $BOOT directive is replaced by $LOADER. $LOADER works much simpler. $BOOT is however still supported.

See also
$LOADER

Example
See BOOT.BAS from the samples dir. But better look at the $LOADER directive.

$CRYSTAL

Action
Instruct the compiler to override the crystal frequency options setting.

Syntax
$CRYSTAL = var

Remarks

var	A numeric constant with the Frequency of the crystal.

The frequency is selectable from the Compiler Settings. It is stored in a configuration file. The $CRYSTAL directive overrides this setting.
It is best to use the $CRYSTAL directive as the used crystal frequency is visible in your program that way.

The $CRYSTAL directive only informs the compiler about the used frequency. It does not set any fuse bit. The frequency must be know by the compiler for a number of reasons. First when you use serial communications, and you specify $BAUD, the compiler can calculate the proper settings for the UBR register. And second there are a number of routines like WAITMS, that use the execution time of a loop to generate a delay. When you specify $CRYSTAL = 1000000 (1 MHz) but in reality, connect a 4 MHz XTAL, you will see that everything will work 4 times as quick.

Most new AVR chips have an internal oscillator that is enabled by default. Check the data sheet for the default value.

See also
$BAUD , BAUD , CONFIG CLOCKDIV

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Print "Hello world"
End
```

$DATA

Action
Instruct the compiler to store the data in the DATA lines following the $DATA directive, in code memory.

Syntax
$DATA

Remarks

The AVR has built-in EEPROM. With the WRITEEEPROM and READEEPROM statements, you can write to and read from the EEPROM.
To store information in the EEPROM, you can add DATA lines to your program that hold the data that must be stored in the EEPROM.
A separate file is generated with the EEP extension. This file can be used to program the EEPROM.

The compiler must know which DATA must go into the code memory and which into the EEPROM memory and therefore two compiler directives were added.

$EEPROM and $DATA.

$EEPROM tells the compiler that the DATA lines following the compiler directive must be stored in the EEP file.
To switch back to the default behavior of the DATA lines, you must use the $DATA directive.

The READ statement that is used to read the DATA info may only be used with normal DATA lines. It does not work with DATA stored in EEPROM.

Do not confuse $DATA directive with the DATA statement.

So while normal DATA lines will store the specified data into the code memory of the micro which is called the flash memory, the $EEPROM and $DATA will cause the data to be stored into the EEPROM. The EEP file is a binary file.

See also

$EEPROM , READEEPROM , WRITEEEPROM , DATA

ASM

NONE

Example

```
'-------------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates $DATA directive

'-------------------------------------------------------------------------
-
$regfile = "2313def.dat"
$baud = 19200
$crystal = 4000000                                          ' 4 MHz crystal

Dim B As Byte
Readeeprom B , 0                                            'now B will be 1
End


Dta:
$eeprom
Data 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8
$data
```

```
End
```

$DBG

Action
Enables debugging output to the hardware UART.

Syntax
$DBG

Remarks
Calculating the hardware, software and frame space can be a difficult task.
With $DBG the compiler will insert characters for the various spaces.

To the Frame space 'F' will be written. When you have a frame size of 4, FFFF will be written.
To the Hardware space 'H' will be written. If you have a hardware stack space of 8, HHHHHHHH will be written to this space.
To the software space 'S' will be written. If you have a software stack space of 6, SSSSSS will be written.
The idea is that when a character is overwritten, it is being used. So by watching these spaces you can determine if the space is used or not.
With the DBG statement a record is written to the HW UART. The record must be logged to a file so it can be analyzed by the stack analyzer.

Make the following steps to determine the proper values:

- Make the frame space 40, the softstack 20 and the HW stack 50
- Add $DBG to the top of your program
- Add a DBG statement to every Subroutine or Function
- Open the terminal emulator and open a new log file. By default it will have the name of your current program with the .log extension
- Run your program and notice that it will dump information to the terminal emulator
- When your program has executed all sub modules or options you have build in, turn off the file logging and turn off the program
- Choose the Tools Stack analyzer option
- A window will be shown with the data from the log file
- Press the Advise button that will determine the needed space. Make sure that there is at least one H, S and F in the data. Otherwise it means that all the data is overwritten and that you need to increase the size.
- Press the Use button to use the advised settings.

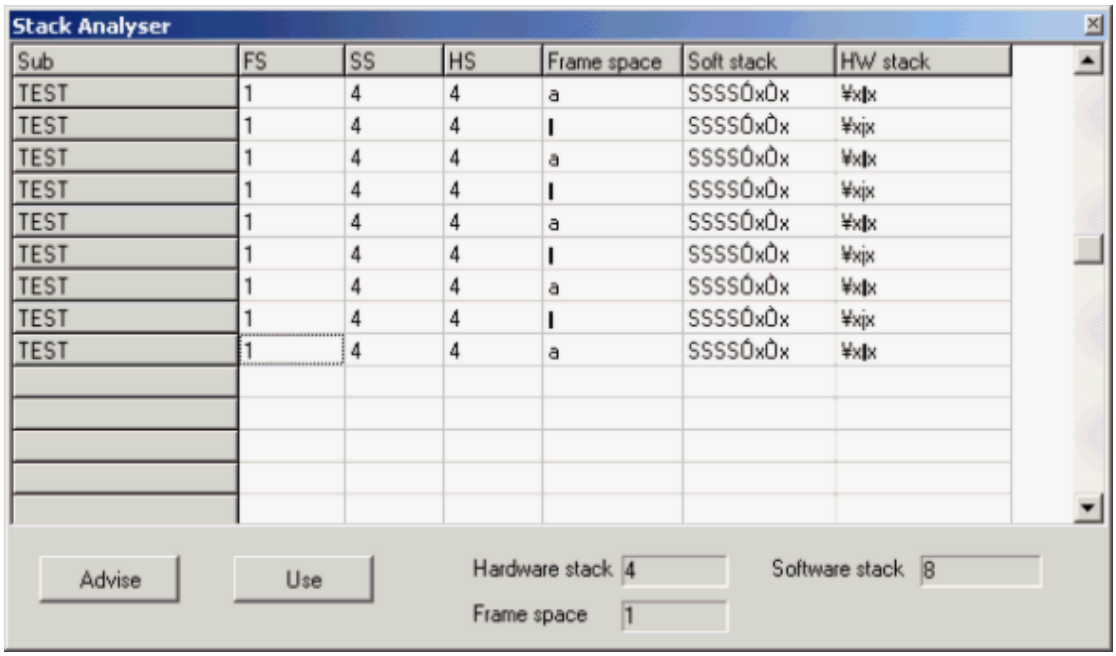
As an alternative you can watch the space in the simulator and determine if the characters are overwritten or not.

The DBG statement will assign an internal variable named ___SUBROUTINE
Because the name of a SUB or Function may be 32 long, this variable uses 33 bytes!

___SUBROUTINE will be assigned with the name of the current SUB or FUNCTION.

When you first run a SUB named Test1234 it will be assigned with Test1234
When the next DBG statement is in a SUB named Test, it will be assigned with Test.

The 234 will still be there so it will be shown in the log file.



Every DBG record will be shown as a row.
The columns are:

Column	Description
Sub	Name of the sub or function from where the DBG was used
FS	Used frame space
SS	Used software stack space
HS	Used hardware stack space
Frame space	Frame space
Soft stack	Soft stack space
HW stack	Hardware stack space

The Frame space is used to store temp and local variables.
It also stores the variables that are passed to subs/functions by value.
Because PRINT , INPUT and the FP num<>String conversion routines require a buffer, the compiler always is using 24 bytes of frame space.

When the advise is to use 2 bytes of frame space, the setting will be 24+2=26.

For example when you use : print var, var need to be converted into a string before it can be printed or shown with LCD.

An alternative for the buffer would be to setup a temp buffer and free it once finished. This gives more code overhead.
In older version of BASCOM the start of the frame was used for the buffer but that gave conflicts when variables were printed from an ISR.

See also

DBG

$DEFAULT

Action
Set the default for data types dimensioning to the specified type.

Syntax
$DEFAULT = var

Remarks

Var	SRAM, XRAM, ERAM

Each variable that is dimensioned will be stored into SRAM, the internal memory of the chip.
You can override it by specifying the data type.
Dim B As XRAM Byte , will store the data into external memory.

When you want all your variables to be stored in XRAM for example, you can use the statement : $DEFAULT XRAM
Each Dim statement will place the variable in XRAM in that case.

To switch back to the default behavior, use $END $DEFAULT

See also
NONE

ASM
NONE

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

$default Xram
Dim A As Byte , B As Byte , C As Byte
'a,b and c will be stored into XRAM

$default Sram
Dim D As Byte
'D will be stored in internal memory, SRAM
```

$EEPLEAVE

Action

Instructs the compiler not to recreate or erase the EEP file.

Syntax
$EEPLEAVE

Remarks
When you want to store data in the EEPROM, and you use an external tool to create the EEP file, you can use the $EEPLEAVE directive.
Normally the EEP file will be created or erased, but this directive will not touch any existing EEP file.
Otherwise you would erase an existing EEP file, created with another tool.

See also
$EEPROMHEX

Example
NONE

$EEPROM

Action
Instruct the compiler to store the data in the DATA lines following the $DATA directive in an EEP file.

Syntax
$EEPROM

Remarks
The AVR has built-in EEPROM. With the WRITEEEPROM and READEEPROM statements, you can write to and read from the EEPROM.
To store information in the EEPROM, you can add DATA lines to your program that hold the data that must be stored in the EEPROM.
A separate file is generated with the EEP extension. This file can be used to program the EEPROM.

The compiler must know which DATA must go into the code memory and which into the EEPROM memory and therefore two compiler directives were added.

$EEPROM and $DATA.

$EEPROM tells the compiler that the DATA lines following the compiler directive must be stored in the EEP file.
To switch back to the default behavior of the DATA lines, you must use the $DATA directive.

The READ statement that is used to read the DATA info may only be used with normal DATA lines. It does not work with DATA stored in EEPROM.

Do not confuse $DATA directive with the DATA statement.

So while normal DATA lines will store the specified data into the code memory of the micro which is called the flash memory, the $EEPROM and $DATA will cause the data to be stored into the EEPROM. The EEP file is a binary file.

See also
$EEPROM , READEEPROM , WRITEEEPROM , DATA

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates $DATA directive

'-----------------------------------------------------------------------------
$regfile = "2313def.dat"
$baud = 19200
$crystal = 4000000                                          ' 4 MHz crystal

Dim B As Byte
Readeeprom B , 0                                            'now B will be 1
End


Dta:
$eeprom
Data 1 , 2 , 3 , 4 , 5 , 6 , 7 , 8
$data


End
```

$EEPROMHEX

Action
Instruct the compiler to store the data in the EEP file in Intel HEX format instead of binary format.

Syntax
$EEPROMHEX

Remarks
The AVR has build in EEPROM. With the WRITEEEPROM and READEEPROM statements, you can write and read to the EEPROM.

To store information in the EEPROM, you can add DATA lines to your program that hold the data that must be stored in the EEPROM. $EEPROM must be used to create a EEP file that holds the data.

The EEP file is by default a binary file. When you use the STK500 you need an Intel HEX file. Use $EEPROMHEX to create an Intel Hex EEP file.

$EEPROMHEX must be used together with $EEPROM.

See also
$EEPROMLEAVE

Example
```
$eeprom'the following DATA lines data will go to the EEP file
Data 200 , 100,50
$data
```

This would create an EEP file of 3 bytes. With the values 200,100 and 50.
Add $eepromhex in order to create an Intel Hex file.

This is how the EEP filecontent looks when using $eepromhex

```
:0A00000001020304050A141E283251
:00000001FF
```

$EXTERNAL

Action
Instruct the compiler to include ASM routines from a library.

Syntax
$EXTERNAL Myroutine [, myroutine2]

Remarks
You can place ASM routines in a library file. With the $EXTERNAL directive you tell the compiler which routines must be included in your program.

See also
$LIB

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
```

```
8 , Clockpol = 0


'In order to let this work you must put the mylib.lib file in the LIB dir
'And compile it to a LBX
'-----------------------------------------------------------------------
'define the used library
$lib"mylib.lbx"
'you can also use the original ASM :
'$LIB "mylib.LIB"

'also define the used routines
$external Test

'this is needed so the parameters will be placed correct on the stack
Declare Sub Test(byval X Asbyte , Y Asbyte)


'reserve some space
Dim Z As Byte


'call our own sub routine
Call Test(1 , Z)

'z will be 2 in the used example
End
```

$FRAMESIZE

Action
Sets the available space for the frame.

Syntax
$FRAMESIZE = var

Remarks

Var	A numeric decimal value.

While you can configure the Frame Size in Options, Compiler, Chip, it is good practice to put the value into your code. This way you do no need the cfg(configuration) file.

The $FRAMESIZE directive overrides the value from the IDE Options.

It is important that the $FRAMESIZE directive occurs in your main project file. It may not be included in an $include file as only the main file is parsed for $FRAMESIZE

See also
$SWSTACK, $HWSTACK

Example
```
'-----------------------------------------------------------------------
--
```

```
'name                    : adc.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : demonstration of GETADC() function for 8535 or M163
micro
'micro                   : Mega163
'suited for demo         : yes
'commercial addon needed : no
'use in simulator        : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space
```

$HWSTACK

Action

Sets the available space for the Hardware stack.

Syntax

$HWSTACK = var

Remarks

Var	A numeric decimal value.

While you can configure the HW Stack in Options, Compiler, Chip, it is good practice to put the value into your code. This way you do no need the cfg(configuration) file.

The $HWSTACK directive overrides the value from the IDE Options.

It is important that the $HWSTACK directive occurs in your main project file. It may not be included in an $include file as only the main file is parsed for $HWSTACK.

The Hardware stack is room in RAM that is needed by your program. When you use GOSUB label, the microprocessor pushes the return address on the hardware stack and will use 2 bytes for that. When you use RETURN, the HW stack is popped back and the program can continue at the proper address. When you nest GOSUB, CALL or functions, you will use more stack space. Most statements use HW stack because a machine language routine is called.

See also

$SWSTACK , $FRAMESIZE

Example

```
'-----------------------------------------------------------------------------
--
'name                    : adc.bas
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of GETADC() function for 8535 or M163
micro
'micro                    : Mega163
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space
```

$INC

Action

Includes a binary file in the program at the current position.

Syntax

$INC label , size | nosize , "file"

Remarks

Label	The name of the label you can use to refer to the data.
Nosize	Specify either nosize or size. When you use size, the size of the data will be included. This way you know how many bytes you can retrieve.
File	Name of the file which must be included.

Use RESTORE to get a pointer to the data. And use READ, to read in the data.

The $INC statement is an alternative for the DATA statement.
While DATA works ok for little data, it is harder to use on large sets of data.

See Also

RESTORE, DATA , READ

Example

```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim Size As Word , W As Word , B As Byte

Restore L1                                                  ' set pointer to
```

```
label
Read Size                                                    ' get size of the
data

Print Size ; " bytes stored at label L1"
For W = 1 To Size
  Read B : Print Chr(b);
Next

End

'include some data here
$inc L1 , Size , "c:\test.bas"
'when you get an error, insert a file you have on your system
```

$INCLUDE

Action
Includes an ASCII file in the program at the current position.

Syntax
$INCLUDE "file"

Remarks

File	Name of the ASCII file, which must contain valid BASCOM statements. This option can be used if you make use of the same routines in many programs. You can write modules and include them into your program. If there are changes to make you only have to change the module file, not all your BASCOM programs. You can only include ASCII files!

Use $INC when you want to include binary files.

See Also
$INC

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

'------------------------------------------------------------
Print "INCLUDE.BAS"
'Note that the file 123.bas contains an error
$include "123.bas"                          'include file that prints Hello
Print "Back in INCLUDE.BAS"
End
```

$INITMICRO

Action
Calls a user routine at startup to perform important initialization functions such as setting ports.

Syntax
$INITMICRO

Remarks
This directive will call a label named _INIT_MICRO just after the most important initialization is performed. You can put the _INIT_MICRO routine into your program, or you can put it in a library. Advantage of a library is that it is the same for all programs, and advantage of storing the code into your program is that you can change it for every program.

It is important that you end the routine with a RETURN as the label is called and expects a return.
The $initmicro can be used to set a port direction or value as it performs before the memory is cleared which can take some mS.
The best solution for a defined logic level at startup remains the usage of pull up/pull down resistors.

See Also
NONE

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits = 8 , Clockpol = 0

$initmicro

Print Version()                                          'show date and time of compilation

Print Portb
Do
  nop
Loop
End


'do not write a complete application in this routine.
'only perform needed init functions
_init_micro:
  Config Portb = Output
  Portb = 3
Return
```

$LCD

Action
Instruct the compiler to generate code for 8-bit LCD displays attached to the data bus.

Syntax
$LCD = [&H]address

Remarks

Address	The address where must be written to, to enable the LCD display and the RS line of the LCD display. The db0-db7 lines of the LCD must be connected to the data lines D0-D7. (or is 4 bit mode, connect only D4-D7) The RS line of the LCD can be configured with the LCDRS statement. On systems with external RAM, it makes more sense to attach the LCD to the data bus. With an address decoder, you can select the LCD display.

Do not confuse $LCD with the LCD statement.

See also
$LCDRS , CONFIG LCD

Example
```
'-----------------------------------------------------------
'                  (c) 1995-2005 MCS Electronics
'-----------------------------------------------------------
'  file: LCD.BAS
'  demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR, HOME
'        CURSOR, DISPLAY
'-----------------------------------------------------------

'note : tested in bus mode with 4-bit on the STK200
'LCD   -   STK200
'-------------------
'D4          D4
'D5          D5
'D6          D6
'D7          D7
'WR          WR
'E           E
'RS          RS
'+5V         +5V
'GND         GND
'V0          V0
'   D0-D3 are not connected since 4 bit bus mode is used!


'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Rem with the config lcdpin statement you can override the compiler settings

$regfile = "8515def.dat"
$lcd = &HC000
```

```
$lcdrs = &H8000
Config Lcdbus = 4

Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen
'other options are 16 * 2 , 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
Wait 1
Lowerline                                                   'select the lower
line
Wait 1
Lcd "Shift this."                                           'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                           'shift the text to
the right
   Wait 1                                                   'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                            'shift the text to
the left
   Wait 1                                                   'wait a moment
Next

Locate 2 , 1                                                'set cursor
position
Lcd "*"                                                     'display this
Wait 1                                                      'wait a moment

Shiftcursor Right                                           'shift the cursor
Lcd "@"                                                     'display this
Wait 1                                                      'wait a moment

Home Upper                                                  'select line 1 and
return home
Lcd "Replaced."                                             'replace the text
Wait 1                                                      'wait a moment

Cursor Off Noblink                                          'hide cursor
Wait 1                                                      'wait a moment
Cursor On Blink                                             'show cursor
Wait 1                                                      'wait a moment
Display Off                                                 'turn display off
Wait 1                                                      'wait a moment
Display On                                                  'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                  'goto home on line
three
```

```
Home Fourth
Home F                                                    'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                       'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                       'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                'value into ACC
!rCall _write_lcd                                         'put it on LCD
End
```

$LCDPUTCTRL

Action

Specifies that LCD control output must be redirected.

Syntax

$LCDPUTCTRL = label

Remarks

Label	The name of the assembler routine that must be called when a control byte is printed with the LCD statement. The character must be placed in register R24.

With the redirection of the LCD statement, you can use your own routines.

See also

$LCDPUTDATA

Example

```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

'dimension used variables
Dim S AsString* 10
```

```
Dim W AsLong

'inform the compiler which routine must be called to get serial 'characters
$lcdputdata= Myoutput
$lcdputctrl= Myoutputctrl
'make a never ending loop
Do
  Lcd "test"
Loop

End

'custom character handling routine
'instead of saving and restoring only the used registers
'and write full ASM code, we use Pushall and PopAll to save and 'restore
'all registers so we can use all BASIC statements
'$LCDPUTDATA requires that the character is passed in R24

Myoutput:
  Pushall                                                    'save all registers
   'your code here
  Popall                                                     'restore registers
Return

MyoutputCtrl:
  Pushall                                                    'save all registers
   'your code here
  Popall                                                     'restore registers
Return
```

$LCDPUTDATA

Action
Specifies that LCD data output must be redirected.

Syntax
$LCDPUTDATA = label

Remarks

Label	The name of the assembler routine that must be called when a character is printed with the LCD statement. The character must be placed in R24.

With the redirection of the LCD statement, you can use your own routines.

See also
$LCDPUTCTRL

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
```

```
'dimension used variables
Dim S AsString* 10
Dim W AsLong

'inform the compiler which routine must be called to get serial 'characters
$lcdputdata= Myoutput
$lcdputctrl= Myoutputctrl
'make a never ending loop
Do
  Lcd "test"
Loop

End

'custom character handling routine
'instead of saving and restoring only the used registers
'and write full ASM code, we use Pushall and PopAll to save and 'restore
'all registers so we can use all BASIC statements
'$LCDPUTDATA requires that the character is passed in R24

Myoutput:
  Pushall                                                    'save all registers
   'your code here
  Popall                                                     'restore registers
Return

MyoutputCtrl:
  Pushall                                                    'save all registers
   'your code here
  Popall                                                     'restore registers
Return
```

$LCDRS

Action

Instruct the compiler to generate code for 8-bit LCD displays attached to the data bus.

Syntax

$LCDRS = [&H]address

Remarks

Address	The address where must be written to, to enable the LCD display. The db0-db7 lines of the LCD must be connected to the data lines D0-D7. (or is 4 bit mode, connect only D4-D7) On systems with external RAM, it makes more sense to attach the LCD to the data bus. With an address decoder, you can select the LCD display.

See also

$LCD , CONFIG LCDBUS

Example

```
'-----------------------------------------------------------------
'                 (c) 1995-2005 MCS Electronics
'-----------------------------------------------------------------
'  file: LCD.BAS
'  demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR, HOME
'        CURSOR, DISPLAY
'-----------------------------------------------------------------

'note : tested in bus mode with 4-bit on the STK200
'LCD   -   STK200
'-------------------
'D4          D4
'D5          D5
'D6          D6
'D7          D7
'WR          WR
'E           E
'RS          RS
'+5V         +5V
'GND         GND
'V0          V0
'   D0-D3 are not connected since 4 bit bus mode is used!


'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Rem with the config lcdpin statement you can override the compiler settings

$regfile = "8515def.dat"
$lcd = &HC000
$lcdrs = &H8000
Config Lcdbus = 4

Dim A As Byte
Config Lcd = 16 * 2                                          'configure lcd
screen
'other options are 16 * 2 , 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                          'clear the LCD
display
Lcd "Hello world."                                           'display this at
the top line
Wait 1
Lowerline                                                    'select the lower
line
Wait 1
Lcd "Shift this."                                            'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                            'shift the text to
the right
   Wait 1                                                    'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                             'shift the text to
the left
```

```
   Wait 1                                                    'wait a moment
Next

Locate 2 , 1                                                 'set cursor
position
Lcd "*"                                                      'display this
Wait 1                                                       'wait a moment

Shiftcursor Right                                            'shift the cursor
Lcd "@"                                                      'display this
Wait 1                                                       'wait a moment

Home Upper                                                   'select line 1 and
return home
Lcd "Replaced."                                              'replace the text
Wait 1                                                       'wait a moment

Cursor Off Noblink                                           'hide cursor
Wait 1                                                       'wait a moment
Cursor On Blink                                              'show cursor
Wait 1                                                       'wait a moment
Display Off                                                  'turn display off
Wait 1                                                       'wait a moment
Display On                                                   'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                   'goto home on line
three
Home Fourth
Home F                                                       'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                          'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                          'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                   'value into ACC
!rCall _write_lcd                                            'put it on LCD
End
```

$LCDVFO

Action

Instruct the compiler to generate very short Enable pulse for VFO displays.

Syntax
$LCDVFO

Remarks
VFO based displays need a very short Enable pulse. Normal LCD displays need a longer pulse. To support VFO displays this compiler directive has been added.

The display need to be instruction compatible with normal HD44780 based text displays. Noritake is the biggest manufactor of VFO displays.

The $LCDVFO directive is intended to be used in combination with the LCD routines.

ASM
NONE

See also
NONE

Example
NONE

$LIB

Action
Informs the compiler about the used libraries.

Syntax
$LIB "libname1" [, "libname2"]

Remarks
Libname1 is the name of the library that holds ASM routines that are used by your program. More filenames can be specified by separating the names by a comma.

The specified libraries will be searched when you specify the routines to use with the $EXTERNAL directive.

The search order is the same as the order you specify the library names.

The MCS.LBX will be searched last and is always included so you don't need to specify it with the $LIB directive.

Because the MCS.LBX is searched last you can include duplicate routines in your own library. These routines will be used instead of the ones from the default MCS.LBX library. This is a good way when you want to enhance the MCS.LBX routines. Just copy the MCS.LIB to a new file and make the changes in this new file. When we make changes to the library your changes will be preserved.

Creating your own LIB file

A library file is a simple ASCII file. It can be created with the BASCOM editor, notepad or any other ASCII editor.
When you use BASCOM, make sure that the LIB extension is added to the Options, Environment, Editor, "No reformat extension".
This will prevent the editor to reformat the LIB file when you open it.

The file must include the following header information. It is not used yet but will be later.
copyright = Your name
www = optional location where people can find the latest source
email = your email address
comment = AVR compiler library
libversion = the version of the library in the format : 1.00
date = date of last modification
statement = A statement with copyright and usage information

The routine must start with the name in brackets and must end with the [END].

The following ASM routine example is from the MYLIB.LIB library.

```
[test]

Test:

ldd r26,y+2 ; load address of X

ldd r27,y+3

ld r24,x ; get value into r24

Inc r24 ; value + 1

St x,r24 ; put back

ldd r26,y+0 ; address pf Y

ldd r27,y+1

st x,r24 ; store

ret ; ready

[END]
```

After you have saved your library in the **LIB** subdirectory you must compile it with the LIB Manager. Or you can include it with the LIB extension in which case you don't have to compile it.

About the assembler.

When you reference constants that are declared in your basic program you need to put a star(*) before the line.

```
'basic program
```

```
CONST myconst = 7


'asm lib

* sbi portb, myconst
```

By adding the *, the line will be compiled when the basic program is compiled. It will not be changed into object code in the LBX file.
When you use constants you need to use valid BASIC constants:

```
Ldi r24,12
Ldi r24, 1+1
Ldi r24, &B001
Ldi r24,0b001
Ldi r24,&HFF
Ldi r24,$FF
Ldi r24,0xFF
```

Other syntax is NOT supported.

See also
$EXTERNAL

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


'In order to let this work you must put the mylib.lib file in the LIB dir
'And compile it to a LBX
'-----------------------------------------------------------------------
'define the used library
$lib"mylib.lbx"
'you can also use the original ASM :
'$LIB "mylib.LIB"

'also define the used routines
$external Test

'this is needed so the parameters will be placed correct on the stack
Declare Sub Test(byval X Asbyte , Y Asbyte)


'reserve some space
Dim Z As Byte


'call our own sub routine
Call Test(1 , Z)

'z will be 2 in the used example
End
```

$LOADER

Action
Instruct the compiler to create a bootloader at the specified address.

Syntax
$LOADER = address

Remarks

address	The address where the bootloader is located. You can find this address in the datasheet.

Most AVR chips have a so called boot section. Normally a chip will start at address 0 when it resets. This is also called the reset vector.
Chips that have a bootsection, split the flash memory in two parts. The bootsection is a small part of the normal flash and by setting a fusebit you select that the chip runs code at the bootsector when it resets instead of the normal reset vector.
Some chips also have fusebits to select the size of the bootloader.

The MCS bootloader sample is a serial bootloader that uses the serial port. It uses the X-modem checksum protocol to receive the data. Most terminal emulators can send X-modem checksum.

The sample is written so it supports all chips with a bootsection. You need to do the following :

- indentify the $regfile directive for your chip
- un-remark the line and the line with the CONST that is used for conditional compilation
- remark all other $regfile lines and CONST lines.
- compile the file
- program the chip
- set the fusebit so reset is pointed to the bootloader
- set the fusebit so the bootsize is 1024 words
- select the MCS Bootloader programmer.

The bootloader is written to work at a baudrate of 57600. This works for most chips that use the internal oscillator. But it is best to check it first with a simple program. When you use a crystal you might even use a higher speed.
Do not forget that the MCS bootloader must be set to the same baud rate as the bootloader program.

Now make a new test program and compile it. Press F4 to start the MCS bootloader. You now need to reset the chip so that it will start the bootloader section. The bootloader will send a byte with value of 123 and the bascom bootloader receives this and thus starts the loader process.

There will be a stand alone bootloader available too. And the sample will be extended to support other AVR chips with bootsection too.

There is a $BOOT directive too. It is advised to use $LOADER as it allows you to write the bootloader in BASIC.

You can not use interrupts in your bootloader program as the interrupts will point to the reset vector which is located in the lower section of the flash. When you start to writing pages, you overwrite this part.

See also

$BOOT , $LOADERSIZE

Example

```
'-----------------------------------------------------------------
'                          (c) 1995-2005, MCS
'                        Bootloader.bas
'  This sample demonstrates how you can write your own bootloader
'  in BASCOM BASIC
'-----------------------------------------------------------------
'This sample will be extended to support other chips with bootloader
'The loader is supported from the IDE

'$regfile = "m88def.dat"
'Const Loader = 88

'$regfile = "m32def.dat"
'Const Loaderchip = 32


'$regfile = "m88def.dat"
'Const Loaderchip = 88

$regfile = "m162def.dat"
Const Loaderchip = 162


#if Loaderchip = 88                                          'Mega88
    $loader = $c00                                          'this address you
can find in the datasheet
    'the loader address is the same as the boot vector address
    Const Maxwordbit = 5
    Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0
#endif
#if Loaderchip = 32                                          ' Mega32
    $loader = $3c00                                         ' 1024 words
    Const Maxwordbit = 6                                    'Z6 is maximum bit
                          '
    Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0
#endif
#if Loaderchip = 8                                           ' Mega8
    $loader = $c00                                          ' 1024 words
    Const Maxwordbit = 5                                    'Z5 is maximum bit
                          '
    Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0
#endif
#if Loaderchip = 161                                         ' Mega161
    $loader = $1e00                                         ' 1024 words
    Const Maxwordbit = 6                                    'Z5 is maximum bit
                          '
#endif
```

```
#if Loaderchip = 162                                        ' Mega162
    $loader = $1c00                                         ' 1024 words
    Const Maxwordbit = 6                                    'Z5 is maximum bit
                          '
    Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 ,
Databits = 8 , Clockpol = 0
#endif



Const Maxword =(2 ^ Maxwordbit) * 2                         '128
Const Maxwordshift = Maxwordbit + 1


$crystal = 8000000
'$crystal = 14745600
$baud = 57600                                               'this loader uses
serial com
'It is VERY IMPORTANT that the baud rate matches the one of the boot loader

'do not try to use buffered com as we can not use interrupts

'Dim the used variables
Dim Bstatus As Byte , Bretries As Byte , Bblock As Byte , Bblocklocal As Byte
Dim Bcsum1 As Byte , Bcsum2 As Byte , Buf(128) As Byte , Csum As Byte
Dim J As Byte , Spmcrval As Byte                            ' self program
command byte value

Dim Z As Word                                               'this is the Z
pointer word
Dim Vl As Byte , Vh As Byte                                 ' these bytes are
used for the data values
Dim Wrd As Byte , Page As Byte                              'these vars contain
the page and word address
'Mega 88 : 32 words, 128 pages



Disable Interrupts                                          'we do not use ints


Waitms 1000                                                 'wait 1 sec
'We start with receiving a file. The PC must send this binary file

'some constants used in serial com
Const Nak = &H15
Const Ack = &H06
Const Can = &H18

'we use some leds as indication in this sample , you might want to remove it
Config Portb = Output
Portb = 255                                                 'the stk200 has
inverted logic for the leds

'$timeout = 1000000                                          'we use a timeout
$timeout = 1000000                                          'we use a timeout

'Do
  Bstatus = Waitkey()                                       'wait for the
loader to send a byte
  Print Chr(bstatus);
  If Bstatus = 123 Then                                     'did we received
value 123 ?
     Goto Loader
  End If
'Loop
```

```
For J = 1 To 10                                             'this is a simple
indication that we start the normal reset vector
   Toggle Portb : Waitms 100
Next

Goto _reset                                                 'goto the normal
reset vector at address 0


'this is the loader routine. It is a Xmodem-checksum reception routine
Loader:
For J = 1 To 3                                              'this is a simple
indication that we start the normal reset vector
   Toggle Portb : Waitms 500
Next

Spmcrval = 3 : Gosub Do_spm                                 ' erase  the first
page
Spmcrval = 17 : Gosub Do_spm                                ' re-enable page


Bretries = 10                                               'number of retries
Do
  Csum = 0                                                  'checksum is 0 when
we start
  Print Chr(nak);                                           ' firt time send a
nack
  Do
    Bstatus = Waitkey()                                     'wait for statuse
byte
    Select Case Bstatus
       Case 1:                                              ' start of heading,
PC is ready to send
            Incr Bblocklocal                                'increase local
block count
            Csum = 1                                        'checksum is 1
            Bblock = Waitkey() : Csum = Csum + Bblock       'get block
            Bcsum1 = Waitkey() : Csum = Csum + Bcsum1       'get checksum first
byte
            For J = 1 To 128                                'get 128 bytes
              Buf(j) = Waitkey() : Csum = Csum + Buf(j)
            Next
            Bcsum2 = Waitkey()                              'get second
checksum byte
            If Bblocklocal = Bblock Then                    'are the blocks the
same?
               If Bcsum2 = Csum Then                        'is the checksum
the same?
                  Gosub Writepage                           'yes go write the
page
                  Print Chr(ack);                           'acknowledge
               Else                                         'no match so send
nak
                  Print Chr(nak);
               End If
            Else
               Print Chr(nak);                              'blocks do not
match
            End If
       Case 4:                                              ' end of
transmission , file is transmitted
             Print Chr(ack);                                ' send ack and
ready

             Portb.3 = 0                                    ' simple indication
```

```
that we are finished and ok
            Goto _reset                                   ' start new program
       Case &H18:                                         ' PC aborts
transmission
            Goto _reset                                   ' ready

       Case Else
          Exit Do                                         ' no valid data
    End Select
  Loop
  If Bretries > 0 Then                                    'attempte left?
     Waitms 1000
     Decr Bretries                                        'decrease attempts
  Else
     Goto _reset                                          'reset chip
  End If
Loop



'write one or more pages
Writepage:
   For J = 1 To 128 Step 2                                'we write 2 bytes
into a page
      Vl = Buf(j) : Vh = Buf(j + 1)                       'get Low and High
bytes
      lds r0, {vl}                                        'store them into r0
and r1 registers
      lds r1, {vh}
      Spmcrval = 1 : Gosub Do_spm                         'write value into
page at word address
      Wrd = Wrd + 2                                       ' word address
increases with 2 because LS bit of Z is not used
      If Wrd = Maxword Then                               ' page is full
          Wrd = 0                                         'Z pointer needs
wrd to be 0
          Spmcrval = 5 : Gosub Do_spm                     'write page
          Page = Page + 1                                 'next page
          Spmcrval = 3 : Gosub Do_spm                     ' erase  next page
          Spmcrval = 17 : Gosub Do_spm                    ' re-enable page
      End If
   Next
   Toggle Portb.2 : Waitms 10 : Toggle Portb.2            'indication that we
write
Return


Do_spm:
  Bitwait Spmcsr.selfprgen , Reset                        ' check for
previous SPM complete
  Bitwait Eecr.eepe , Reset                               'wait for eeprom

  Z = Page                                                'make equal to page
  Shift Z , Left , Maxwordshift                           'shift to proper
place
  Z = Z + Wrd                                             'add word
  lds r30,{Z}
  lds r31,{Z+1}

  Spmcsr = Spmcrval                                       'assign register
  spm                                                     'this is an asm
instruction
  nop
  nop
Return
```

```
'How you need to use this program:
'1- compile this program
'2- program into chip with sample elctronics programmer
'3- select MCS Bootloader from programmers
'4- compile a new program for example M88.bas
'5- press F4 and reset your micro
' the program will now be uploaded into the chip with Xmodem Checksum
' you can write your own loader. And we will release a command line loader in
the future
```

$LOADERSIZE

Action
Instruct the compiler that a boot loader is used so it will not overwrite the boot space.

Syntax
$LOADERSIZE = size

Remarks

size	The amount of space that is used by the boot loader.

When you use a boot loader it will use space from the available flash memory. The compiler does not know if you use a boot loader or not. When your program exceeds the available space and runs into the boot sector space, it will overwrite the boot loader.
The $loadersize directive will take the boot loader size into account so you will get an error when the target file gets too big.

When you select the MCS bootloader as programmer the IDE also will take into account the specified boot loader size.
The directive can be used when you have a different programmer selected. For example an external programmer that does not know about the boot size.

See also
$LOADER

ASM
NONE

Example
NONE

$MAP

Action
Will generate label info in the report.

Syntax

$MAP

Remarks
The $MAP directive will put an entry for each line number with the address into the report file. This info can be used for debugging purposes with other tools.

See also
NONE

ASM
NONE

Example
$MAP

The report file will not contain the following section :

Code map

Line	Address(hex)
1	0
9	36
26	39
30	3B
31	3E
32	48
33	4B
36	50
37	56
42	5B
43	6C
44	7D
45	80
46	81

$NOINIT

Action
Instruct the compiler to generate code without initialization code.

Syntax
$NOINIT

Remarks

$NOINIT is only needed in rare situations. It will instruct the compiler not to add initialization code. But that means that you need to write your own code then.
$NOINIT was added in order to support boot loaders. But the new $LOADER directive can better be used as it does not require special ASM knowledge.

See also
$LOADER

Example

$NORAMCLEAR

Action
Instruct the compiler to not generate initial RAM clear code.

Syntax
$NORAMCLEAR

Remarks
Normally the SRAM is cleared in the initialization code. When you don't want the SRAM to be cleared(set to 0) you can use this directive.

Because all variables are automatically set to 0 or ""(strings) without the $NORAMCLEAR, using $NORAMCLEAR will set the variables to an unknown value. That is, the variables will probably set to FF but you cannot count on it.

When you have a battery back upped circuit, you do not want to clear the RAM at start up. So that would be a situation when you could use $NORAMCLEAR.

See also
$NOINIT

$PROG

Action
Directive to auto program the lock and fuse bits.

Syntax
$PROG LB, FB , FBH , FBX

Remarks
While the lock and fuse bits make the AVR customizable, the settings for your project can

give some problems.
The $PROG directive will create a file with the project name and the PRG extension.

Every time you program the chip, it will check the lock and fuse bit settings and will change them if needed.
So in a new chip, the lock and fuse bits will be set automatically. A chip that has been programmed with the desired settings will not be changed.

The programmer has an option to create the PRG file from the current chip settings.

The LB, FH, FBH and FBX values are stored in hexadecimal format in the PRJ file.
You may use any notation as long as it is a numeric constant.

Some chips might not have a setting for FBH or FBX, or you might not want to set all values. In that case, do NOT specify the value. For example:

$PROG &H20 ,,,

This will only write the Lockbit settings.

$PROG ,,&H30,

This will only write the FBH settings.

LB	Lockbit settings
FB	Fusebit settings
FBH	Fusebit High settings
FBX	Extended Fusebit settings

Sometimes the data sheet refers to the Fusebit as the Fusebit Low settings.

The $PROG setting is only supported by the AVRISP, STK200/300, Sample Electronics and Universal MCS Programmer Interface. The USB-ISP programmer also supports the $PROG directive.

When you select the wrong Fuse bit, you could lock your chip. For example when you choose the wrong oscillator option, it could mean that the micro expects an external crystal oscillator. But when you connect a simple crystal, it will not work.
In these cases where you can not communicate with the micro anymore, the advise is to apply a clock signal to X1 input of the micro.
You can then select the proper fusebits again.
When you set the Lockbits, you can not read the chip content anymore. Only after erasing the chip, it could be reprogrammed again.

Once the lockbits and fuse bits are set, it is best to remark the $PROG directive. This because it takes more time to read and compare the bits every time.

See also
Programmers , $PROG

$PROGRAMMER

Action
Will set the programmer from the source code.

Syntax
$PROGRAMMER = number

Remarks

Number	A numeric constant that identifies the programmer.

The $PROGRAMMER directive will set the programmer just before it starts programming. When you press F4 to program a chip, the selected programmer will be made active. This is convenient when you have different project open and use different programmers.
But it can also lead to frustration as you might think that you have the 'STK200' selected, and the directive will set it to USB-ISP.

The following values can be used :

Value	Programmer
0	AVR-ISP programmer(old AN 910)
1	STK200/STK300
2	PG302
3	External programmer
4	Sample Electronics
5	Eddie Mc Mullen
6	KITSRUS K122
7	STK500
8	Universal MCS Interface
9	STK500 extended
10	Lawicel Bootloader
11	MCS USB
12	USB-ISP I
13	MCS Bootloader

See also
$PROG

ASM
NONE

Example
```
$REGFILE
```

$REGFILE

Action
Instruct the compiler to use the specified register file instead of the selected dat file.

Syntax
$REGFILE = "name"

Remarks

Name	The name of the register file. The register files are stored in the BASCOM-AVR application directory and they all have the DAT extension. The register file holds information about the chip such as the internal registers and interrupt addresses. The register file info is derived from atmel defenition files.

The $REGFILE statement overrides the setting from the Options, Compiler, Chip menu.
The settings are stored in a <project>.CFG file.

The $REGFILE directive must be the first statement in your program. It may not be put into an included file since only the main source file is checked for the $REGFILE directive.

It is good practice to use the $REGFILE directive. It has the advantage that you can see at the source which chip it was written for.

The register files contain the hardware register names from the micro. They also contain the bit names. These are constants that you may use in your program. But the names can not be used to dim a variable for example.

Example :
DIM PORTA As Byte
This will not work as PORTA is a register constant.

See also
$SWSTACK , $HWSTACK , $FRAMESIZE

ASM
NONE

Example
$REGFILE = "8515DEF.DAT"

$ROMSTART

Action
Instruct the compiler to generate a hex file that starts at the specified address.

Syntax
$ROMSTART = address

Remarks

Address	The address where the code must start. By default the first address is 0. The bin file will still begin at address 0.

The $ROMFILE could be used to locate code at a different address for example for a boot loader.

It is best to use the new $LOADER directive to add boot loader support.

See also
$LOADER

ASM
NONE

Example
```
$ROMSTART = &H4000
```

$SERIALINPUT

Action
Specifies that serial input must be redirected.

Syntax
$SERIALINPUT = label

Remarks

Label	The name of the assembler routine that must be called when a character is needed by the INPUT routine. The character must be returned in R24.

With the redirection of the INPUT command, you can use your own input routines.

This way you can use other devices as input devices.
Note that the INPUT statement is terminated when a RETURN code (13) is received.

By default when you use INPUT or INKEY(), the compiler will expect data from the COM port. When you want to use a keyboard or remote control as the input device you can write a custom routine that puts the data into register R24 once it needs this data.

See also
$SERIALOUTPUT

Example
```
'------------------------------------------------------------------------------
--
'name                     : $serialinput.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates $SERIALINPUT redirection of serial
input
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'------------------------------------------------------------------------------
--

$regfile = "m48def.dat"

'define used crystal
$crystal = 4000000

$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              'default use 10 for
the SW stack
$framesize = 40                                            'default use 40 for
the frame space

'dimension used variables
Dim S As String * 10
Dim W As Long

'inform the compiler which routine must be called to get serial characters
$serialinput = Myinput

'make a never ending loop
Do
  'ask for name
  Input "name " , S
  Print S
  'error is set on time out
  Print "Error " ; Err
Loop

End

'custom character handling  routine
'instead of saving and restoring only the used registers
'and write full ASM code, we use Pushall and PopAll to save and restore
'all registers so we can use all BASIC statements
'$SERIALINPUT requires that the character is passed back in R24
Myinput:
  Pushall                                                  'save all registers
  W = 0                                                    'reset counter
Myinput1:
   Incr W                                                  'increase counter
   Sbis USR, 7                                             ' Wait for
character
   Rjmp myinput2                                           'no charac waiting
so check again
   Popall                                                  'we got something
   Err = 0                                                 'reset error
   In _temp1, UDR                                          ' Read character
from UART
```

```
   Return                                                    'end of routine
Myinput2:
   If W > 1000000 Then                                       'with 4 MHz ca 10
sec delay
      rjmp Myinput_exit                                      'waited too long
   Else
      Goto Myinput1                                          'try again
   End If
Myinput_exit:
  Popall                                                     'restore registers
  Err = 1                                                    'set error variable
  ldi R24, 13                                                'fake enter so
INPUT will end
Return
```

$SERIALINPUT1

Action
Specifies that serial input of the second UART must be redirected.

Syntax
$SERIALINPUT1 = label

Remarks

Label	The name of the assembler routine that must be called when a character is needed from the INPUT routine. The character must be returned in R24.

With the redirection of the INPUT command, you can use your own input routines.

This way you can use other devices as input devices.
Note that the INPUT statement is terminated when a RETURN code (13) is received.

By default when you use INPUT or INKEY(), the compiler will expect data from the COM2 port. When you want to use a keyboard or remote control as the input device you can write a custom routine that puts the data into register R24 once it asks for this data.

See also
$SERIALOUTPUT1 , $SERIALINPUT , $SERIALOUTPUT

Example
See the $SERIALINPUT sample

$SERIALINPUT2LCD

Action
This compiler directive will redirect all serial input to the LCD display instead of echo-ing to the serial port.

Syntax
$SERIALINPUT2LCD

Remarks
You can also write your own custom input or output driver with the $SERIALINPUT and $SERIALOUTPUT statements, but the $SERIALINPUT2LCD is handy when you use a LCD display. By adding only this directive, you can view all output form routines such as PRINT, PRINTBIN, on the LCD display.

See also
$SERIALINPUT , $SERIALOUTPUT , $SERIALINPUT1 , $SERIALOUTPUT1

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Config Lcdpin = Pin , Db4 = Portb.4 , Db5 = Portb.5 , Db6 = Portb.6 , Db7 =
Portb.7 , E = Portc.7 , Rs = Portc.6

$serialinput2lcd
Dim V As Byte
Do
  Cls
  Input "Number " , V                                    'this will go to
the LCD display
Loop
```

$SERIALOUTPUT

Action
Specifies that serial output must be redirected.

Syntax
$SERIALOUTPUT = label

Remarks

Label	The name of the assembler routine that must be called when a character is send to the serial buffer (UDR). The character is placed into R24.

With the redirection of the PRINT and other serial output related commands, you can use your own routines.
This way you can use other devices as output devices.

See also

$SERIALINPUT , $SERIALINPUT2LCD , $SERIALINPUT1 , $SERIALOUTPUT1

Example

```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

$serialoutput = Myoutput
'your program goes here
Do
  Print "Hello"
Loop
End

myoutput:
'perform the needed actions here
'the data arrives in R24
'just set the output to PORTB
  !outportb,r24
ret
```

$SERIALOUTPUT1

Action

Specifies that serial output of the second UART must be redirected.

Syntax

$SERIALOUTPUT1 = label

Remarks

Label	The name of the assembler routine that must be called when a character is send to the serial buffer (UDR1). The character is placed into R24.

With the redirection of the PRINT and other serial output related commands, you can use your own routines.
This way you can use other devices as output devices.

See also

$SERIALINPUT1 , $SERIALINPUT , $SERIALINPUT2LCD , $SERIALOUTPUT

Example

See the $SERIALOUTPUT example

$SIM

Action
Instructs the compiler to generate empty wait loops for the WAIT and WAITMS statements. This to allow faster simulation.

Syntax
$SIM

Remarks
Simulation of a WAIT statement can take a long time especially when memory view windows are opened.
The $SIM compiler directive instructs the compiler to not generate code for WAITMS and WAIT. This will of course allows faster simulation.

When your application is ready you must remark the $SIM directive or otherwise the WAIT and WAITMS statements will not work as expected.
When you forget to remove the $SIM option and you try to program a chip you will receive a warning that $SIM was used.

See also
NONE

ASM
NONE

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

$sim
Do
  Wait 1
  Print "Hello"
Loop
```

$SWSTACK

Action
Sets the available space for the software stack.

Syntax
$SWSTACK = var

Remarks

Var	A numeric decimal value.

While you can configure the SW Stack in Options, Compiler, Chip, it is good practice to put the value into your code. This way you do no need the cfg(configuration) file.

The $SWSTACK directive overrides the value from the IDE Options.

It is important that the $SWSTACK directive occurs in your main project file. It may not be included in an $include file as only the main file is parsed for $SWSTACK

See also
$HWSTACK , $FRAMESIZE

Example
```
'-----------------------------------------------------------------------------
--
'name                     : adc.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of GETADC() function for 8535 or M163
micro
'micro                    : Mega163
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space
```

$TIMEOUT

Action
Enable timeout on the hardware UART 0 and UART1.

Syntax
$TIMEOUT = value

Remarks

Value	A constant that fits into a LONG , indicating how much time must be waited before the waiting is terminated.

All RS-232 serial statements and functions(except INKEY) that use the HW UART, will halt the

program until a character is received. Only with buffered serial input you can process your main program while the buffer received data on the background.

$TIMEOUT is an alternative for normal serial reception. It is not intended to be used with buffered serial reception.

When you assign a constant to $TIMEOUT, you actual assign a value to the internal created value named ___*TIMEOUT*.

This value will be decremented in the routine that waits for serial data. When it reaches zero, it will terminate.

So the bigger the value, the longer the wait time before the timeout occurs. The timeout is not in seconds or microseconds, it is a relative number. Only the speed of the oscillator has effect on the duration. And the value of the number of course.

When the time out is reached, a zero/null will be returned to the calling routine. Waitkey() will return 0 when used with a byte. When you use INPUT with a string, the timeout will be set for every character. So when 5 characters are expected, and they arrive just before the timeout value is reached, it may take a long time until the code is executed.

When the timeout occurs on the first character, it will return much faster.

When you already sent data, this data will be returned. For example, "123" was sent but a RETURN was never sent, INPUT will return "123". While without the $TIMEOUT, INPUT will not return until a RETURN is received.

When you activate $TIMEOUT, and your micro has two UARTS(Mega128 for example) it will be active for both UART0 and UART1.

See Also

INPUT , WAITKEY

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : timeout.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of the $timeout option
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'most serial communication functions and routines wait until a character
```

```
'or end of line is received.
'This blocks execution of your program. SOmething you can change by using
buffered input
'There is also another option : using a timeout
'$timeout Does Not Work With Buffered Serial Input


Dim Sname As String * 10
Dim B As Byte
Do
   $timeout = 1000000
   Input "Name : " , Sname
   Print "Hello " ; Sname

   $timeout = 5000000
   Input "Name : " , Sname
   Print "Hello " ; Sname

Loop

'you can re-configure $timeout
```

$TINY

Action
Instruct the compiler to generate initialize code without setting up the stacks.

Syntax
$TINY

Remarks
The tiny11 for example is a powerful chip. It only does not have SRAM. BASCOM depends on SRAM for the hardware stack and software stack.
When you like to program in ASM you can use BASCOM with the $TINY directive.

Some BASCOM statements will also already work but the biggest part will not work.
A future version will support a subset of the BASCOM statements and function to be used with the chips without SRAM.

Note that the generated code is not yet optimized for the tiny parts. Some used ASM statements for example will not work because the chip does not support it.

See also
NONE

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                         : tiny15.bas
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrate using ATtiny15
'micro                    : Tiny15
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
-----------

$regfile = "at15def.dat"                                    ' specify the used
micro
$crystal = 1000000                                          ' used crystal
frequency

$tiny
$noramclear
Dim A As Iram Byte
Dim B As Iram Byte
A = 100 : B = 5
A = A + B
nop
```

$WAITSTATE

Action
Compiler directive to activate external SRAM and to insert a WAIT STATE for a slower ALE signal.

Syntax
$WAITSTATE

Remarks
The $WAITSTATE can be used to override the Compiler Chip Options setting.
Wait states are needed for slow external components that can not handle the fast ALE signal from the AVR chip.

See also
$XA

Example
$WAITSTATE

$XA

Action
Compiler directive to activate external memory access.

Syntax
$XA

Remarks
The $XA directive can be used to override the Compiler Chip Options setting.
This way you can store the setting in your program code. It is strongly advised to do this.

See also
$WAITSTATE

Example
$XA

$XRAMSIZE

Action
Specifies the size of the external RAM memory.

Syntax
$XRAMSIZE = [&H] size

Remarks

Size	A constant with the size of the external RAM memory chip.

The size of the chip can be selected from the Options Compiler Chip menu.
The $XRAMSIZE overrides this setting. It is important that $XRAMSTART precedes $XRAMSIZE

See also
$XRAMSTART

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : m128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrate using $XRAM directive
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 1000000                                          ' used crystal
frequency
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
```

```
for the frame space

$xramstart = &H1000

$xramsize = &H1000
Dim X As X
```

$XRAMSTART

Action
Specifies the location of the external RAM memory.

Syntax
$XRAMSTART = [&H]address

Remarks

Address	The (hex)-address where the data is stored. Or the lowest address that enables the RAM chip. You can use this option when you want to run your code in systems with external RAM memory. Address must be a constant.

By default the extended RAM will start after the internal memory so the lower addresses of the external RAM can't be used to store information.

When you want to protect an area of the chip, you can specify a higher address for the compiler to store the data. For example, you can specify &H400. The first dimensioned variable will be placed in address &H400 and not in &H260.

It is important that when you use $XRAMSTART and $XRAMSIZE that $XRAMSTART comes before $XRAMSIZE.

See also
$XRAMSIZE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : m128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrate using $XRAM directive
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 1000000                                          ' used crystal
frequency
$hwstack = 32                                               ' default use 32
```

```
for the hardware stack
$swstack = 10                                                    ' default use 10
for the SW stack
$framesize = 40                                                  ' default use 40
for the frame space

$xramstart = &H1000

$xramsize = &H1000
Dim X As X
```

1WIRECOUNT

Action

This statement reads the number of 1wire devices attached to the bus.

Syntax

var2 = **1WIRECOUNT**()
var2 = **1WIRECOUNT**(port , pin)

Remarks

var2	A WORD variable that is assigned with the number of devices on the bus.
port	The PIN port name like PINB or PIND.
pin	The pin number of the port. In the range from 0-7. May be a numeric constant or variable.

The variable must be of the type word or integer.
You can use the 1wirecount() function to know how many times the 1wsearchNext() function should be called to get all the Id's on the bus.

The 1wirecount function will take 4 bytes of SRAM.

___1w_bitstorage , Byte used for bit storage :
lastdeviceflag bit 0
id_bit bit 1
cmp_id_bit bit 2
search_dir bit 3
___1wid_bit_number, Byte
___1wlast_zero, Byte
___1wlast_discrepancy , Byte

ASM

The following asm routines are called from mcs.lib.

_1wire_Count : (calls _1WIRE, _1WIRE_SEARCH_FIRST , _1WIRE_SEARCH_NEXT)

Parameters passed : R24 : pin number, R30 : port , Y+0,Y+1 : 2 bytes of soft stack, X : pointer to the frame space

Returns Y+0 and Y+1 with the value of the count. This is assigned to the target variable.

See also

1WWRITE , 1WRESET , 1WREAD , 1WSEARCHFIRST, 1WSEARCHNEXT , Using the 1wire protocol

Example

```
'-----------------------------------------------------------------------------
'name                     : 1wireSearch.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wsearch
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space

Config 1wire = Portb.0                                      'use this pin
'On the STK200 jumper B.0 must be inserted

'The following internal bytes are used by the scan routines
'___1w_bitstorage , Byte used for bit storage :
'      lastdeviceflag bit 0
'      id_bit         bit 1
'      cmp_id_bit     bit 2
'      search_dir     bit 3
'___1wid_bit_number, Byte
'___1wlast_zero,  Byte
'___1wlast_discrepancy , Byte
'___1wire_data , string * 7 (8 bytes)

'[DIM variables used]
'we need some space from at least 8 bytes to store the ID
Dim Reg_no(8) As Byte

'we need a loop counter and a word/integer for counting the ID's on the bus
Dim I As Byte , W As Word

'Now search for the first device on the bus
Reg_no(1) = 1wsearchfirst()

For I = 1 To 8                                              'print the number
    Print Hex(reg_no(i));
Next
Print

Do
  'Now search for other devices
  Reg_no(1) = 1wsearchnext()
  For I = 1 To 8
     Print Hex(reg_no(i));
  Next
```

```
  Print
Loop Until Err = 1



'When ERR = 1 is returned it means that no device is found anymore
'You could also count the number of devices
W = 1wirecount()
'It is IMPORTANT that the 1wirecount function returns a word/integer
'So the result variable must be of the type word or integer
'But you may assign it to a byte or long too of course
Print W


'as a bonus the next routine :
' first fill the array with an existing number
Reg_no(1) = 1wsearchfirst()
' unremark next line to chance a byte to test the ERR flag
'Reg_no(1) = 2
'now verify if the number exists
1wverify Reg_no(1)
Print Err
'err =1 when the ID passed n reg_no() does NOT exist
' optinal call it with pinnumber line  1wverify reg_no(1),pinb,1

'As for the other 1wire statements/functions, you can provide the port and pin
number as anoption
'W = 1wirecount(pinb , 1)                                    'for example look
at pin PINB.1
End
```

1WRESET

Action

This statement brings the 1wire pin to the correct state, and sends a reset to the bus.

Syntax

1WRESET
1WRESET , PORT , PIN

Remarks

1WRESET	Reset the 1WIRE bus. The error variable ERR will return 1 if an error occurred
Port	The register name of the input port. Like PINB, PIND.
Pin	The pin number to use. In the range from 0-7. May be a numeric constant or variable.

The global variable ERR is set when an error occurs.
There is also support for multi 1-wire devices on different pins.

To use this you must specify the port and pin that is used for the communication.

The 1wreset, 1wwrite and 1wread statements will work together when used with the old syntax. And the pin can be configured from the compiler options or with the CONFIG 1WIRE statement.

The syntax for additional 1-wire devices is :

1WRESET port , pin
1WWRITE var/constant ,bytes] , port, pin
var = 1WREAD(bytes) , for the configured 1 wire pin
var = 1WREAD(bytes, port, pin) ,for reading multiple bytes

See also

1WREAD , 1WWRITE

Example

```
'-----------------------------------------------------------------------------
--
'name                     : 1wire.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wreset, 1wwrite and 1wread()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' pull-up of 4K7 required to VCC from Portb.2
' DS2401 serial button connected to Portb.2
'-----------------------------------------------------------------------------
--

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space

'when only bytes are used, use the following lib for smaller code
$lib "mcsbyte.lib"


Config 1wire = Portb.0                                      'use this pin
'On the STK200 jumper B.0 must be inserted
Dim Ar(8) As Byte , A As Byte , I As Byte


Do
  Wait 1
  1wreset                                                   'reset the device
  Print Err                                                 'print error 1 if
error
  1wwrite &H33                                              'read ROM command
  For I = 1 To 8
    Ar(i) = 1wread()                                        'place into array
  Next

'You could also read 8 bytes a time by unremarking the next line
'and by deleting the for next above
'Ar(1) = 1wread(8)                                           'read 8 bytes

  For I = 1 To 8
     Print Hex(ar(i));                                      'print output
```

```
  Next
  Print                                                    'linefeed
Loop


'NOTE THAT WHEN YOU COMPILE THIS SAMPLE THE CODE WILL RUN TO THIS POINT
'THIS because of the DO LOOP that is never terminated!!!

'New is the possibility to use more than one 1 wire bus
'The following syntax must be used:
For I = 1 To 8
  Ar(i) = 0                                                'clear array to see
that it works
Next

1wreset Pinb , 2                                           'use this port and
pin for the second device
1wwrite &H33 , 1 , Pinb , 2                                'note that now the
number of bytes must be specified!
'1wwrite Ar(1) , 5,pinb,2

'reading is also different
Ar(1) = 1wread(8 , Pinb , 2)                               'read 8 bytes from
portB on pin 2

For I = 1 To 8
  Print Hex(ar(i));
Next

'you could create a loop with a variable for the bit number !
For I = 0 To 3                                             'for pin 0-3
  1wreset Pinb , I
  1wwrite &H33 , 1 , Pinb , I
  Ar(1) = 1wread(8 , Pinb , I)
  For A = 1 To 8
    Print Hex(ar(a));
  Next
  Print
Next

End
```

1WREAD

Action

This statement reads data from the 1wire bus into a variable.

Syntax

var2 = **1WREAD**([bytes])
var2 = **1WREAD**(bytes , port , pin)

Remarks

var2	Reads a byte from the bus and places it into variable var2. Optional the number of bytes to read can be specified.
Port	The PIN port name like PINB or PIND.

Pin	The pin number of the port. In the range from 0-7. Maybe a numeric constant or variable.

Multi 1-wire devices on different pins are supported.
To use this you must specify the port pin that is used for the communication.

The 1wreset, 1wwrite and 1wread statements will work together when used with the old syntax. And the pin can be configured from the compiler options or with the CONFIG 1WIRE statement.

The syntax for additional 1-wire devices is :
1WRESET port, pin
1WWRITE var/constant , bytes, port, pin
var = 1WREAD(bytes, port, pin) for reading multiple bytes

See also
1WWRITE , 1WRESET

Example
```
'-----------------------------------------------------------------------------
'name                     : 1wire.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wreset, 1wwrite and 1wread()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' pull-up of 4K7 required to VCC from Portb.2
' DS2401 serial button connected to Portb.2
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space

'when only bytes are used, use the following lib for smaller code
$lib "mcsbyte.lib"


Config 1wire = Portb.0                                      'use this pin
'On the STK200 jumper B.0 must be inserted
Dim Ar(8) As Byte , A As Byte , I As Byte


Do
  Wait 1
  1wreset                                                   'reset the device
  Print Err                                                 'print error 1 if
error
  1wwrite &H33                                              'read ROM command
  For I = 1 To 8
```

```
    Ar(i) = 1wread()                                        'place into array
  Next

'You could also read 8 bytes a time by unremarking the next line
'and by deleting the for next above
'Ar(1) = 1wread(8)                                         'read 8 bytes

  For I = 1 To 8
     Print Hex(ar(i));                                      'print output
  Next
  Print                                                     'linefeed
Loop


'NOTE THAT WHEN YOU COMPILE THIS SAMPLE THE CODE WILL RUN TO THIS POINT
'THIS because of the DO LOOP that is never terminated!!!

'New is the possibility to use more than one 1 wire bus
'The following syntax must be used:
For I = 1 To 8
  Ar(i) = 0                                                 'clear array to see
that it works
Next

1wreset Pinb , 2                                            'use this port and
pin for the second device
1wwrite &H33 , 1 , Pinb , 2                                 'note that now the
number of bytes must be specified!
'1wwrite Ar(1) , 5,pinb,2

'reading is also different
Ar(1) = 1wread(8 , Pinb , 2)                                'read 8 bytes from
portB on pin 2

For I = 1 To 8
  Print Hex(ar(i));
Next

'you could create a loop with a variable for the bit number !
For I = 0 To 3                                              'for pin 0-3
  1wreset Pinb , I
  1wwrite &H33 , 1 , Pinb , I
  Ar(1) = 1wread(8 , Pinb , I)
  For A = 1 To 8
    Print Hex(ar(a));
  Next
  Print
Next

End
```

1WSEARCHFIRST

Action

This statement reads the first ID from the 1wire bus into a variable(array).

Syntax

var2 = **1WSEARCHFIRST**()
var2 = **1WSEARCHFIRST**(port , pin)

Remarks

var2	A variable or array that should be at least 8 bytes long that will be assigned with the 8 byte ID from the first 1wire device on the bus.
port	The PIN port name like PINB or PIND.
pin	The pin number of the port. In the range from 0-7. Maybe a numeric constant or variable.

The 1wireSearchFirst() function must be called once to initiate the ID retrieval process. After the 1wireSearchFirst() function is used you should use successive function calls to the 1wSearchNext function to retrieve other ID's on the bus.

A string can not be assigned to get the values from the bus. This because a nul may be returned as a value and the nul is also used as a string terminator.

I would advice to use a byte array as shown in the example.

The 1wirecount function will take 4 bytes of SRAM.
___1w_bitstorage , Byte used for bit storage :
lastdeviceflag bit 0
id_bit bit 1
cmp_id_bit bit 2
search_dir bit 3
___1wid_bit_number, Byte
___1wlast_zero, Byte
___1wlast_discrepancy , Byte

ASM

The following asm routines are called from mcs.lib.
_1wire_Search_First : (calls _1WIRE, _ADJUST_PIN , _ADJUST_BIT_ADDRESS)
Parameters passed : R24 : pin number, R30 : port , X : address of target array
Returns nothing.

See also

1WWRITE , 1WRESET , 1WREAD , 1WSEARCHNEXT, 1WIRECOUNT

Example

```
'-----------------------------------------------------------------------------
--
'name                    : 1wireSearch.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : demonstrates 1wsearch
'micro                   : Mega48
'suited for demo         : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
--

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                              ' default use 32
for the hardware stack
```

```
$swstack = 10                                                 'default use 10 for
the SW stack
$framesize = 40                                               'default use 40 for
the frame space

Config 1wire = Portb.0                                        'use this pin
'On the STK200 jumper B.0 must be inserted

'The following internal bytes are used by the scan routines
'___1w_bitstorage , Byte used for bit storage :
'      lastdeviceflag bit 0
'      id_bit         bit 1
'      cmp_id_bit     bit 2
'      search_dir     bit 3
'___1wid_bit_number, Byte
'___1wlast_zero,  Byte
'___1wlast_discrepancy , Byte
'___1wire_data , string * 7 (8 bytes)

'[DIM variables used]
'we need some space from at least 8 bytes to store the ID
Dim Reg_no(8) As Byte

'we need a loop counter and a word/integer for counting the ID's on the bus
Dim I As Byte , W As Word

'Now search for the first device on the bus
Reg_no(1) = 1wsearchfirst()

For I = 1 To 8                                                'print the number
    Print Hex(reg_no(i));
Next
Print

Do
  'Now search for other devices
  Reg_no(1) = 1wsearchnext()
  For I = 1 To 8
     Print Hex(reg_no(i));
  Next
  Print
Loop Until Err = 1



'When ERR = 1 is returned it means that no device is found anymore
'You could also count the number of devices
W = 1wirecount()
'It is IMPORTANT that the 1wirecount function returns a word/integer
'So the result variable must be of the type word or integer
'But you may assign it to a byte or long too of course
Print W


'as a bonus the next routine :
' first fill the array with an existing number
Reg_no(1) = 1wsearchfirst()
' unremark next line to chance a byte to test the ERR flag
'Reg_no(1) = 2
'now verify if the number exists
1wverify Reg_no(1)
Print Err
'err =1 when the ID passed n reg_no() does NOT exist
' optinal call it with pinnumber line  1wverify reg_no(1),pinb,1

'As for the other 1wire statements/functions, you can provide the port and pin
number as anoption
```

```
'W = 1wirecount(pinb , 1)                                    'for example look
at pin PINB.1
End
```

1WSEARCHNEXT

Action
This statement reads the next ID from the 1wire bus into a variable(array).

Syntax
var2 = **1WSEARCHNEXT**()
var2 = **1WSEARCHNEXT**(port , pin)

Remarks

var2	A variable or array that should be at least 8 bytes long that will be assigned with the 8 byte ID from the next 1wire device on the bus.
Port	The PIN port name like PINB or PIND.
Pin	The pin number of the port. In the range from 0-7. May be a numeric constant or variable.

The 1wireSearchFirst() function must be called once to initiate the ID retrieval process. After the 1wireSearchFirst() function is used you should use successive function calls to the 1wireSearchNext function to retrieve other ID's on the bus.

A string can not be assigned to get the values from the bus. This because a nul may be returned as a value and the nul is also used as a string terminator.

I would advice to use a byte array as shown in the example.

The 1wirecount function will take 4 bytes of SRAM.

___1w_bitstorage , Byte used for bit storage :
lastdeviceflag bit 0
id_bit bit 1
cmp_id_bit bit 2
search_dir bit 3
___1wid_bit_number, Byte
___1wlast_zero, Byte
___1wlast_discrepancy , Byte

ASM
The following asm routines are called from mcs.lib.

_1wire_Search_Next : (calls _1WIRE, _ADJUST_PIN , _ADJUST_BIT_ADDRESS)
Parameters passed : R24 : pin number, R30 : port , X : address of target array
Returns nothing.

See also

1WWRITE , 1WRESET , 1WREAD , 1WSEARCHFIRST, 1WIRECOUNT

Example

```
'-----------------------------------------------------------------------------
--
'name                     : 1wireSearch.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wsearch
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
--

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              'default use 10 for
the SW stack
$framesize = 40                                            'default use 40 for
the frame space

Config 1wire = Portb.0                                     'use this pin
'On the STK200 jumper B.0 must be inserted

'The following internal bytes are used by the scan routines
'___1w_bitstorage , Byte used for bit storage :
'      lastdeviceflag bit 0
'      id_bit         bit 1
'      cmp_id_bit     bit 2
'      search_dir     bit 3
'___1wid_bit_number, Byte
'___1wlast_zero,  Byte
'___1wlast_discrepancy , Byte
'___1wire_data , string * 7 (8 bytes)

'[DIM variables used]
'we need some space from at least 8 bytes to store the ID
Dim Reg_no(8) As Byte

'we need a loop counter and a word/integer for counting the ID's on the bus
Dim I As Byte , W As Word

'Now search for the first device on the bus
Reg_no(1) = 1wsearchfirst()

For I = 1 To 8                                             'print the number
    Print Hex(reg_no(i));
Next
Print

Do
  'Now search for other devices
  Reg_no(1) = 1wsearchnext()
  For I = 1 To 8
     Print Hex(reg_no(i));
  Next
  Print
Loop Until Err = 1
```

```
'When ERR = 1 is returned it means that no device is found anymore
'You could also count the number of devices
W = 1wirecount()
'It is IMPORTANT that the 1wirecount function returns a word/integer
'So the result variable must be of the type word or integer
'But you may assign it to a byte or long too of course
Print W


'as a bonus the next routine :
' first fill the array with an existing number
Reg_no(1) = 1wsearchfirst()
' unremark next line to chance a byte to test the ERR flag
'Reg_no(1) = 2
'now verify if the number exists
1wverify Reg_no(1)
Print Err
'err =1 when the ID passed n reg_no() does NOT exist
' optinal call it with pinnumber line  1wverify reg_no(1),pinb,1

'As for the other 1wire statements/functions, you can provide the port and pin
number as anoption
'W = 1wirecount(pinb , 1)                                    'for example look
at pin PINB.1
End
```

1WVERIFY

Action
This verifies if an ID is available on the 1wire bus.

Syntax
1WVERIFY ar(1)

Remarks

Ar(1)	A byte array that holds the ID to verify.

Returns ERR set to 0 when the ID is found on the bus otherwise it will be 1.

ASM
The following asm routines are called from mcs.lib.
_1wire_Search_Next : (calls _1WIRE, _ADJUST_PIN , _ADJUST_BIT_ADDRESS)

See also
1WWRITE , 1WRESET , 1WREAD , 1WSEARCHFIRST, 1WIRECOUNT

Example

```
'-----------------------------------------------------------------------------
--
'name                    : 1wireSearch.bas
'copyright               : (c) 1995-2005, MCS Electronics
```

```
'purpose                  : demonstrates 1wsearch
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
--

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                             ' default use 32
for the hardware stack
$swstack = 10                                             'default use 10 for
the SW stack
$framesize = 40                                           'default use 40 for
the frame space

Config 1wire = Portb.0                                    'use this pin
'On the STK200 jumper B.0 must be inserted

'The following internal bytes are used by the scan routines
'___1w_bitstorage , Byte used for bit storage :
'      lastdeviceflag bit 0
'      id_bit         bit 1
'      cmp_id_bit     bit 2
'      search_dir     bit 3
'___1wid_bit_number, Byte
'___1wlast_zero,  Byte
'___1wlast_discrepancy , Byte
'___1wire_data , string * 7 (8 bytes)

'[DIM variables used]
'we need some space from at least 8 bytes to store the ID
Dim Reg_no(8) As Byte

'we need a loop counter and a word/integer for counting the ID's on the bus
Dim I As Byte , W As Word

'Now search for the first device on the bus
Reg_no(1) = 1wsearchfirst()

For I = 1 To 8                                            'print the number
    Print Hex(reg_no(i));
Next
Print

Do
  'Now search for other devices
  Reg_no(1) = 1wsearchnext()
  For I = 1 To 8
     Print Hex(reg_no(i));
  Next
  Print
Loop Until Err = 1



'When ERR = 1 is returned it means that no device is found anymore
'You could also count the number of devices
W = 1wirecount()
'It is IMPORTANT that the 1wirecount function returns a word/integer
'So the result variable must be of the type word or integer
'But you may assign it to a byte or long too of course
Print W


'as a bonus the next routine :
```

```
' first fill the array with an existing number
Reg_no(1) = 1wsearchfirst()
' unremark next line to chance a byte to test the ERR flag
'Reg_no(1) = 2
'now verify if the number exists
1wverify Reg_no(1)
Print Err
'err =1 when the ID passed n reg_no() does NOT exist
' optinal call it with pinnumber line  1wverify reg_no(1),pinb,1

'As for the other 1wire statements/functions, you can provide the port and pin
number as anoption
'W = 1wirecount(pinb , 1)                                    'for example look
at pin PINB.1
End
```

1WWRITE

Action

This statement writes a variable to the 1wire bus.

Syntax

1WWRITE var1
1WWRITE var1, bytes
1WWRITE var1 , bytes , port , pin

Remarks

var1	Sends the value of var1 to the bus. The number of bytes can be specified too but this is optional.
bytes	The number of bytes to write. Must be specified when port and pin are used.
port	The name of the PORT PINx register like PINB or PIND.
pin	The pin number in the range from 0-7. May be a numeric constant or variable.

Multiple 1-wire devices on different pins are supported.
To use this you must specify the port and pin that are used for the communication.

The 1wreset, 1wwrite and 1wread statements will work together when used with the old syntax. And the pin can be configured from the compiler options or with the CONFIG 1WIRE statement.

The syntax for additional 1-wire devices is :
1WRESET port , pin
1WWRITE var/constant, bytes, port , pin
var = 1WREAD(bytes, port, pin) ,for reading multiple bytes

See also

1WREAD , 1WRESET

Example

```
'-----------------------------------------------------------------------------
--
'name                     : 1wire.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wreset, 1wwrite and 1wread()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' pull-up of 4K7 required to VCC from Portb.2
' DS2401 serial button connected to Portb.2
'-----------------------------------------------------------------------------
--

$regfile = "m48def.dat"
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space

'when only bytes are used, use the following lib for smaller code
$lib "mcsbyte.lib"


Config 1wire = Portb.0                                      'use this pin
'On the STK200 jumper B.0 must be inserted
Dim Ar(8) As Byte , A As Byte , I As Byte


Do
  Wait 1
  1wreset                                                   'reset the device
  Print Err                                                 'print error 1 if
error
  1wwrite &H33                                              'read ROM command
  For I = 1 To 8
    Ar(i) = 1wread()                                        'place into array
  Next

'You could also read 8 bytes a time by unremarking the next line
'and by deleting the for next above
'Ar(1) = 1wread(8)                                           'read 8 bytes

  For I = 1 To 8
     Print Hex(ar(i));                                      'print output
  Next
  Print                                                     'linefeed
Loop


'NOTE THAT WHEN YOU COMPILE THIS SAMPLE THE CODE WILL RUN TO THIS POINT
'THIS because of the DO LOOP that is never terminated!!!

'New is the possibility to use more than one 1 wire bus
'The following syntax must be used:
For I = 1 To 8
  Ar(i) = 0                                                 'clear array to see
that it works
Next

1wreset Pinb , 2                                            'use this port and
```

```
pin for the second device
1wwrite &H33 , 1 , Pinb , 2                                    'note that now the
number of bytes must be specified!
'1wwrite Ar(1) , 5,pinb,2

'reading is also different
Ar(1) = 1wread(8 , Pinb , 2)                                   'read 8 bytes from
portB on pin 2

For I = 1 To 8
  Print Hex(ar(i));
Next

'you could create a loop with a variable for the bit number !
For I = 0 To 3                                                 'for pin 0-3
  1wreset Pinb , I
  1wwrite &H33 , 1 , Pinb , I
  Ar(1) = 1wread(8 , Pinb , I)
  For A = 1 To 8
    Print Hex(ar(a));
  Next
  Print
Next

End
```

ABS

Action
Returns the absolute value of a numeric signed variable.

Syntax
var = **ABS**(var2)

Remarks

Var	Variable that is assigned with the absolute value of var2.
Var2	The source variable to retrieve the absolute value from.

var : Integer , Long, Single or Double.
var2 : Integer, Long, Single or Double.

The absolute value of a number is always positive.

See also
NONE

ASM
Calls: _abs16 for an Integer and _abs32 for a Long
Input: R16-R17 for an Integer and R16-R19 for a Long

Output:R16-R17 for an Integer and R16-R19 for a Long

Calls _Fltabsmem for a single from the fp_trig library.

Example
```
Dim a as Integer, c as Integer
a =-1000
c = Abs(a)
Print c
End
```

ACOS

Action
Returns the arccosine of a single in radians.

Syntax
var = **ACOS**(x)

Remarks

Var	A floating point variable such as single or double, that is assigned with the ACOS of variable x.
X	The float to get the ACOS of. Input is valid from –1 to +1 and returns p to 0. If Input is < -1 than p and input is > 1 than 0 will returned.

If Input is cause of rounding effect in float-operations a little bit over 1 or -1, the value for 1.0 (-1.0) will be returned. This is the reason to give the value of the limit-point back, if Input is beyond limit. Generally the user have to take care, that Input to this function lies within –1 to +1.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , COS , SIN , TAN , ATN , ASIN , ATN2

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space
```

```
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
x= 0.5 : S = Acos(x)
Print S
End
```

ALIAS

Action
Indicates that the variable can be referenced with another name.

Syntax
newvar **ALIAS** oldvar

Remarks

oldvar	Name of the variable such as PORTB.1
newvar	New name of the variable such as direction

Aliasing port pins can give the pin names a more meaningful name. For example, when your program uses 4 different pins to control 4 different relays, you could name them portb.1, portb.2, portb.3 and portb.4.
But it would be more convenient to refer to them as relais1, relais2, relais3 and realais4.

When you later on change your PCB and decide that relays 4 must be connected to portD.4 instead of portb.4, you only need to change the ALIAS line, and not your whole program.

See also
CONST

Example
```
'-------------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates ALIAS

'-------------------------------------------------------------------------
-
$regfile = "m48def.dat"
$crystal = 4000000                                          ' 4 MHz crystal

Const On = 1
Const Off = 0

Config Portb = Output
Relais1 Alias Portb.1
Relais2 Alias Portb.2
```

```
Relais3 Alias Portd.5
Relais4 Alias Portd.2

Set Relais1
Relais2 = 0
Relais3 = On
Relais4 = Off

End
```

ASC

Action
Assigns a numeric variable with the ASCII value of the first character of a string.

Syntax
var = **ASC**(string)

Remarks

Var	Target numeric variable that is assigned.
String	String variable or constant from which to retrieve the ASCII value.

Note that only the first character of the string will be used.
When the string is empty, a zero will be returned.

ASCII stands for American Standard Code for Information Interchange. Computers can only understand numbers, so an ASCII code is the numerical representation of a character such as 'a' or '@' or an action of some sort. ASCII was developed a long time ago and now the non-printing characters are rarely used for their original purpose. Below is the ASCII character table and this includes descriptions of the first 32 non-printing characters. ASCII was actually designed for use with teletypes and so the descriptions are somewhat obscure. If someone says they want your CV however in ASCII format, all this means is they want 'plain' text with no formatting such as tabs, bold or underscoring - the raw format that any computer can understand. This is usually so they can easily import the file into their own applications without issues. Notepad.exe creates ASCII text, or in MS Word you can save a file as 'text only'

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
0	00	Null	32	20	Space	64	40	@	96	60	`
1	01	Start of heading	33	21	!	65	41	A	97	61	a
2	02	Start of text	34	22	"	66	42	B	98	62	b
3	03	End of text	35	23	#	67	43	C	99	63	c
4	04	End of transmit	36	24	$	68	44	D	100	64	d
5	05	Enquiry	37	25	%	69	45	E	101	65	e
6	06	Acknowledge	38	26	&	70	46	F	102	66	f
7	07	Audible bell	39	27	'	71	47	G	103	67	g
8	08	Backspace	40	28	(	72	48	H	104	68	h
9	09	Horizontal tab	41	29	)	73	49	I	105	69	i
10	0A	Line feed	42	2A	*	74	4A	J	106	6A	j
11	0B	Vertical tab	43	2B	+	75	4B	K	107	6B	k
12	0C	Form feed	44	2C	,	76	4C	L	108	6C	l
13	0D	Carriage return	45	2D	-	77	4D	M	109	6D	m
14	0E	Shift out	46	2E	.	78	4E	N	110	6E	n
15	0F	Shift in	47	2F	/	79	4F	O	111	6F	o
16	10	Data link escape	48	30	0	80	50	P	112	70	p
17	11	Device control 1	49	31	1	81	51	Q	113	71	q
18	12	Device control 2	50	32	2	82	52	R	114	72	r
19	13	Device control 3	51	33	3	83	53	S	115	73	s
20	14	Device control 4	52	34	4	84	54	T	116	74	t
21	15	Neg. acknowledge	53	35	5	85	55	U	117	75	u
22	16	Synchronous idle	54	36	6	86	56	V	118	76	v
23	17	End trans. block	55	37	7	87	57	W	119	77	w
24	18	Cancel	56	38	8	88	58	X	120	78	x
25	19	End of medium	57	39	9	89	59	Y	121	79	y
26	1A	Substitution	58	3A	:	90	5A	Z	122	7A	z
27	1B	Escape	59	3B	;	91	5B	[	123	7B	{
28	1C	File separator	60	3C	<	92	5C	\	124	7C	|
29	1D	Group separator	61	3D	=	93	5D	]	125	7D	}
30	1E	Record separator	62	3E	>	94	5E	^	126	7E	~
31	1F	Unit separator	63	3F	?	95	5F	_	127	7F	□

Extended ASCII

As people gradually required computers to understand additional characters and non-printing characters the ASCII set became restrictive. As with most technology, it took a while to get a single standard for these extra characters and hence there are few varying 'extended' sets. The most popular is presented below.

Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char	Dec	Hex	Char
128	80	Ç	160	A0	á	192	C0	└	224	E0	α
129	81	ü	161	A1	í	193	C1	┴	225	E1	ß
130	82	é	162	A2	ó	194	C2	┬	226	E2	Γ
131	83	â	163	A3	ú	195	C3	├	227	E3	π
132	84	ä	164	A4	ñ	196	C4	─	228	E4	Σ
133	85	à	165	A5	Ñ	197	C5	┼	229	E5	σ
134	86	å	166	A6	ª	198	C6	╞	230	E6	µ
135	87	ç	167	A7	º	199	C7	╟	231	E7	τ
136	88	ê	168	A8	¿	200	C8	╚	232	E8	Φ
137	89	ë	169	A9	⌐	201	C9	╔	233	E9	Θ
138	8A	è	170	AA	¬	202	CA	╩	234	EA	Ω
139	8B	ï	171	AB	½	203	CB	╦	235	EB	δ
140	8C	î	172	AC	¼	204	CC	╠	236	EC	∞
141	8D	ì	173	AD	¡	205	CD	═	237	ED	ø
142	8E	Ä	174	AE	«	206	CE	╬	238	EE	ε
143	8F	Å	175	AF	»	207	CF	╧	239	EF	∩
144	90	É	176	B0	░	208	D0	╨	240	F0	≡
145	91	æ	177	B1	▒	209	D1	╤	241	F1	±
146	92	Æ	178	B2	▓	210	D2	╥	242	F2	≥
147	93	ô	179	B3	│	211	D3	╙	243	F3	≤
148	94	ö	180	B4	┤	212	D4	╘	244	F4	⌠
149	95	ò	181	B5	╡	213	D5	╒	245	F5	⌡
150	96	û	182	B6	╢	214	D6	╓	246	F6	÷
151	97	ù	183	B7	╖	215	D7	╫	247	F7	≈
152	98	ÿ	184	B8	╕	216	D8	╪	248	F8	°
153	99	Ö	185	B9	╣	217	D9	┘	249	F9	∙
154	9A	Ü	186	BA	║	218	DA	┌	250	FA	·
155	9B	¢	187	BB	╗	219	DB	█	251	FB	√
156	9C	£	188	BC	╝	220	DC	▄	252	FC	ⁿ
157	9D	¥	189	BD	╜	221	DD	▌	253	FD	²
158	9E	₧	190	BE	╛	222	DE	▐	254	FE	■
159	9F	ƒ	191	BF	┐	223	DF	▀	255	FF	

See also
CHR

ASM
NONE

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space
```

```
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim A As Byte , S As String * 10
s ="ABC"
A = Asc(s)
Print A                                                    'will print 65
End
```

ASIN

Action
Returns the arcsine of a single in radians.

Syntax
var = **ASIN**(x)

Remarks

Var	A float variable such as single or double that is assigned with the ASIN of variable x.
X	The float to get the ASIN of. Input is valid from –1 to +1 and returns -p/2 to +p/2. If Input is < -1 than -p/2 and input is > 1 than p/2 will returned.

If Input is cause of rounding effect in single-operations a little bit over 1 or -1, the value for 1.0 (-1.0) will be returned. This is the reason to give the value of the limit-point back, if Input is beyond limit. Generally the user have to take care, that Input to this function lies within –1 to +1.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , COS , SIN , TAN , ATN , ACOS , ATN2

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space
```

```
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
X = 0.5 : S = Asin(x)
Print S    '0.523595867

End
```

ATN

Action
Returns the Arctangent of a single in radians.

Syntax
var = **ATN**(single)

Remarks

Var	A float variable that is assigned with the arctangent of variable single.
Single	The float variable to get the arctangent of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , COS , SIN , TAN , ATN2

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
S = Atn(1) * 4
Print S ' prints 3.141593 PI
End
```

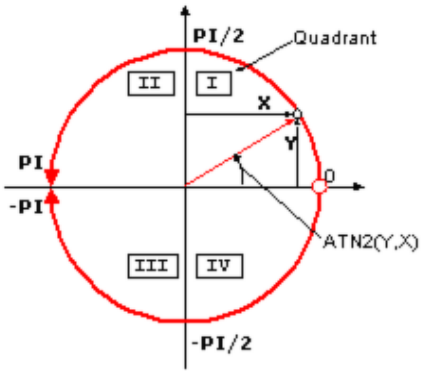
ATN2

Action
ATN2 is a four-quadrant arc-tangent.
While the ATN-function returns from -p/2 (-90°) to p/2 (90°), the ATN2 function returns the whole range of a circle from -p (-180°) to +p (180°). The result depends on the ratio of Y/X and the signs of X and Y.

Syntax
var = **ATN2**(y, x)

Remarks

Var	A single variable that is assigned with the ATN2 of variable single.
X	The single variable with the distance in x-direction.
Y	The single variable with the distance in y-direction



Quadrant	Sign Y	Sign X	ATN2
I	+	+	0 to p/2
II	+	-	p/2 to p
III	-	-	-p/2 to -p
IV	-	+	0 to –p/2

If you go with the ratio Y/X into ATN you will get same result for X greater zero (right side in coordinate system) as with ATN2. ATN2 uses X and Y and can give information of the angle of the point over 360° in the coordinates system.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , COS , SIN , TAN , ATN

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
X = 0.5 : S = 1.1
S = Atn2(s , X)
Print S ' prints 1.144164676

End
```

BASE64DEC

Action

Converts Base-64 data into the original data.

Syntax

Result = **BASE64DEC**(source)

Remarks

Result	A string variable that is assigned with the un-coded string.
Source	The source string that is coded with base-64.

Base-64 is not an encryption protocol. It sends data in 7-bit ASCII data format. MIME, web servers, and other Internet servers and clients use Base-64 coding.

The provided Base64Dec() function is a decoding function. It was written to add authentication to the web server sample.
When the web server asks for authentication, the client will send the user and password unencrypted, but base-64 coded to the web server.
Base-64 coded strings are always in pairs of 4 bytes. These 4 bytes represent 3 bytes.

See also

CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN , BASE64ENC

Example

```
$regfile = "m48def.dat"                                      ' specify the used
micro
$crystal = 8000000                                           ' used crystal
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
```

```
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space
$lib "tcpip.lbx"
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As String * 15 , Z As String * 15

S = "bWFyazptYXJr"
Z = Base64dec(s)
Print Z                                                     'mark:mark

End
```

BASE64ENC

Action
Converts a string into the Base-64 representation.

Syntax
Result = **BASE64ENC**(source)

Remarks

Result	A string variable that is assigned with the coded string.
Source	The source string that must be code with base-64.

Base-64 is not an encryption protocol. It sends data in 7-bit ASCII data format. MIME, web servers, and other Internet servers and clients use Base-64 coding.

The provided Base64Enc() function is an encoding function. You need it when you want to send attachments with POP3 for example.
The target string will use 1 additional byte for every 3 bytes.
So make sure the target string is dimensioned longer then the original string.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN , BASE64DEC

Example
```
$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
```

```
for the frame space
$lib "tcpip.lbx"
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As String * 15 , Z As String * 15

S = "bWFyazptYXJr"
Z = Base64dec(s)
Print Z                                                    'mark:mark
s = Base64Enc(z)
Print s

End
```

BAUD

Action
Changes the baud rate for the hardware UART.

Syntax
BAUD = var
BAUD #x , const

Remarks

Var	The baud rate that you want to use.
X	The channel number of the software UART.
Const	A numeric constant for the baud rate that you want to use.

Do not confuse the BAUD statement with the $BAUD compiler directive.

And do not confuse $CRYSTAL and CRYSTAL

$BAUD overrides the compiler setting for the baud rate and BAUD will change the current baud rate.
So $BAUD is a global project setting in your source code while BAUD will change the baud rate during run time.
You could use BAUD to change the baud rate during run time after the user changes a setting.

BAUD = ... will work on the hardware UART.

BAUD #x, yyyy will work on the software UART.

See also
$CRYSTAL , $BAUD , BAUD1

ASM
NONE

Example
```
$regfile = "m48def.dat"
$crystal = 4000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Print "Hello"

'Now change the baud rate in a program
Baud = 9600
Print "Did you change the terminal emulator baud rate too?"
End
```

BAUD1

Action
Changes the baud rate for the second hardware UART.

Syntax
BAUD1 = var
BAUD1 #x , const

Remarks

Var	The baud rate that you want to use.
X	The channel number of the software UART.
Const	A numeric constant for the baud rate that you want to use.

Do not confuse the BAUD1 statement with the $BAUD1 compiler directive.

And do not confuse $CRYSTAL and CRYSTAL

$BAUD1 overrides the compiler setting for the baud rate and BAUD1 will change the current baud rate.
BAUD1 = ... will work on the hardware UART.
BAUD #x, yyyy will work on the software UART.

See also
$CRYSTAL , $BAUD , $BAUD1 , BAUD

ASM
NONE

Example
```
'-----------------------------------------------------------------------
-
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega162
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates BAUD1 directive and BAUD1 statement

'-------------------------------------------------------------------------------
-
$regfile = "M162def.dat"
$baud1 = 2400
$crystal= 14000000 ' 14 MHz crystal

Open "COM2:" For BINARY As #1

Print #1 , "Hello"
'Now change the baud rate in a program
Baud1 = 9600                                                    '
Print #1 , "Did you change the terminal emulator baud rate too?"
Close #1

End
```

BCD

Action
Converts a variable stored in BCD format into a string.

Syntax
PRINT **BCD**(var)
LCD **BCD**(var)

Remarks

Var	Numeric variable to convert.

When you want to use an I2C clock device which stores its values in BCD format you can use this function to print the value correctly.
BCD() displays values with a leading zero.

The BCD() function is intended for the PRINT/LCD statements.
Use the MAKEBCD function to convert variables from decimal to BCD.
Use the MAKEDEC function to convert variables from BCD to decimal.

See also
MAKEDEC , MAKEBCD

ASM
Calls: _BcdStr
Input: X hold address of variable
Output: R0 with number of bytes, frame with data.

Example
```
'-------------------------------------------------------------------------------
```

```
--
'name                      : bcd.bas
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : demonstration of split and combine BCD Bytes
'suited for demo           : yes
'commercial addon needed   : no
'use in simulator          : possible
'-------------------------------------------------------------------------
--
$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'=========================================================================
=
' Set up Variables
'=========================================================================
=
Dim A As Byte                                             'Setup A Variable
Dim B As Byte                                             'Setup B Variable
Dim C As Byte                                             'Setup C Variable

A = &H89
'=========================================================================
=
' Main
'=========================================================================
=
Main:
Print "Combined :    " ; Hex(a)                           'Print A

'-------------------------------------------------------------------------
-
B = A And &B1111_0000                                     'Mask To Get Only High
Nibble Of Byte
Shift B , Right , 4                                       'Shift High Nibble To
Low Nibble Position , Store As B

C = A And &B0000_1111                                     'Mask To Get Only Low
Nibble Of Byte , Store As C

Print "Split :       " ; B ; " " ; C                      'Print B (High Nibble) ,
C(low Nibble)

'-------------------------------------------------------------------------
-
Shift B , Left , 4                                        'Shift Data From Low
Nibble Into High Nibble Position

A = B + C                                                 'Add B (High Nibble) And
C(low Nibble) Together

Print "Re-Combined: " ; Hex(a)                            'Print A (re -combined
Byte)
End                                                       'End Program
```

BIN

Action
Convert a numeric variable into the binary string representation.

Syntax
Var = **Bin**(source)

Remarks

Var	The target string that will be assigned with the binary representation of the variable source.
Source	The numeric variable that will be converted.

The BIN() function can be used to display the state of a port.
When the variable source has the value &B10100011 the string named var will be assigned with "10100011".
It can be easily printed to the serial port.

See also
HEX , STR , VAL , HEXVAL , BINVAL

ASM
NONE

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim B As Byte
' assign value to B
B = 45

Dim S As String * 10
'convert to string
S = Bin(b)
```

```
'assign value to portb
Portb = 33
Print Bin(portb)

'of course it also works for other numerics
End
```

BINVAL

Action
Converts a string representation of a binary number into a number.

Syntax
var = **Binval**(s)

Remarks

Var	A numeric variable that is assigned with the value of s.
S	Variable of the string type. Should contain only 0 and 1 digits.

See also
STR , HEXVAL , HEX , BIN , VAL

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As String * 8
S = "11001100"

Dim B As Byte
' assign value to B
B = Binval(s)

Print B

End
```

BIN2GRAY

Action
Returns the Gray-code of a variable.

Syntax
var1 = **Bin2gray**(var2)

Remarks

var1	Variable that will be assigned with the Gray code.
var2	A variable that will be converted.

Gray code is used for rotary encoders. Bin2gray() works with byte , integer, word and long variables.
The data type of the variable that will be assigned determines if a byte, word or long conversion will be done.

See also
GRAY2BIN , ENCODER

ASM
Depending on the data type of the target variable the following routine will be called from mcs.lbx:
_grey2Bin for bytes , _grey2bin2 for integer/word and _grey2bin4 for longs.

Example
```
'-----------------------------------------------------------------------------
'name                     : graycode.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : show the Bin2Gray and Gray2Bin functions
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"                                     ' specify the used micro
$crystal = 4000000                                          ' used crystal frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32 for the hardware stack
$swstack = 10                                               ' default use 10 for the SW stack
$framesize = 40                                             ' default use 40 for the frame space

'Bin2Gray() converts a byte,integer,word or long into grey code.
'Gray2Bin() converts a gray code into a binary value

Dim B As Byte                                               ' could be
```

```
word,integer or long too

Print "BIN" ; Spc(8) ; "GREY"
For B = 0 To 15
  Print B ; Spc(10) ; Bin2gray(b)
Next

Print "GREY" ; Spc(8) ; "BIN"
For B = 0 To 15
  Print B ; Spc(10) ; Gray2bin(b)
Next

End
```

BITWAIT

Action
Wait until a bit is set or reset.

Syntax
BITWAIT x , SET/RESET

Remarks

X	Bit variable or internal register like PORTB.x , where x ranges from 0-7.

When using bit variables make sure that they are set/reset by software otherwise your program will stay in a loop.

When you use internal registers that can be set/reset by hardware such as PINB.0 this doesn't apply since this state can change as a result from for example a key press.

See also
NONE

ASM
Calls: NONE
Input: NONE
Output: NONE

Code : shown for address 0-31

```
label1:
Sbic PINB.0,label2
Rjmp label1
Label2:
```

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
```

```
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim A As Bit
Bitwait A , Set                                             'wait until bit a
is set
'the above will never contine because it is not set i software
'it could be set in an ISR routine

Bitwait Pinb.7 , Reset                                      'wait until bit 7
of Port B is 0.
End
```

BITS

Action
Set all specified bits to 1.

Syntax
Var = **Bits**(b1 [,bn])

Remarks

Var	The BYTE/PORT variable that is assigned with the constant.
B1 , bn	A list of bit numbers that must be set to 1.

While it is simple to assign a value to a byte, and there is special boolean notation &B for assigning bits, the Bits() function makes it simple to assign a few bits.

B = &B1000001 : how many zero's are there?

This would make it more readable : B = Bits(0, 6)

You can read from the code that bit 0 and bit 6 are set to 1.
It does not save code space as the effect is the same.
It can only be used on bytes and port registers.

Valid bits are in range from 0 to 7.

See Also
NBITS

Example
```
'-----------------------------------------------------------------------------
```

```
--
'name                     : bits-nbits.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo for Bits() AND Nbits()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
'-----------------------------------------------------------------------------
--

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim B As Byte

'while you can use &B notation for setting bits, like B = &B1000_0111
'there is also an alternative by specifying the bits to set
B = Bits(0 , 1 , 2 , 7)                                     'set only bit 0,1,2
and 7
Print B

'and while bits() will set all bits specified to 1, there is also Nbits()
'the N is for NOT. Nbits(1,2) means, set all bits except 1 and 2
B = Nbits(7)                                                'do not set bit 7
Print B
End
```

BLOAD

Action

Writes the Content of a File into SRAM

Syntax

BLoad sFileName, wSRAMPointer

Remarks

sFileName	(String) Name of the File to be read
wSRAMPointer	(Word) Variable, which holds the SRAM Address to which the content of the file should be written

This function writes the content of a file to a desired space in SRAM. A free handle is needed for this function.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_BLoad	
Input	X: Pointer to string with filename	Z: Pointer to Long-variable, which holds the start position of SRAM
Output	r25: Errorcode	C-Flag: Set on Error

Example
```
' THIS IS A CODE FRAGMENT, it needs AVR-DOS in order to work
'now the good old bsave and bload
Dim Ar(100)as Byte , I Asbyte
For I = 1 To 100
  Ar(i) = I                                                 ' fill the array
Next

Wait 2

W = Varptr(ar(1))
Bsave"josef.img", W , 100
For I = 1 To 100
  Ar(i) = 0                                                 ' reset the array
Next

Bload "josef.img" , W                                       ' Josef you are
amazing !

For I = 1 To 10
  Print Ar(i) ; " ";
Next
Print
```

BOX

Action
Create a filled box on a graphical display.

Syntax
BOX (x1,y1) - (x2,y2) , color

Remarks

x1	The left corner position of the box
y1	The top position of the box
x2	The right corner position of the box
y2	The bottom position of the box
color	The color to use to fill the box

The BOX command will only work on Color displays. In a future version it will be implemented for other graphical displays as well.
The BOX command will create a filled box with the specified color.

See also
LINE, CIRCLE

ASM
NONE

Example
```
' -----------------------------------------------------------------------------------------
' The support for this display has been made possible by Peter Küsters from (c) Display3000
' You can buy the displays from Display3000 or MCS Electronics
' -----------------------------------------------------------------------------------------'
'
$lib "lcd-pcf8833.lbx"                                      'special color display support

$regfile = "m88def.dat"                                     'ATMega 8, change if using different
processors
$crystal = 8000000                                          '8 MHz

'First we define that we use a graphic LCD
Config Graphlcd = Color , Controlport = Portc , Cs = 1 , Rs = 0 , Scl = 3 , Sda = 2

'here we define the colors

Const Blue = &B00000011                                     ''predefined contants are making
programming easier
Const Yellow = &B11111100
Const Red = &B11100000
Const Green = &B00011100
Const Black = &B00000000
Const White = &B11111111
Const Brightgreen = &B00111110
Const Darkgreen = &B00010100
Const Darkred = &B10100000
Const Darkblue = &B00000010
Const Brightblue = &B00011111
Const Orange = &B11111000


'clear the display
Cls

'create a cross
Line(0 , 0) -(130 , 130) , Blue
Line(130 , 0) -(0 , 130) , Red

Waitms 1000

'show an RLE encoded picture
Showpic 0 , 0 , Plaatje
Showpic 40 , 40 , Plaatje

Waitms 1000

'select a font
Setfont Color16x16
'and show some text
Lcdat 100 , 0 , "12345678" , Blue , Yellow


Waitms 1000
Circle(30 , 30) , 10 , Blue

Waitms 1000
'make a box
Box(10 , 30) -(60 , 100) , Red

'set some pixels
Pset 32 , 110 , Black
Pset 38 , 110 , Black
Pset 35 , 112 , Black


End
```

```
Plaatje:
$bgf "a.bgc"


$include "color.font"
$include "color16x16.font"
```

BSAVE

Action
Save a range in SRAM to a File

Syntax
BSave sFileName, wSRAMPointer, wLength

Remarks

sFileName	(String) Name of the File to be written
wSRAMPointer	(Word) Variable, which holds the SRAM Address, from where SRAM should be written to a File
wLength	(Word) Count of Bytes from SRAM, which should be written to the file

This function writes a range from the SRAM to a file. A free file handle is needed for this function.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_BSave	
Input	X: Pointer to string with filename	Z: Pointer to Long-variable, which holds the start position of SRAM
	r20/r21: Count of bytes to be written	
Output	r25: Errorcode	C-Flag: Set on Error

Example
```
' THIS IS A CODE FRAGMENT, it needs AVR-DOS in order to work
'now the good old bsave and bload
Dim Ar(100)as Byte , I Asbyte
For I = 1 To 100
  Ar(i) = I                                                 ' fill the array
Next

Wait 2
```

```
W = Varptr(ar(1))
Bsave"josef.img", W , 100
For I = 1 To 100
  Ar(i) = 0                                                    ' reset the array
Next

Bload "josef.img" , W                                          ' Josef you are
amazing !

For I = 1 To 10
  Print Ar(i) ; " ";
Next
Print
```

BUFSPACE

Action
Returns the amount of free space of a serial buffer.

Syntax
Var = **BufSpace**(n)

Remarks

Var	A word or integer variable that is assigned with the free buffer space.
N	A constant in the range from 0-3. A value of 0 : output buffer first UART A value of 1 : input buffer first UART A value of 2 : output buffer second UART A value of 3 : input buffer second UART

While serial buffers are great because you do not have to wait/block the processor, the buffer can become full when the micro has no time to empty the buffer. With the bufspace() function you can determine if there is still room in the buffer.

See Also
CONFIG SERIAL , CLEAAR

Example
```
'-----------------------------------------------------------
NONE
```

BYVAL

Action
Specifies that a variable will be passed by value.

Syntax
Sub Test(**BYVAL** var)

Remarks
Var	Variable name

The default for passing variables to SUBS and FUNCTIONS, is by reference(BYREF). When you pass a variable by reference, the address is passed to the SUB or FUNCTION. When you pass a variable by Value, a temp variable is created on the frame and the address of the copy is passed.

When you pass by reference, changes to the variable will be made to the calling variable. When you pass by value, changes to the variable will be made to the copy so the original value will not be changed.

By default passing by reference is used.
Note that calling by reference will generate less code.

See also
CALL , DECLARE , SUB , FUNCTION

ASM
NONE

Example
```
Declare Sub Test(Byval X As Byte, Byref Y As Byte, Z As Byte)
```

CALL

Action
Call and execute a subroutine.

Syntax
CALL Test [(var1, var-n)]

Remarks
Var1	Any BASCOM variable or constant.
Var-n	Any BASCOM variable or constant.
Test	Name of the subroutine. In this case Test.

You can call sub routines with or without passing parameters.

It is important that the SUB routine is DECLARED before you make the CALL to the subroutine. Of course the number of declared parameters must match the number of passed parameters.

It is also important that when you pass constants to a SUB routine, you must DECLARE these parameters with the BYVAL argument.

With the CALL statement, you can call a procedure or subroutine.

For example: Call Test2

The call statement enables you to implement your own statements.
You don't have to use the CALL statement:
Test2 will also call subroutine test2

When you don't supply the CALL statement, you must leave out the parenthesis.
So Call Routine(x,y,z) must be written as Routine x,y,x

Unlike normal SUB programs called with the GOSUB statement, the CALL statement enables you to pass variables to a SUB routine that may be local to the SUB.

See also

DECLARE , SUB , EXIT , FUNCTION , LOCAL

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim A As Byte , B As Byte                                  'dimension some
variables
Declare Sub Test(b1 As Byte , Byval B2 As Byte)            'declare the SUB
program
A = 65                                                     'assign a value to
variable A
Call Test(a , 5)'call test with parameter A and constant
Test A , 5                                                 'alternative call
Print A                                                    'now print the new
value
End

Sub Test(b1 As Byte , Byval B2 As Byte)                    'use the same
variable names as 'the declared one
  Print B1                                                 'print it
  Print Bcd(b2)
  B1 = 10                                                  'reassign the
variable
  B2 = 15                                                  'reassign the
variable
End Sub
```

One important thing to notice is that you can change b2 but that the change will not be reflected to the calling program!
Variable A is changed however.

This is the difference between the BYVAL and BYREF argument in the DECLARE ration of the SUB program.

When you use BYVAL, this means that you will pass the argument by its value. A copy of the variable is made and passed to the SUB program. So the SUB program can use the value and modify it, but the change will not be reflected to the calling parameter. It would be impossible too when you pass a numeric constant for example.

If you do not specify BYVAL, BYREF will be used by default and you will pass the address of the variable. So when you reassign B1 in the above example, you are actually changing parameter A.

CHECKSUM

Action
Returns a checksum of a string.

Syntax
PRINT **Checksum**(var)
b = **Checksum**(var)

Remarks

Var	A string variable.
B	A numeric variable that is assigned with the checksum.

The checksum is computed by counting all the bytes of the string variable.
Checksums are often used with serial communication.
The checksum is a byte checksum. The following VB code is equivalent :

```
Dim Check as Byte
Check = 255
For x = 1 To Len(s$)
  Check = check – ASC(mid$(s$,x,1))
Next
```

See also
CRC8 , CRC16 , CRC32

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
```

```
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As String * 10                                         'dim variable
S = "test"                                                   'assign variable
Print Checksum(s)                                            'print value (192)
End
```

CHR

Action

Convert a numeric variable or a constant to a string with a length of 1 character. The character represents the ASCII value of the numeric value.

Syntax

PRINT **CHR**(var)
s = **CHR**(var)

Remarks

Var	Numeric variable or numeric constant.
S	A string variable.

When you want to print a character to the screen or the LCD display,
you must convert it with the CHR() function.

When you use PRINT numvar, the value will be printed.
When you use PRINT Chr(numvar), the ASCII character itself will be printed.
The Chr() function is handy in combination with the LCD custom characters where you can redefine characters 0-7 of the ASCII table.

See also

ASC

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : chr.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to use the CHR() and BCD() function and
'                           HEX() function in combination with a PRINT
statement
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
```

```
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim K As Byte

K = 65
Print K ; Chr(k) ; K ; Chr(66) ; Bcd(k) ; Hex(k)
End
```

CIRCLE

Action
Draws a circle on a graphic display.

Syntax
CIRCLE(x0,y0) , radius, color

Remarks

X0	Starting horizontal location of the line.
Y0	Starting vertical location of the line.
Radius	Radius of the circle
Color	Color of the circle

See Also
LINE

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : t6963_240_128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : T6963C graphic display support demo 240 * 128
'micro                    : Mega8535
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m8535.dat"                                     ' specify the used
```

```
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'-----------------------------------------------------------------------
'                     (c) 2001-2003 MCS Electronics
'                 T6963C graphic display support demo 240 * 128
'-----------------------------------------------------------------------

'The connections of the LCD used in this demo
'LCD pin                  connected to
' 1        GND            GND
 '2        GND            GND
 '3        +5V            +5V
 '4        -9V            -9V potmeter
 '5        /WR            PORTC.0
 '6        /RD            PORTC.1
 '7        /CE            PORTC.2
 '8        C/D            PORTC.3
 '9        NC             not conneted
 '10       RESET          PORTC.4
 '11-18    D0-D7           PA
 '19       FS             PORTC.5
 '20       NC             not connected

'First we define that we use a graphic LCD
' Only 240*64 supported yet
Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'Clear the screen will both clear text and graph display
Cls
'Other options are :
' CLS TEXT   to clear only the text display
' CLS GRAPH  to clear only the graphical part

Cursor Off

Wait 1
'locate works like the normal LCD locate statement
' LOCATE LINE,COLUMN LINE can be 1-8 and column 0-30


Locate 1 , 1

'Show some text
Lcd "MCS Electronics"
'And some othe text on line 2
Locate 2 , 1 : Lcd "T6963c support"
Locate 3 , 1 : Lcd "12345678901234567890123456789012345678901234567890"
Locate 16 , 1 : Lcd "write this to the lower line"
```

```
Wait 2

Cls Text


'use the new LINE statement to create a box
'LINE(X0,Y0) - (X1,Y1), on/off
Line(0 , 0) -(239 , 127) , 255                                  ' diagonal line
Line(0 , 127) -(239 , 0) , 255                                  ' diagonal line
Line(0 , 0) -(240 , 0) , 255                                    ' horizontal upper
line
Line(0 , 127) -(239 , 127) , 255                                'horizontal lower
line
Line(0 , 0) -(0 , 127) , 255                                    ' vertical left
line
Line(239 , 0) -(239 , 127) , 255                                ' vertical right
line


Wait 2
' draw a line using PSET X,Y, ON/OFF
' PSET on.off param is 0 to clear a pixel and any other value to turn it on
For X = 0 To 140
   Pset X , 20 , 255                                            ' set the pixel
Next

For X = 0 To 140
   Pset X , 127 , 255                                           ' set the pixel
Next

Wait 2

'circle time
'circle(X,Y), radius, color
'X,y is the middle of the circle,color must be 255 to show a pixel and 0 to
clear a pixel
For X = 1 To 10
  Circle(20 , 20) , X , 255                                     ' show circle
  Wait 1
  Circle(20 , 20) , X , 0                                       'remove circle
  Wait 1
Next

Wait 2

For X = 1 To 10
  Circle(20 , 20) , X , 255                                     ' show circle
  Waitms 200
Next
Wait 2
'Now it is time to show a picture
'SHOWPIC X,Y,label
'The label points to a label that holds the image data
Test:
Showpic 0 , 0 , Plaatje
Showpic 0 , 64 , Plaatje                                        ' show 2 since we
have a big display
Wait 2
Cls Text                                                        ' clear the text
End


'This label holds the mage data
Plaatje:
```

```
'$BGF will put the bitmap into the program at this location
$bgf "mcs.bgf"

'You could insert other picture data here
```

CLEAR

Action
Clear serial input ir output buffer

Syntax
CLEAR bufname

Remarks

Bufname	Serialbuffer name such as Serialin, Serialin1 , Serialout or Serialout1 For chips with more UARTS : SERIALIN2, SERIALIN3, SERIALOUT2, SERIALOUT3

When you use buffered serial input or buffered serial output, you might want to clear the buffer.
While you can make the head pointer equal to the tail pointer, an interrupt could be active which might result in an update of the buffer variables, resulting in an unexpected result.
The CLEAR statement will reset the head and tail pointers of the ring buffer, and it will set the buffer count variable to 0. The buffer count variable is new and introduced in 1.11.8.3. It counts how many bytes are in the buffer.
The internal buffercount variable is named _RS_BUFCOUNTxy , where X is **R** for **R**eceive, and **W** for **W**rite, and y is 0 for the first UART, and 1 for the second UART.
The

See also
CONFIG SERIALIN, CONFIG SERIALOUT

ASM
Calls _BUF_CLEAR from MCS.LIB

Example
```
CLEAR SERIALIN
```

CLS

Action
Clear the LCD display and set the cursor to home.

Syntax
CLS

Syntax for graphical LCD

CLS
CLS TEXT
CLS GRAPH

Remarks

Clearing the LCD display does not clear the CG-RAM in which the custom characters are stored.
For graphical LCD displays CLS will clear both the text and the graphical display.

See also

$LCD , $LCDRS , LCD , SHIFTLCD , SHIFTCURSOR , SHIFTLCD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : lcd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR,
HOME
'                           CURSOR, DISPLAY
'micro                    : Mega8515
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8515.dat"                                      ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings
```

```
Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
Wait 1
Lowerline                                                   'select the lower
line
Wait 1
Lcd "Shift this."                                           'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                           'shift the text to
the right
   Wait 1                                                   'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                            'shift the text to
the left
   Wait 1                                                   'wait a moment
Next

Locate 2 , 1                                                'set cursor
position
Lcd "*"                                                     'display this
Wait 1                                                      'wait a moment

Shiftcursor Right                                           'shift the cursor
Lcd "@"                                                     'display this
Wait 1                                                      'wait a moment

Home Upper                                                  'select line 1 and
return home
Lcd "Replaced."                                             'replace the text
Wait 1                                                      'wait a moment

Cursor Off Noblink                                          'hide cursor
Wait 1                                                      'wait a moment
Cursor On Blink                                             'show cursor
Wait 1                                                      'wait a moment
Display Off                                                 'turn display off
Wait 1                                                      'wait a moment
Display On                                                  'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                  'goto home on line
three
```

```
Home Fourth
Home F                                                    'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                       'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                       'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                'value into ACC
!rCall _write_lcd                                         'put it on LCD
End
```

CLOCKDIVISION

Action

Will set the system clock division available in the MEGA chips.

Syntax

CLOCKDIVISON = var

Remarks

Var	Variable or numeric constant that sets the clock division. Valid values are from 2-129. A value of 0 will disable the division.

On the MEGA 103 and 603 the system clock frequency can be divided so you can save power for instance. A value of 0 will disable the clock divider. The divider can divide from 2 to 127. So the other valid values are from 2 - 127.

Some routines that rely on the system clock will not work proper anymore when you use the divider. WAITMS for example will take twice the time when you use a value of 2.

See also

POWERSAVE

Example

```
$regfile = "m103def.dat"                                  ' specify the used
micro
$crystal = 8000000                                        ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Clockdivision = 2
```

CLOSE

Action
Closes an opened device.

Syntax
OPEN "device" for MODE As #channel
CLOSE #channel

Remarks

Device	The default device is COM1 and you don't need to open a channel to use INPUT/OUTPUT on this device. With the implementation of the software UART, the compiler must know to which pin/device you will send/receive the data. So that is why the OPEN statement must be used. It tells the compiler about the pin you use for the serial input or output and the baud rate you want to use. COMB.0:9600,8,N,2 will use PORT B.0 at 9600 baud with 2 stop bits. The format for COM1 is : COM1: Some chips have 2 UARTS. You can use COM2: to open the second HW UART. The format for the software UART is: COMpin:speed,8,N,stop bits[,INVERTED] Where pin is the name of the PORT-pin. Speed must be specified and stop bits can be 1 or 2. An optional parameter ,INVERTED can be specified to use inverted RS-232. Open "COMD.1:9600,8,N,1,INVERTED" For Output As #1 , will use pin PORTD.1 for output with 9600 baud, 1 stop bit and with inverted RS-232.
MODE	You can use BINARY or RANDOM for COM1 and COM2, but for the software UART pins, you must specify INPUT or OUTPUT.
Channel	The number of the channel to open. Must be a positive constant >0.

The statements that support the device are PRINT , INPUT and INPUTHEX , INKEY, WAITKEY.

Every opened device must be closed using the CLOSE #channel statement. Of course, you must use the same channel number.

The best place for the CLOSE statement is at the end of your program.

The INPUT statement in combination with the software UART, will not echo characters back because there is no default associated pin for this.

For the AVR-DOS filesystem, you may place the CLOSE at any place in your program. This because the filesystem supports real file handles.

See also

OPEN , PRINT

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : open.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates software UART
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 10000000                                        ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim B As Byte

'Optional you can fine tune the calculated bit delay
'Why would you want to do that?
'Because chips that have an internal oscillator may not
'run at the speed specified. This depends on the voltage, temp etc.
'You can either change $CRYSTAL or you can use
'BAUD #1,9610

'In this example file we use the DT006 from www.simmstick.com
'This allows easy testing with the existing serial port
'The MAX232 is fitted for this example.
'Because we use the hardware UART pins we MAY NOT use the hardware UART
'The hardware UART is used when you use PRINT, INPUT or other related
statements
'We will use the software UART.
Waitms 100

'open channel for output
Open "comd.1:19200,8,n,1" For Output As #1
Print #1 , "serial output"
```

```
'Now open a pin for input
Open "comd.0:19200,8,n,1" For Input As #2
'since there is no relation between the input and output pin
'there is NO ECHO while keys are typed
Print #1 , "Number"
'get a number
Input #2 , B
'print the number
Print #1 , B

'now loop until ESC is pressed
'With INKEY() we can check if there is data available
'To use it with the software UART you must provide the channel
Do
   'store in byte
   B = Inkey(#2)
   'when the value > 0 we got something
   If B > 0 Then
      Print #1 , Chr(b)                                    'print the
character
   End If
Loop Until B = 27


Close #2
Close #1


'OPTIONAL you may use the HARDWARE UART
'The software UART will not work on the hardware UART pins
'so you must choose other pins
'use normal hardware UART for printing
'Print B


'When you dont want to use a level inverter such as the MAX-232
'You can specify ,INVERTED :
'Open "comd.0:300,8,n,1,inverted" For Input As #2
'Now the logic is inverted and there is no need for a level converter
'But the distance of the wires must be shorter with this
End
```

CLOSESOCKET

Action

Closes a socket connection.

Syntax

CloseSocket socket

Remarks

Socket	The socket number you want to close in the range of 0-3. When the socket is already closed, no action will be performed.

You must close a socket when you receive the SOCK_CLOSE_WAIT status.
You may also close a socket if that is needed by your protocol.

You will receive a SOCK_CLOSE_WAIT status when the server closes the connection.

When you use CloseSocket you actively close the connection.
Note that it is not needed to wait for a SOCK_CLOSE_WAIT message in order to close a socket connection.

After you have closed the connection, you need to use GetSocket in order to use the socket number again.

See also

CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, SOCKETLISTEN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : clienttest.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : start the easytcp.exe program and listen to port
5000
'micro                    : Mega161
'suited for demo          : no
'commercial addon needed  : yes
'-----------------------------------------------------------------------------
-----------

$regfile = "M161def.dat"
$crystal = 4000000
$baud = 19200
$hwstack = 40                                               ' default use 40
for the hardware stack
$swstack = 40                                               ' default use 40
for the SW stack
$framesize = 64                                             ' default use64 for
the frame space

Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
```

```
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW



$lib "tcpip.lbx"                                            ' specify the tcpip
library
Print "Init , set IP to 192.168.0.8"                       ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 0.0.0.0 , Localport = 1000 , Tx = $55 , Rx = $55

'Use the line below if you have a gate way
'Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

Dim Bclient As Byte                                         ' socket number
Dim Idx As Byte
Dim Result As Word                                          ' result
Dim S As String * 80

For Idx = 0 To 3                                            ' for all sockets
  Bclient = Getsocket(idx , Sock_stream , 0 , 0)            ' get socket for
client mode, specify port 0 so loal_port is used
  Print "Local port : " ; Local_port                       ' print local port
that was used
  Print "Socket " ; Idx ; " " ; Bclient
  Result = Socketconnect(idx , 192.168.0.3 , 5000)          ' connect to
easytcpip.exe server
  Print "Result " ; Result
Next

Do

  If Ischarwaiting() <> 0 Then                              ' is there a key
waiting in the uart?
     Bclient = Waitkey()                                    ' get the key
     If Bclient = 27 Then
       Input "Enter string to send " , S                    ' send WHO , TIME
or EXIT
       For Idx = 0 To 3
          Result = Tcpwritestr(idx , S , 255)
       Next
     End If
  End If

  For Idx = 0 To 3
     Result = Socketstat(idx , 0)                           ' get status
     Select Case Result
```

```
       Case Sock_established
            Result = Socketstat(idx , Sel_recv)              ' get number of
bytes waiting
            If Result > 0 Then
               Do
                 Result = Tcpread(idx , S)
                 Print "Data from server: " ; Idx ; " " ; S
               Loop Until Result = 0
            End If
       Case Sock_close_wait
            Print "close_wait"
            Closesocket Idx
       Case Sock_closed
            'Print "closed"
     End Select
  Next
Loop
End
```

CONFIG

The CONFIG statement is used to configure the various hardware devices.

DIRECTIVE	RE-USABLE
CONFIG 1WIRE	NO
CONFIG ACI	YES
CONFIG ADC	NO
CONFIG ATEMU	NO
CONFIG BCCARD	NO
CONFIG CLOCK	NO
CONFIG CLOCKDIV	YES
CONFIG COM1	YES
CONFIG COM2	YES
CONFIG DATE	NO
CONFIG DEBOUNCE	NO
CONFIG GRAPHLCD	NO
CONFIG I2CDELAY	NO
CONFIG I2CSLAVE	NO
CONFIG INTx	YES
CONFIG KBD	NO
CONFIG KEYBOARD	NO
CONFIG LCD	NO
CONFIG LCDBUS	NO
CONFIG LCDMODE	NO
CONFIG LCDPIN	NO
CONFIG RC5	NO
CONFIG PORT	YES
CONFIG PRINT	NO
CONFIG PRINTBIN	NO
CONFIG SERIALIN	NO
CONFIG SERIALIN1	NO

CONFIG SERIALOUT	NO
CONFIG SERIALOUT1	NO
CONFIG SERVOS	NO
CONFIG PS2EMU	NO
CONFIG SINGLE	NO
CONFIG SDA	NO
CONFIG SCL	NO
CONFIG SPI	NO
CONFIG TCPIP	NO
CONFIG TWI	YES
CONFIG TWISLAVE	NO
CONFIG TIMER0	YES
CONFIG TIMER1	YES
CONFIG TIMER2 and 3	YES
CONFIG WATCHDOG	YES
CONFIG WAITSUART	NO
CONFIG X10	NO

Some CONFIG directives are intended to be used once. Others can be used multiple times. For example you can specify that a port must be set to input after you have specified that it is used as an input.

You cannot change the LCD pins during run time. In that case the last specification will be used or an error message will be displayed.

CONFIG 1WIRE

Action
Configure the pin to use for 1WIRE statements and override the compiler setting.

Syntax
CONFIG 1WIRE = pin

Remarks

Pin	The port pin to use such as PORTB.0

The CONFIG 1WIRE statement, only overrides the compiler setting.
You can configure only one pin for the 1WIRE statements because the idea is that you can attach multiple 1WIRE devices to the 1WIRE bus.

You can however use multiple pins and thus multiple busses. All 1wire commands and functions need the port and pin in that case.

The 1wire commands and function will automatically set the DDR and PORT register bits to the proper state. You do not need to bring the pins into the right state yourself.

It is important that you use a pull up resistor of 4K7 ohm on the 1wire pin. The build in pull up resistor of the AVR is not sufficient.

Also notice that some 1wire chips also need +5V.

See also

1WRESET , 1WREAD , 1WWRITE , 1WIRECOUNT , 1WRESET , 1WSEARCHFIRST , 1WSEARCHNEXT

Example

```
'-----------------------------------------------------------------------------
'name                     : 1wire.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates 1wreset, 1wwrite and 1wread()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' pull-up of 4K7 required to VCC from Portb.2
' DS2401 serial button connected to Portb.2
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"
$crystal = 8000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space


Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

'when only bytes are used, use the following lib for smaller code
$lib "mcsbyte.lib"


Config 1wire = Portb.0                                      'use this pin
'On the STK200 jumper B.0 must be inserted
Dim Ar(8) As Byte , A As Byte , I As Byte


Do
  Wait 1
  1wreset                                                   'reset the device
  Print Err                                                 'print error 1 if
error
  1wwrite &H33                                              'read ROM command
  For I = 1 To 8
    Ar(i) = 1wread()                                        'place into array
  Next

'You could also read 8 bytes a time by unremarking the next line
'and by deleting the for next above
'Ar(1) = 1wread(8)                                           'read 8 bytes

  For I = 1 To 8
     Print Hex(ar(i));                                      'print output
  Next
  Print                                                     'linefeed
Loop
```

```
'NOTE THAT WHEN YOU COMPILE THIS SAMPLE THE CODE WILL RUN TO THIS POINT
'THIS because of the DO LOOP that is never terminated!!!

'New is the possibility to use more than one 1 wire bus
'The following syntax must be used:
For I = 1 To 8
  Ar(i) = 0                                                 'clear array to see
that it works
Next

1wreset Pinb , 2                                            'use this port and
pin for the second device
1wwrite &H33 , 1 , Pinb , 2                                 'note that now the
number of bytes must be specified!
'1wwrite Ar(1) , 5,pinb,2

'reading is also different
Ar(1) = 1wread(8 , Pinb , 2)                                'read 8 bytes from
portB on pin 2

For I = 1 To 8
  Print Hex(ar(i));
Next

'you could create a loop with a variable for the bit number !
For I = 0 To 3                                              'for pin 0-3
  1wreset Pinb , I
  1wwrite &H33 , 1 , Pinb , I
  Ar(1) = 1wread(8 , Pinb , I)
  For A = 1 To 8
    Print Hex(ar(a));
  Next
  Print
Next

End
```

CONFIG ACI

Action

Configures the Analog Comparator.

Syntax

CONFIG ACI = ON|OFF, COMPARE = ON|OFF, TRIGGER=TOGGLE|RISING|FALLING

Remarks

ACI	Can be switched on or off
COMPARE	Can be on or off. When switched ON, the TIMER1 in capture mode will trigger on ACI too.
TRIGGER	Specifies which comparator events trigger the analog comparator interrupts.

See also

NONE

Example
NONE

CONFIG ADC

Action
Configures the A/D converter.

Syntax
CONFIG ADC = single, PRESCALER = AUTO, REFERENCE = opt

Remarks

ADC	Running mode. May be SINGLE or FREE.
PRESCALER	A numeric constant for the clock divider. Use AUTO to let the compiler generate the best value depending on the XTAL
REFERENCE	Some chips like the M163 have additional reference options. Value may be OFF , AVCC or INTERNAL. See the data sheets for the different modes.

See also
GETADC

ASM
The following ASM is generated(depending on the chip)

```
In _temp1,ADCSR ; get settings of ADC
Ori _temp1, XXX ; or with settings
Out ADCSR,_temp1 ; write back to ADC register
```

Example
```
'-----------------------------------------------------------------------
--
'name                     : adc.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of GETADC() function for 8535 or M163
micro
'micro                    : Mega163
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000
```

```
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                'default use 10 for
the SW stack
$framesize = 40                                              'default use 40 for
the frame space


'configure single mode and auto prescaler setting
'The single mode must be used with the GETADC() function

'The prescaler divides the internal clock by 2,4,8,16,32,64 or 128
'Because the ADC needs a clock from 50-200 KHz
'The AUTO feature, will select the highest clockrate possible
Config Adc = Single , Prescaler = Auto
'Now give power to the chip
Start Adc

'With STOP ADC, you can remove the power from the chip
'Stop Adc

Dim W As Word , Channel As Byte

Channel = 0
'now read A/D value from channel 0
Do
  W = Getadc(channel)
  Print "Channel " ; Channel ; " value " ; W
  Incr Channel
  If Channel > 7 Then Channel = 0
Loop
End

'The new M163 has options for the reference voltage
'For this chip you can use the additional param :
'Config Adc = Single , Prescaler = Auto, Reference = Internal
'The reference param may be :
'OFF      : AREF, internal reference turned off
'AVCC     : AVCC, with external capacitor at AREF pin
'INTERNAL : Internal 2.56 voltage reference with external capacitor ar AREF pin

'Using the additional param on chip that do not have the internal reference
will have no effect.
```

CONFIG ATEMU

Action

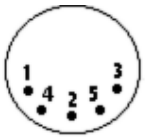
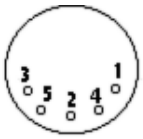
Configures the PS/2 keyboard data and clock pins.

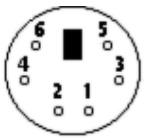
Syntax

CONFIG ATEMU = int , DATA = data, CLOCK=clock

Remarks

Int	The interrupt used such as INT0 or INT1.
DATA	The pin that is connected to the DATA line. This must be the same pin as the used interrupt.
CLOCK	The pin that is connected to the CLOCK line.

Male	Female	5-pin DIN (AT/XT):
 (Plug)	 (Socket)	1 - Clock 2 - Data 3 - Not Implemented 4 - Ground 5 - +5v

Male	Female	6-pin Mini-DIN (PS/2):
(Plug)	 (Socket)	1 - Data 2 - Not Implemented 3 - Ground 4 - +5v 5 - Clock 6 - Not Implemented

Old PC's are equipped with a 5-pin DIN female connector. Newer PC's have a 6-pin mini DIN female connector.
The male sockets must be used for the connection with the micro.

Besides the DATA and CLOCK you need to connect from the PC to the micro, you need to connect ground. You can use the +5V from the PC to power your microprocessor.

The config statement will setup an ISR that is triggered when the INT pin goes low. This routine you can find in the library.
The ISR will retrieve a byte from the PC and will send the proper commands back to the PC.

The SENDSCANKBD statement allows you to send keyboard commands.

Note that unlike the mouse emulator, the keyboard emulator is also recognized after your PC has booted.

The PS2 Keyboard and mouse emulator needs an additonal commercial addon library.

See also
SENDSCANKBD

Example
```
'-----------------------------------------------------------------------
```

```
-----------
'name                     : ps2_kbdemul.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PS2 AT Keyboard emulator
'micro                    : 90S2313
'suited for demo          : no, ADD ONE NEEDED
'commercial addon needed  : yes
'-------------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

$lib "mcsbyteint.lbx"                                       ' use optional lib
since we use only bytes

'configure PS2 AT pins
Enable Interrupts                                           ' you need to turn
on interrupts yourself since an INT is used
Config Atemu = Int1 , Data = Pind.3 , Clock = Pinb.0
'                  ^------------------------ used interrupt
'                               ^------------ pin connected to DATA
'                                        ^-- pin connected to clock
'Note that the DATA must be connected to the used interrupt pin


Waitms 500                                                  ' optional delay

'rcall _AT_KBD_INIT
Print "Press t for test, and set focus to the editor window"
Dim Key2 As Byte , Key As Byte
Do
    Key2 = Waitkey()                                        ' get key from
terminal
    Select Case Key2
      Case "t" :
      Waitms 1500
      Sendscankbd Mark                                      ' send a scan code
      Case Else
    End Select
Loop
Print Hex(key)

Mark:                                                       ' send mark
Data 12 , &H3A , &HF0 , &H3A , &H1C , &HF0 , &H1C , &H2D , &HF0 , &H2D , &H42 ,
 &HF0 , &H42
'    ^ send 12 bytes
'           m                   a                   r                   k
```

CONFIG CLOCK

Action

Configures the timer to be used for the TIME$ and DATE$ variables.

Syntax

CONFIG CLOCK = soft | USER [, GOSUB = SECTIC]

Remarks

Soft	Use SOFT for using the software based clock routines. Use USER to write/use your own code in combination with an I2C clock chip for example.
Sectic	This option allows to jump to a user routine with the label sectic. Since the interrupt occurs every second you may handle various tasks in the sectic label. It is important that you use the name SECTIC and that you return with a RETURN statement from this label. The usage of the optional SECTIC routine will use 30 bytes of the hardware stack. This option only works with the SOFT clock mode. It does not work in USER mode.

When you use the CONFIG CLOCK directive the compiler will DIM the following variables automatic : _sec , _min , _hour, _day , _month , _year
The variables TIME$ and DATE$ will also be dimensioned. These are special variables since they are treated different. See TIME$ and DATE$.

The _sec, _min and other internal variables can be changed by the user too.
But of course changing their values will change the DATE$/TIME$ variables.

The compiler also creates an ISR that gets updates once a second. This works only for the 8535, M163 and M103 and M603, or other AVR chips that have a timer that can work in asynchrony mode.

For the 90S8535, timer2 is used. It can not be used my the user anymore! This is also true for the other chips async timer.

Notice that you need to connect a 32768 Hz crystal in order to use the timer in async mode, the mode that is used for the clock timer.

When you choose the USER option, only the internal variables are created. With the USER option you need to write the clock code yourself.

See the datetime.bas example that shows how you can use a DS1307 clock chip for the date and time generation.

Numeric Values to calculate with Date and Time:

- SecOfDay: (Type LONG) Seconds elapsed since Midnight. 00:00:00 start with 0 to 85399 at 23:59:59.
- SysSec: (Type LONG) Seconds elapsed since begin of century (at 2000-01-01!). 00:00:00 at 2000-01-01 start with 0 to 2147483647 (overflow of LONG-Type) at 2068-01-19 03:14:07
- DayOfYear: (Type WORD) Days elapsed since first January of the current year.
- First January start with 0 to 364 (365 in a leap year)
- SysDay: (Type WORD) Days elapsed since begin of century (at 2000-01-01!). 2000-01-01 starts with 0 to 36524 at 2099-12-31
- DayOfWeek: (Type Byte) Days elapsed since Monday of current week. Monday start with 0 to Sunday = 6

With the numeric type calculations with Time and date are possible. Type 1 (discrete Bytes) and 2 (Strings) can be converted to an according numeric value. Than Seconds (at SecOfDay and SysSec) or Days (at DayOfYear, SysDay), can be added or subtracted. The Result can be converted back.

See also
TIME$, DATE$, CONFIG DATE

ASM
The following ASM routines are called from datetime.lib
_soft_clock. This is the ISR that gets called once per second.

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : megaclock.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows the new TIME$ and DATE$ reserved variables
'micro                    : Mega103
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'With the 8535 and timer2 or the Mega103 and TIMER0 you can
'easily implement a clock by attaching a 32768 Hz xtal to the timer
'And of course some BASCOM code

'This example is written for the STK300 with M103
Enable Interrupts

'[configure LCD]
$lcd = &HC000                                               'address for E and
RS
$lcdrs = &H8000                                             'address for only E
Config Lcd = 20 * 4                                         'nice display from
bg micro
Config Lcdbus = 4                                           'we run it in bus
mode and I hooked up only db4-db7
Config Lcdmode = Bus                                        'tell about the bus
mode

'[now init the clock]
Config Date = Mdy , Separator = /                           ' ANSI-Format
```

```
Config Clock = Soft                                          'this is how simple
it is
'The above statement will bind in an ISR so you can not use the TIMER anymore!
'For the M103 in this case it means that TIMER0 can not be used by the user
anymore

'assign the date to the reserved date$
'The format is MM/DD/YY
Date$ = "11/11/00"

'assign the time, format in hh:mm:ss military format(24 hours)
'You may not use 1:2:3 !! adding support for this would mean overhead
'But of course you can alter the library routines used

Time$ = "02:20:00"

'-----------------------------------------------------

'clear the LCD display
Cls

Do
  Home                                                       'cursor home
  Lcd Date$ ; "   " ; Time$                                  'show the date and
time
Loop

'The clock routine does use the following internal variables:
'_day , _month, _year , _sec, _hour, _min
'These are all bytes. You can assign or use them directly
_day = 1
'For the _year variable only the year is stored, not the century
End
```

CONFIG CLOCKDIV

Action

Sets the clock divisor.

Syntax

CONFIG CLOCKDIV = constant

Remarks

constant	The clockdivision factor to use. Possible values are 1 , 2 , 4 , 8 ,16 , 32 ,64 , 128 and 256.

The options to set the clock divisor is available in most new chips. Under normal conditions the clock divisor is one. Thus an oscillator value of 8 Mhz will result in a system clock of 8 Mhz. With a clock divisor of 8, you would get a system clock of 1 Mhz.
Low speeds can be used to generate an accurate system frequency and for low power consumption.
Some chips have a 8 or 16 division enabled by default by a fuse bit.
You can then reprogram the fuse bit or you can set the divisor from code.

When you set the clock divisor take care that you adjust the $CRYSTAL directive also. $CRYSTAL specifies the clock frequency of the system. So with 8 Mhz clock and divisor of 8 you would specify $CRYSTAL = 1000000.

See also
$CRYSTAL

Example
```
CONFIG CLOCKDIV = 8 'we divide 8 Mhz crystal clock by 8 resulting in 1 Mhz
speed
```

CONFIG COM1

Action
Configures the UART of AVR chips that have an extended UART like the M8.

Syntax
CONFIG COM1 = baud , synchrone=0|1,parity=none|disabled|even|odd,stopbits=1|2,databits=4|6|7|8|9,clockpol=0|1

Remarks

baud	Baud rate to use. Use 'dummy' to leave the baud rate at the $baud value.
synchrone	0 for synchrone operation (default) and 1 for asynchrone operation.
Parity	None, disabled, even or odd
Stopbits	The number of stopbits : 1 or 2
Databits	The number of databits : 4,5,7,8 or 9.
Clockpol	Clock polarity. 0 or 1.

Note that not all AVR chips have the extended UART. Most AVR chips have a UART with fixed communication parameters. These are : No parity, 1 stopbit, 8 data bits.

Normally you set the BAUD rate with $BAUD or at run time with BAUD. You may also set the baud rate when you open the COM channel. It is intended for the Mega2560 that has 4 UARTS and it is simpler to specify the baud rate when you open the channel. It may also be used with the first and second UART but it will generate additional code since using the first UART will always result in generating BAUD rate init code.

See Also
CONFIG COM2 , CONFIG COMx

Example
```
'-----------------------------------------------------------------------
-----------
'name                    :
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : test for M128 support in M128 mode
```

```
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$baud1 = 19200
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


'By default the M128 has the M103 compatibility fuse set. Set the fuse to M128
'It also runs on a 1 MHz internal oscillator by default
'Set the internal osc to 4 MHz for this example DCBA=1100

'use the m128def.dat file when you wanto to use the M128 in M128 mode
'The M128 mode will use memory from $60-$9F for the extended registers

'Since some ports are located in extended registers it means that some
statements
'will not work on these ports. Especially statements that will set or reset a
bit
'in a register. You can set any bit yourself with the PORTF.1=1 statement for
example
'But the I2C routines use ASM instructions to set the bit of a port. These ASM
instructions may
'only be used on port registers. PORTF and PORTG will not work with I2C.


'The M128 has an extended UART.
'when CONFIG COMx is not used, the default N,8,1 will be used
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

'try the second hardware UART
Open "com2:" For Binary As #1

'try to access an extended register
Config Portf = Output
'Config Portf = Input

Print "Hello"
Dim B As Byte
Do
   Input "test serial port 0" , B
   Print B
   Print #1 , "test serial port 2"
Loop

Close #1

End
```

CONFIG COM2

Action
Configures the UART of AVR chips that have a second extended UART like the M128.

Syntax
CONFIG COM2 = baud , synchrone=0|1,parity=none|disabled|even|odd,stopbits=1|2,databits=4|6|7|8|9,clockpol=0|1

Remarks

baud	Baud rate to use. Use 'dummy' to leave the baud rate at the $baud1 value.
synchrone	0 for synchrone operation (default) and 1 for asynchrone operation.
Parity	None, disabled, even or odd
Stopbits	The number of stopbits : 1 or 2
Databits	The number of databits : 4,5,7,8 or 9.
Clockpol	Clock polarity. 0 or 1.

Normally you set the BAUD rate with $BAUD or at run time with BAUD. You may also set the baud rate when you open the COM channel. It is intended for the Mega2560 that has 4 UARTS and it is simpler to specify the baud rate when you open the channel. It may also be used with the first and second UART but it will generate additional code since using the first or second UART will always result in generating BAUD rate init code.

Note that not all AVR chips have the extended UART. Most AVR chips have a UART with fixed communication parameters. They are : No parity, 1 stopbit, 8 data bits.

See Also
CONFIG COM1 , CONFIG COMx

Example
```
'-----------------------------------------------------------------------
-----------
'name                     :
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : test for M128 support in M128 mode
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$baud1 = 19200
$hwstack = 32                                               ' default use 32
for the hardware stack
```

```
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


'By default the M128 has the M103 compatibility fuse set. Set the fuse to M128
'It also runs on a 1 MHz internal oscillator by default
'Set the internal osc to 4 MHz for this example DCBA=1100

'use the m128def.dat file when you wanto to use the M128 in M128 mode
'The M128 mode will use memory from $60-$9F for the extended registers

'Since some ports are located in extended registers it means that some
statements
'will not work on these ports. Especially statements that will set or reset a
bit
'in a register. You can set any bit yourself with the PORTF.1=1 statement for
example
'But the I2C routines use ASM instructions to set the bit of a port. These ASM
instructions may
'only be used on port registers. PORTF and PORTG will not work with I2C.


'The M128 has an extended UART.
'when CONFIG COMx is not used, the default N,8,1 will be used
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

'try the second hardware UART
Open "com2:" For Binary As #1

'try to access an extended register
Config Portf = Output
'Config Portf = Input

Print "Hello"
Dim B As Byte
Do
   Input "test serial port 0" , B
   Print B
   Print #1 , "test serial port 2"
Loop

Close #1

End
```

CONFIG COMx

Action

Configures the UART of AVR chips that have an extended UART like the M2560.

Syntax

CONFIG COMx = baud , synchrone=0|1,parity=none|disabled|even|odd,stopbits=1|2,databits=4|6|7|8|9,clockpol=0|1

Remarks

COMx	The COM port to configure. Value in range from 1-4
baud	Baud rate to use.
synchrone	0 for synchrone operation (default) and 1 for asynchrone operation.
Parity	None, disabled, even or odd
Stopbits	The number of stopbits : 1 or 2
Databits	The number of databits : 4,5,7,8 or 9.
Clockpol	Clock polarity. 0 or 1.

Note that not all AVR chips have the extended UART. Most AVR chips have a UART with fixed communication parameters. These are : No parity, 1 stopbit, 8 data bits.
The Mega2560 does support 4 UART's.

See Also

CONFIG COM1 , CONFIG COM2

Example

```
'-----------------------------------------------------------------------------
-----------
'name                    :
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : test for M2560 support
'micro                   : Mega2560
'suited for demo         : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m2560def.dat"                                   ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$hwstack = 40                                               ' default use 32
for the hardware stack
$swstack = 40                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'The M128 has an extended UART.
'when CO'NFIG COMx is not used, the default N,8,1 will be used
Config Com1 = 19200 , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = 19200 , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com3 = 19200 , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com4 = 19200 , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


'Open all UARTS
Open "com2:" For Binary As #1
Open "Com3:" For Binary As #2
Open "Com4:" For Binary As #3


Print "Hello"                                              'first uart
Dim B As Byte
```

```
Dim Tel As Word

Do
  Incr Tel
  Print Tel ; " test serial port 1"
  Print #1 , Tel ; " test serial port 2"
  Print #2 , Tel ; " test serial port 3"
  Print #3 , Tel ; " test serial port 4"

  B = Inkey(#3)
  If B <> 0 Then
     Print #3 , B ; " from port 4"
  End If
  Waitms 500
Loop

Close #1
Close #2
Close #3

End
```

CONFIG DATE

Action

Configure the Format of the Date String for Input to and Output from BASCOM – Date functions

Syntax

CONFIG DATE = DMY , Separator = char

Remarks

DMY	The Day, month and year order. Use DMY, MDY or YMD.
Char	A character used to separate the day, month and year. Use / , - or . (dot)

The following table shows the common formats of date and the associated statements.

Country	Format	Statement
American	mm/dd/yy	Config Date = MDY, Separator = /
ANSI	yy.mm.dd	Config Date = YMD, Separator = .
Britisch/French	dd/mm/yy	Config Date = DMY, Separator = /
German	dd.mm.yy	Config Date = DMY, Separator = .
Italian	dd-mm-yy	Config Date = DMY, Separator = -
Japan/Taiwan	yy/mm/dd	Config Date = YMD, Separator = /
USA	mm-dd-yy	Config Date = MDY, Separator = -

When you live in Holland you would use :
CONFIG DATE = DMY, separator = -
This would print 24-04-02 for 24 November 2002.

When you line in the US, you would use :

CONFIG DATE = MDY , separator = /
This would print 04/24/02 for 24 November 2002.

See also

CONFIG CLOCK , DATE TIME functions , DayOfWeek , DayOfYear , SecOfDay , SecElapsed , SysDay , SysSec , SysSecElapsed , Time , Date

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : megaclock.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows the new TIME$ and DATE$ reserved variables
'micro                    : Mega103
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'With the 8535 and timer2 or the Mega103 and TIMER0 you can
'easily implement a clock by attaching a 32768 Hz xtal to the timer
'And of course some BASCOM code

'This example is written for the STK300 with M103
Enable Interrupts

'[configure LCD]
$lcd = &HC000                                               'address for E and
RS
$lcdrs = &H8000                                             'address for only E
Config Lcd = 20 * 4                                         'nice display from
bg micro
Config Lcdbus = 4                                           'we run it in bus
mode and I hooked up only db4-db7
Config Lcdmode = Bus                                        'tell about the bus
mode

'[now init the clock]
Config Date = Mdy , Separator = /                           ' ANSI-Format

Config Clock = Soft                                         'this is how simple
it is
'The above statement will bind in an ISR so you can not use the TIMER anymore!
'For the M103 in this case it means that TIMER0 can not be used by the user
anymore

'assign the date to the reserved date$
'The format is MM/DD/YY
Date$ = "11/11/00"

'assign the time, format in hh:mm:ss military format(24 hours)
```

```
'You may not use 1:2:3 !! adding support for this would mean overhead
'But of course you can alter the library routines used

Time$ = "02:20:00"

'-----------------------------------------------------

'clear the LCD display
Cls

Do
  Home                                                    'cursor home
  Lcd Date$ ; "  " ; Time$                                'show the date and
time
Loop

'The clock routine does use the following internal variables:
'_day , _month, _year , _sec, _hour, _min
'These are all bytes. You can assign or use them directly
_day = 1
'For the _year variable only the year is stored, not the century
End
```

CONFIG DATE

Action

Configures the delay time for the DEBOUNCE statement.

Syntax

CONFIG DEBOUNCE = time

Remarks

Time	A numeric constant which specifies the delay time in mS.

When debounce time is not configured, 25 mS will be used as a default.

See also

DEBOUNCE

Example

```
'-----------------------------------------------------------------------------
-----------
'name                    : deboun.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : demonstrates DEBOUNCE
'micro                   : Mega48
'suited for demo         : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                   ' specify the used
micro
$crystal = 4000000                                        ' used crystal
frequency
```

```
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Config Debounce = 30                                         'when the config
statement is not used a default of 25mS will be used


  'Debounce Pind.0 , 1 , Pr 'try this for branching when high(1)
  Debounce Pind.0 , 0 , Pr , Sub
  Debounce Pind.0 , 0 , Pr , Sub
  '                    ^----- label to branch to
  '                ^---------- Branch when P1.0 goes low(0)
  '          ^---------------- Examine P1.0

  'When Pind.0 goes low jump to subroutine Pr
  'Pind.0 must go high again before it jumps again
  'to the label Pr when Pind.0 is low

  Debounce Pind.0 , 1 , Pr                                   'no branch
  Debounce Pind.0 , 1 , Pr                                   'will result in a
return without gosub
End

Pr:
  Print "PIND.0 was/is low"
Return
```

CONFIG I2CDELAY

Action

Compiler directive that overrides the internal I2C delay routine.

Syntax

CONFIG I2CDELAY = value

Remarks

value	A numeric value in the range from 1 to 255. A higher value means a slower I2C clock.

For the I2C routines the clock rate is calculated depending on the used crystal. In order to make it work for all I2C devices the slow mode is used. When you have faster I2C devices you can specify a low value.

By default a value of 5 is used. This will give a 200 kHZ clock.
When you specify 10, 10 uS will be used resulting in a 100 KHz clock.

When you use a very low crystal frequency, it is not possible to work with high clock frequencies.

ASM

The I2C routines are located in the i2c.lib/i2c.lbx files.
For chips that have hardware TWI, you can use the MasterTWI lib.

See also

CONFIG SCL , CONFIG SDA

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : i2c.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: I2CSEND and I2CRECEIVE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Scl = Portb.4
Config Sda = Portb.5

Declare Sub Write_eeprom(byval Adres As Byte , Byval Value As Byte)
Declare Sub Read_eeprom(byval Adres As Byte , Value As Byte)

Const Addressw = 174                                       'slave write
address
Const Addressr = 175                                       'slave read address

Dim B1 As Byte , Adres As Byte , Value As Byte             'dim byte

Call Write_eeprom(1 , 3)                                   'write value of
three to address 1 of EEPROM


Call Read_eeprom(1 , Value) : Print Value                  'read it back
Call Read_eeprom(5 , Value) : Print Value                  'again for address
5


'-------- now write to a PCF8474 I/O expander -------
I2csend &H40 , 255                                         'all outputs high
I2creceive &H40 , B1                                       'retrieve input
Print "Received data " ; B1                                'print it
End

Rem Note That The Slaveaddress Is Adjusted Automaticly With I2csend &
I2creceive
Rem This Means You Can Specify The Baseaddress Of The Chip.
```

```
'sample of writing a byte to EEPROM AT2404
Sub Write_eeprom(byval Adres As Byte , Byval Value As Byte)
    I2cstart                                                'start condition
    I2cwbyte Addressw                                       'slave address
    I2cwbyte Adres                                          'asdress of EEPROM
    I2cwbyte Value                                          'value to write
    I2cstop                                                 'stop condition
    Waitms 10                                               'wait for 10
milliseconds
End Sub


'sample of reading a byte from EEPROM AT2404
Sub Read_eeprom(byval Adres As Byte , Value As Byte)
   I2cstart                                                 'generate start
   I2cwbyte Addressw                                        'slave adsress
   I2cwbyte Adres                                           'address of EEPROM
   I2cstart                                                 'repeated start
   I2cwbyte Addressr                                        'slave address
(read)
   I2crbyte Value , Nack                                    'read byte
   I2cstop                                                  'generate stop
End Sub


' when you want to control a chip with a larger memory like the 24c64 it
requires an additional byte
' to be sent (consult the datasheet):
' Wires from the I2C address that are not connected will default to 0 in most
cases!

'   I2cstart                                                'start condition
'   I2cwbyte &B1010_0000                                    'slave address
'   I2cwbyte H                                              'high address
'   I2cwbyte L                                              'low address
'   I2cwbyte Value                                          'value to write
'   I2cstop                                                 'stop condition
'   Waitms 10
```

CONFIG I2CSLAVE

Action

Configures the I2C slave mode.

Syntax

CONFIG I2CSLAVE = address , INT = interrupt , TIMER = tmr

Remarks

Address	The slave address you want to assign to the I2C slave chip. This is an address that must be even like 60. So 61 cannot be used.
Interrupt	The interrupt that must be used. This is INT0 by default.
Tmr	The timer that must be used. This is TIMER0 by default.

While the interrupt can be specified, you need to change the library code when you use a non-default interrupt. For example when you like to use INT1 instead of the default INT0.

The same applies to the TIMER. You need to change the library when you like to use another timer.

See Also

CONFIG TWI

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : i2c_pcf8574.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how you could use the I2C slave library to
create a PCF8574
'micro                    : AT90S2313
'suited for demo          : NO, ADDON NEEDED
'commercial addon needed  : yes
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 3684000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'This program shows how you could use the I2C slave library to create a PCF8574
'The PCF8574 is an IO extender chip that has 8 pins.
'The pins can be set to a logic level by writing the address followed by a
value
'In order to read from the pins you need to make them '1' first

'This program uses a AT90S2313, PORTB is used as the PCF8574 PORT
'The slave library needs INT0 and TIMER0 in order to work.
'SCL is PORTD.4 (T0)
'SDA is PORTD.2 (INT0)
'Use 10K pull up resistors for both SCL and SDA

'The Slave library will only work for chips that have T0 and INT0 connected to
the same PORT.
'These chips are : 2313,2323, 2333,2343,4433,tiny22, tiny12,tiny15, M8
'The other chips have build in hardware I2C(slave) support.

'specify the slave address. This is &H40 for the PCF8574
'You always need to specify the address used for write. In this case &H40 ,

'The config i2cslave command will enable the global interrupt enable flag !
Config I2cslave = &B01000000                                ' same as &H40
'Config I2cslave = &H40 , Int = Int0 , Timer = Timer0
'A byte named _i2c_slave_address_received is generated by the compiler.
'This byte will hold the received address.

'A byte named _i2c_slave_address is generated by the compiler.
'This byte must be assigned with the slave address of your choice

'the following constants will be created that are used by the slave library:

' _i2c_pinmask = &H14
' _i2c_slave_port = Portd
```

```
' _i2c_slave_pin = Pind
' _i2c_slave_ddr = Ddrd
' _i2c_slave_scl = 4
' _i2c_slave_sda = 2

'These values are adjusted automatic depending on the selected chip.
'You do not need to worry about it, only provided as additional info

'by default the PCF8574 port is set to input
Config Portb = Input
Portb = 255                                                 'all pins high by
default

'DIM a byte that is not needed but shows how you can store/write the I2C DATA
Dim Bfake As Byte


'empty loop
 Do
   ' you could put your other program code here
   'In any case, do not use END since it will disable interrupts

 Loop


'here you can write your other program code
'But do not forget, do not use END. Use STOP when needed

'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
'             The following labels are called from the slave library
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

'When the master wants to read a byte, the following label is allways called
'You must put the data you want to send to the master in variable _a1 which is
register R16
I2c_master_needs_data:
  'when your code is short, you need to put in a waitms statement
  'Take in mind that during this routine, a wait state is active and the master
will wait
  'After the return, the waitstate is ended
  Config Portb = Input                                      ' make it an input
  _a1 = Pinb                                                ' Get input from
portB and assign it
Return


'When the master writes a byte, the following label is always called
'It is your task to retrieve variable _A1 and do something with it
'_A1 is register R16 that could be destroyed/altered by BASIC statements
'For that reason it is important that you first save this variable

I2c_master_has_data:
  'when your code is short, you need to put in a waitms statement
  'Take in mind that during this routine, a wait state is active and the master
will wait
  'After the return, the waitstate is ended

  Bfake = _a1                                               ' this is not
needed but it shows how you can store _A1 in a byte
  'after you have stored the received data into bFake, you can alter R16
  Config Portb = Output                                     ' make it an output
since it could be an input
  Portb = _a1                                               'assign _A1 (R16)
Return


'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
```

```
'You could simply extend this sample so it will use 3 pins of PORT D for the
address selection
'For example portD.1 , portd.2 and portD.3 could be used for the address
selection
'Then after the CONFIG I2CSLAVE = &H40 statement, you can put code like:
'Dim switches as Byte    ' dim byte
'switches = PIND         ' get dip switch value
'switches = switches and &H1110 ' we only need the lower nibble without the LS
bit
'_i2c_slave_address = &H40 + switches ' set the proper address
```

CONFIG INTx

Action

Configures the way the interrupts 0,1 and 4-7 will be triggered.

Syntax

CONFIG INTx = state
Where X can be 0,1 and 4 to 7 in the MEGA chips.

Remarks

state	LOW LEVEL to generate an interrupt while the pin is held low. Holding the pin low will generate an interrupt over and over again. FALLING to generate an interrupt on the falling edge. RISING to generate an interrupt on the rising edge. CHANGE to generate an interrupt on the change of the edge.

The MEGA103 has also INT0-INT3. These are always low level triggered so there is no need /possibility for configuration.
The number of interrupt pins depend on the used chip. Most chips only have int0 and int1.

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : spi-softslave.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to implement a SPI SLAVE with software
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
```

```
$framesize = 40                                             ' default use 40
for the frame space

'Some atmel chips like the 2313 do not have a SPI port.
'The BASCOM SPI routines are all master mode routines
'This example show how to create a slave using the 2313
'ISP slave code


'define the constants used by the SPI slave
Const _softslavespi_port = Portd                            ' we used portD
Const _softslavespi_pin = Pind                              'we use the PIND
register for reading
Const _softslavespi_ddr = Ddrd                              ' data direction of
port D

Const _softslavespi_clock = 5                               'pD.5 is used for
the CLOCK
Const _softslavespi_miso = 3                                'pD.3 is MISO
Const _softslavespi_mosi = 4                                'pd.4 is MOSI
Const _softslavespi_ss = 2                                  ' pd.2 is SS
'while you may choose all pins you must use the INT0 pin for the SS
'for the 2313 this is pin 2

'PD.3(7),  MISO  must be output
'PD.4(8),  MOSI
'Pd.5(9) , Clock
'PD.2(6),  SS /INT0

'define the spi slave lib
$lib "spislave.lbx"
'sepcify wich routine to use
$external _spisoftslave

'we use the int0 interrupt to detect that our slave is addressed
On Int0 Isr_sspi Nosave
'we enable the int0 interrupt
Enable Int0
'we configure the INT0 interrupt to trigger when a falling edge is detected
Config Int0 = Falling
'finally we enabled interrupts
Enable Interrupts

'
Dim _ssspdr As Byte                                         ' this is out SPI
SLAVE SPDR register
Dim _ssspif As Bit                                          ' SPI interrupt
revceive bit
Dim Bsend As Byte , I As Byte , B As Byte                   ' some other demo
variables

_ssspdr = 0                                                 ' we send a 0 the
first time the master sends data
Do
   If _ssspif = 1 Then
   Print "received: " ; _ssspdr
   Reset _ssspif
   _ssspdr = _ssspdr + 1                                    ' we send this the
next time
   End If
Loop
```

CONFIG GRAPHLCD

Action
Configures the Graphical LCD display.

Syntax
Config GRAPHLCD = type , DATAPORT = port, CONTROLPORT=port , CE = pin , CD = pin , WR = pin, RD=pin, RESET= pin, FS=pin, MODE = mode

Remarks

Type	This must be 240 * 64, 128* 128, 128 * 64 , 160 * 48 or 240 * 128. For SED displays use 128 * 64sed or 120* 64SED For 132x132 color displays, use COLOR
Dataport	The name of the port that is used to put the data on the LCD data pins db0-db7. PORTA for example.
Controlport	This is the name of the port that is used to control the LCD control pins. PORTC for example
Ce	The pin number that is used to enable the chip on the LCD.
Cd	The pin number that is used to control the CD pin of the display.
WR	The pin number that is used to control the /WR pin of the display.
RD	The pin number that is used to control the /RD pin of the display.
FS	The pin number that is used to control the FS pin of the display. Not needed for SED based displays.
RESET	The pin number that is used to control the RESET pin of the display.
MODE	The number of columns for use as text display. Use 8 for X-pixels / 8 = 30 columns for a 240 pixel screen. When you specify 6, 240 / 6 = 40 columns can be used.

The first chip supported was T6963C. There are also driver for other LCD's such as SED and KS0108. The most popular LCD's will be supported with a custom driver.

The following connections were used for the T6963C:

PORTA.0 to PORTA.7 to DB0-DB7 of the LCD
PORTC.5 to FS, font select of LCD
PORTC.2 to CE, chip enable of LCD
PORTC.3 to CD, code/data select of LCD
PORTC.0 to WR of LCD, write
PORTC.1 to RD of LCD, read
PORTC.4 to RESET of LCD, reset LCD

The LCD used from www.conrad.de needs a negative voltage for the contrast.

Two 9V batteries were used with a pot meter.
Some displays have a Vout that can be used for the contrast(Vo)

The T6963C displays have both a graphical area and a text area. They can be used together. The routines use the XOR mode to display both text and graphics layered over each other.

The statements that can be used with the graphical LCD are :

CLS, will clear the graphic display and the text display

CLS GRAPH will clear only the graphic part of the display

CLS TEXT will only clear the text part of the display

LOCATE row,column Will place the cursor at the specified row and column

The row may vary from 1 to 16 and the column from 1 to 40. This depends on the size and mode of the display.

CURSOR ON/OFF BLINK/NOBLINK can be used the same way as for text displays.

LCD can be handled the same way as for text displays.

SHOWPIC X, Y , Label where X and Y are the column and row and Label is the label where the picture info is placed.

PSET X, Y , color Will set or reset a pixel. X can range from 0-239 and Y from 9-63. When color is 0 the pixel will turned off. When it is 1 the pixel will be set on.

$BGF "file.bgf" 'inserts a BGF file at the current location

LINE(x0,y0) – (x1,y1) , color Will draw a line from the coordinate x0,y0 to x1,y1.

Color must be 0 to clear the line and 255 for a black line.

The Graphic routines are located in the glib.lib or glib.lbx files.
You can hard wire the FS and RESET and change the code from the glib.lib file so these pins can be used for other tasks.

COLOR LCD

Color displays were always relatively expensive. The mobile phone market changed that. And Display3000.com , sorted out how to connect these small nice colorfull displays.
You can buy brand new Color displays from Display3000. MCS Electronics offers the same displays.
There are two different chip sets used. One chipset is from EPSON and the other from Philips. For this reason there are two different libraries. When you select the wrong one it will not work, but you will not damage anything.
LCD-EPSON.LBX need to be used with the EPSON chipset.
LCD-PCF8833.LBX need to be used with the Philips chipset.

Config Graphlcd = Color , Controlport = Portc , Cs = 1 , Rs = 0 , Scl = 3 , Sda = 2

Controlport	The port that is used to control the pins. PORTA, PORTB, etc.
CS	The chip select pin of the display screen. Specify the pin number. 1 will mean PORTC.1
RS	The RESET pin of the display
SCL	The clock pin of the display
SDA	The data pin of the display

As the color display does not have a built in font, you need to generate the fonts yourself. You can use the Fonteditor for this task.

A number of statements accept a color parameter. See the samples below in **bold**.

LINE	Line(0 , 0) -(130 , 130) , **Blue**
LCDAT	Lcdat 100 , 0 , "12345678" , **Blue , Yellow**
CIRCLE	Circle(30 , 30) , 10 , **Blue**
PSET	32 , 110 , **Black**
BOX	Box(10 , 30) -(60 , 100) , **Red**

See also

SHOWPIC , PSET , $BGF , LINE , LCD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : t6963_240_128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : T6963C graphic display support demo 240 * 128
'micro                    : Mega8535
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8535.dat"                                      ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'-----------------------------------------------------------------
'                    (c) 2001-2003 MCS Electronics
'                T6963C graphic display support demo 240 * 128
'-----------------------------------------------------------------

'The connections of the LCD used in this demo
'LCD pin                  connected to
' 1        GND            GND
 '2        GND            GND
 '3        +5V            +5V
 '4        -9V            -9V potmeter
 '5        /WR            PORTC.0
 '6        /RD            PORTC.1
 '7        /CE            PORTC.2
 '8        C/D            PORTC.3
 '9        NC             not conneted
 '10       RESET          PORTC.4
 '11-18    D0-D7           PA
 '19       FS             PORTC.5
 '20       NC             not connected

'First we define that we use a graphic LCD
' Only 240*64 supported yet
```

```
Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'Clear the screen will both clear text and graph display
Cls
'Other options are :
' CLS TEXT   to clear only the text display
' CLS GRAPH  to clear only the graphical part

Cursor Off

Wait 1
'locate works like the normal LCD locate statement
' LOCATE LINE,COLUMN LINE can be 1-8 and column 0-30


Locate 1 , 1

'Show some text
Lcd "MCS Electronics"
'And some othe text on line 2
Locate 2 , 1 : Lcd "T6963c support"
Locate 3 , 1 : Lcd "12345678901234567890123456789012345678901234567890"
Locate 16 , 1 : Lcd "write this to the lower line"

Wait 2

Cls Text


'use the new LINE statement to create a box
'LINE(X0,Y0) - (X1,Y1), on/off
Line(0 , 0) -(239 , 127) , 255                                  ' diagonal line
Line(0 , 127) -(239 , 0) , 255                                  ' diagonal line
Line(0 , 0) -(240 , 0) , 255                                    ' horizontal upper
line
Line(0 , 127) -(239 , 127) , 255                                'horizontal lower
line
Line(0 , 0) -(0 , 127) , 255                                    ' vertical left
line
Line(239 , 0) -(239 , 127) , 255                                ' vertical right
line


Wait 2
' draw a line using PSET X,Y, ON/OFF
' PSET on.off param is 0 to clear a pixel and any other value to turn it on
For X = 0 To 140
   Pset X , 20 , 255                                            ' set the pixel
Next

For X = 0 To 140
   Pset X , 127 , 255                                           ' set the pixel
Next

Wait 2

'circle time
```

```
'circle(X,Y), radius, color
'X,y is the middle of the circle,color must be 255 to show a pixel and 0 to
clear a pixel
For X = 1 To 10
  Circle(20 , 20) , X , 255                                    ' show circle
  Wait 1
  Circle(20 , 20) , X , 0                                      'remove circle
  Wait 1
Next

Wait 2

For X = 1 To 10
  Circle(20 , 20) , X , 255                                    ' show circle
  Waitms 200
Next
Wait 2
'Now it is time to show a picture
'SHOWPIC X,Y,label
'The label points to a label that holds the image data
Test:
Showpic 0 , 0 , Plaatje
Showpic 0 , 64 , Plaatje                                       ' show 2 since we
have a big display
Wait 2
Cls Text                                                       ' clear the text
End



'This label holds the mage data
Plaatje:
'$BGF will put the bitmap into the program at this location
$bgf "mcs.bgf"

'You could insert other picture data here
```

CONFIG KBD

Action

Configure the GETKBD() function and tell which port to use.

Syntax

CONFIG KBD = PORTx , DEBOUNCE = value [, DELAY = value]

Remarks

PORTx	The name of the PORT to use such as PORTB or PORTD.
DEBOUNCE	By default the debounce value is 20. A higher value might be needed. The maximum is 255.
Delay	An optional parameter that will cause Getkbd() to wait the specified amount of time after the key is detected. This parameter might be added when you call GetKbd() repeatedly in a loop. Because of noise and static electricity, wrong values can be returned. A delau of say 100 mS, can eliminate this problem.

The GETKBD() function can be used to read the pressed key from a matrix keypad attached to a port of the uP.

You can define the port with the CONFIG KBD statement.

In addition to the default behavior you can configure the keyboard to have 6 rows instead of 4 rows.

CONFIG KBD = PORTx , DEBOUNCE = value , rows=6, row5=pinD.6, row6=pind.7

This would specify that row5 is connected to pind.6 and row7 to pind.7
Note that you can only use rows=6. Other values will not work.

See also
GETKBD

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : getkbd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : GETKBD
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'specify which port must be used
'all 8 pins of the port are used
Config Kbd = Portb

'dimension a variable that receives the value of the pressed key
Dim B As Byte

'loop for ever
Do
  B = Getkbd()
  'look in the help file on how to connect the matrix keyboard
  'when you simulate the getkbd() it is important that you press/click the
keyboard button
  ' before running the getkbd() line !!!
  Print B
  'when no key is pressed 16 will be returned
  'use the Lookup() function to translate the value to another one
' this because the returned value does not match the number on the keyboad
Loop

End
```

CONFIG KEYBOARD

Action
Configure the GETATKBD() function and tell which port pins to use.

Syntax
CONFIG KEYBOARD = PINX.y , DATA = PINX.y , KEYDATA = table

Remarks

KEYBOARD	The PIN that serves as the CLOCK input.
DATA	The PIN that serves as the DATA input.
KEYDATA	The label where the key translation can be found. The AT keyboard returns scan codes instead of normal ASCII codes. So a translation table s needed to convert the keys. BASCOM allows the use of shifted keys too. Special keys like function keys are not supported.

The AT keyboard can be connected with only 4 wires: clock,data, gnd and vcc.
Some info is displayed below. This is copied from an Atmel data sheet.

The INT0 or INT1 shown can be in fact any pin that can serve as an INPUT pin.

The application note from Atmel works in interrupt mode. For BASCOM we rewrote the code so that no interrupt is needed/used.

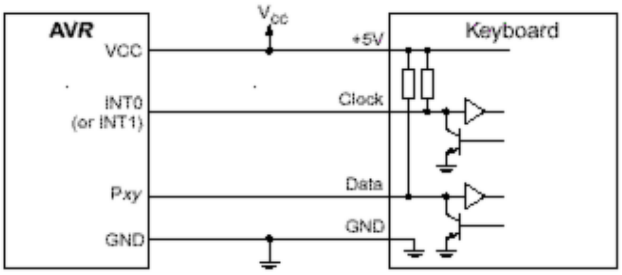


Table 1. AT Keyboard Connector Pin Assignments

AT Computer		
Signals	**DIN41524, Female at Computer, 5-pin DIN 180°**	**6-pin Mini DIN PS2 Style Female at Computer**
Clock	1	5
Data	2	1
nc	3	2,6
GND	4	3
+5V	5	4
Shield	Shell	Shell

See also
GETATKBD

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : getatkbd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PC AT-KEYBOARD Sample
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "8535def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'For this example :
'connect PC AT keyboard clock to PIND.2 on the 8535
'connect PC AT keyboard data to PIND.4 on the 8535

'The GetATKBD() function does not use an interrupt.
'But it waits until a key was pressed!

'configure the pins to use for the clock and data
'can be any pin that can serve as an input
'Keydata is the label of the key translation table
Config Keyboard = Pind.2 , Data = Pind.4 , Keydata = Keydata

'Dim some used variables
Dim S As String * 12
Dim B As Byte

'In this example we use SERIAL(COM) INPUT redirection
$serialinput = Kbdinput

'Show the program is running
Print "hello"

Do
  'The following code is remarked but show how to use the GetATKBD() function
  ' B = Getatkbd()     'get a byte and store it into byte variable
  'When no real key is pressed the result is 0
  'So test if the result was > 0
  ' If B > 0 Then
  '    Print B ; Chr(b)
  ' End If

  'The purpose of this sample was how to use a PC AT keyboard
  'The input that normally comes from the serial port is redirected to the
  'external keyboard so you use it to type
  Input "Name " , S
  'and show the result
```

```
  Print S
  'now wait for the F1 key , we defined the number 200 for F1 in the table
  Do
    B = Getatkbd()
  Loop Until B <> 0
  Print B
Loop
End

'Since we do a redirection we call the routine from the redirection routine
'
Kbdinput:
 'we come here when input is required from the COM port
 'So we pass the key into R24 with the GetATkbd function
' We need some ASM code to save the registers used by the function
$asm
 push r16           ; save used register
 push r25
 push r26
 push r27

Kbdinput1:
 rCall _getatkbd    ; call the function
 tst r24            ; check for zero
 breq Kbdinput1     ; yes so try again
 pop r27            ; we got a valid key so restore registers
 pop r26
 pop r25
 pop r16
 $end Asm
 'just return
Return

'The tricky part is that you MUST include a normal call to the routine
'otherwise you get an error
'This is no clean solution and will be changed
B = Getatkbd()

'This is the key translation table

Keydata:
'normal keys lower case
Data 0 , 0 , 0 , 0 , 0 , 200 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , &H5E , 0
Data 0 , 0 , 0 , 0 , 0 , 113 , 49 , 0 , 0 , 0 , 122 , 115 , 97 , 119 , 50 , 0
Data 0 , 99 , 120 , 100 , 101 , 52 , 51 , 0 , 0 , 32 , 118 , 102 , 116 , 114 ,
53 , 0
Data 0 , 110 , 98 , 104 , 103 , 121 , 54 , 7 , 8 , 44 , 109 , 106 , 117 , 55 ,
56 , 0
Data 0 , 44 , 107 , 105 , 111 , 48 , 57 , 0 , 0 , 46 , 45 , 108 , 48 , 112 ,
43 , 0
Data 0 , 0 , 0 , 0 , 0 , 92 , 0 , 0 , 0 , 0 , 13 , 0 , 0 , 92 , 0 , 0
Data 0 , 60 , 0 , 0 , 0 , 0 , 8 , 0 , 0 , 49 , 0 , 52 , 55 , 0 , 0 , 0
Data 48 , 44 , 50 , 53 , 54 , 56 , 0 , 0 , 0 , 43 , 51 , 45 , 42 , 57 , 0 , 0

'shifted keys UPPER case
Data 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0
Data 0 , 0 , 0 , 0 , 0 , 81 , 33 , 0 , 0 , 0 , 90 , 83 , 65 , 87 , 34 , 0
Data 0 , 67 , 88 , 68 , 69 , 0 , 35 , 0 , 0 , 32 , 86 , 70 , 84 , 82 , 37 , 0
Data 0 , 78 , 66 , 72 , 71 , 89 , 38 , 0 , 0 , 76 , 77 , 74 , 85 , 47 , 40 , 0
Data 0 , 59 , 75 , 73 , 79 , 61 , 41 , 0 , 0 , 58 , 95 , 76 , 48 , 80 , 63 , 0
Data 0 , 0 , 0 , 0 , 0 , 96 , 0 , 0 , 0 , 0 , 13 , 94 , 0 , 42 , 0 , 0
Data 0 , 62 , 0 , 0 , 0 , 8 , 0 , 0 , 49 , 0 , 52 , 55 , 0 , 0 , 0 , 0
Data 48 , 44 , 50 , 53 , 54 , 56 , 0 , 0 , 0 , 43 , 51 , 45 , 42 , 57 , 0 , 0
```

CONFIG LCD

Action
Configure the LCD display and override the compiler setting.

Syntax
CONFIG LCD = LCDtype , CHIPSET=KS077 | Dogm163v5 | DOG163V3 | DOG162V5 | DOG162V3 [,CONTRAST=value]

Remarks

LCDtype	The type of LCD display used. This can be : 40 * 4,16 * 1, 16 * 2, 16 * 4, 16 * 4, 20 * 2 or 20 * 4 or 16 * 1a or 20*4A. Default 16 * 2 is assumed.
Chipset KS077	Most text based LCD displays use the same chip from Hitachi. But some use the KS077 which is highly compatible but needs an additional function register to be set. This parameter will cause that this register is set when you initialize the display.
CHIPSET DOGM	The DOGM chip set uses a special function register that need to be set. The 16 x 2 LCD displays need DOG162V3 for 3V operation or DOG162V5 for 5V operation. The 16 x 3 LCD displays need DOG163V3 for 3V operation or Dogm163v5 for 5V operation
CONTRAST	The optional contrast parameter is only supported for the EADOG displays. By default a value from the manufacture is used. But you might want to override this value with a custom setting.

When you have a 16 * 2 display, you don't have to use this statement.
The 16 * 1a is special. It is used for 2 * 8 displays that have the address of line 2, starting at location &H8.
The 20*4A is also special. It uses the addresses &H00, &H20, &H40 and &H60 for the 4 lines. It will also set a special function register.

See Also
CONFIG LCDPIN , CONFIG LCDBUS

Example1
```
'-----------------------------------------------------------------------------
'name                     : lcd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR, HOME
'                           CURSOR, DISPLAY
'micro                    : Mega8515
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m8515.dat"                                      ' specify the used micro
$crystal = 4000000                                          ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings


Dim A As Byte
Config Lcd = 16 * 2                                          'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                          'clear the LCD
display
Lcd "Hello world."                                           'display this at
the top line
Wait 1
Lowerline                                                    'select the lower
line
Wait 1
Lcd "Shift this."                                            'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                            'shift the text to
the right
   Wait 1                                                    'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                             'shift the text to
the left
   Wait 1                                                    'wait a moment
Next
```

```
Locate 2 , 1                                                'set cursor
position
Lcd "*"                                                     'display this
Wait 1                                                      'wait a moment

Shiftcursor Right                                           'shift the cursor
Lcd "@"                                                     'display this
Wait 1                                                      'wait a moment

Home Upper                                                  'select line 1 and
return home
Lcd "Replaced."                                             'replace the text
Wait 1                                                      'wait a moment

Cursor Off Noblink                                          'hide cursor
Wait 1                                                      'wait a moment
Cursor On Blink                                             'show cursor
Wait 1                                                      'wait a moment
Display Off                                                 'turn display off
Wait 1                                                      'wait a moment
Display On                                                  'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                  'goto home on line
three
Home Fourth
Home F                                                      'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                         'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                         'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                  'value into ACC
!rCall _write_lcd                                           'put it on LCD
End
```

Example2

```
'-----------------------------------------------------------
'                      EADOG-M163.bas
'      Demonstration for EADOG 163 display
'                 (c) 1995-2006, MCS Electronics
'-----------------------------------------------------------
'

$regfile = "M8515.dat"
$crystal = 4000000
'I used the following settings
'Config Lcdpin = Pin , Db4 = Portb.2 , Db5 = Portb.3 , Db6 = Portb.4 , Db7 = Portb.5 , E = Portb.1
, Rs = Portb.0
```

```
'CONNECT vin TO 5 VOLT
Config Lcd = 16 * 3 , Chipset = Dogm163v5                   '16*3 type LCD display
'other options for chipset are DOG163V3 for 3Volt operation


'Config Lcd = 16 * 3 , Chipset = Dogm163v3 , Contrast = &H702       '16*3 type LCD display
'The CONTRAST can be specified when the default value is not what you need


'The EADOG-M162 is also supported :
'Chipset params for the DOGM162 : DOG162V5, DOG162V3

Cls                                                         'Dit maakt het scherm leeg
Locate 1 , 1 : Lcd "Hello World"
Locate 2 , 1 : Lcd "line 2"
Locate 3 , 1 : Lcd "line 3"

End
```

CONFIG LCDBUS

Action
Configures the LCD data bus and overrides the compiler setting.

Syntax
CONFIG LCDBUS = constant

Remarks

Constant	4 for 4-bit operation, 8 for 8-bit mode (default)

Use this statement together with the $LCD = address statement.

When you use the LCD display in the bus mode the default is to connect all the data lines. With the 4-bit mode, you only have to connect data lines d7-d4.

See also
CONFIG LCD

Example

```
'-----------------------------------------------------------
'                  (c) 1995-2005 MCS Electronics
'-----------------------------------------------------------
'  file: LCD.BAS
'  demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR, HOME
'        CURSOR, DISPLAY
'-----------------------------------------------------------

'note : tested in bus mode with 4-bit on the STK200
'LCD   -   STK200
'--------------------
'D4          D4
'D5          D5
'D6          D6
'D7          D7
'WR          WR
'E           E
'RS          RS
'+5V         +5V
'GND         GND
```

```
'V0         V0
'   D0-D3 are not connected since 4 bit bus mode is used!


'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Rem with the config lcdpin statement you can override the compiler settings

$regfile = "8515def.dat"
$lcd = &HC000
$lcdrs = &H8000
Config Lcdbus = 4

Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen
'other options are 16 * 2 , 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
Wait 1
Lowerline                                                   'select the lower
line
Wait 1
Lcd "Shift this."                                           'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                           'shift the text to
the right
   Wait 1                                                   'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                            'shift the text to
the left
   Wait 1                                                   'wait a moment
Next

Locate 2 , 1                                                'set cursor
position
Lcd "*"                                                     'display this
Wait 1                                                      'wait a moment

Shiftcursor Right                                           'shift the cursor
Lcd "@"                                                     'display this
Wait 1                                                      'wait a moment

Home Upper                                                  'select line 1 and
return home
Lcd "Replaced."                                             'replace the text
Wait 1                                                      'wait a moment

Cursor Off Noblink                                          'hide cursor
Wait 1                                                      'wait a moment
Cursor On Blink                                             'show cursor
Wait 1                                                      'wait a moment
```

```
Display Off                                                 'turn display off
Wait 1                                                      'wait a moment
Display On                                                  'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                  'goto home on line
three
Home Fourth
Home F                                                      'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                         'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                         'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                  'value into ACC
!rCall _write_lcd                                           'put it on LCD
```

CONFIG LCDMODE

Action

Configures the LCD operation mode and overrides the compiler setting.

Syntax

CONFIG LCDMODE = type

Remarks

Type	**PORT** Will drive the LCD in 4-bit port mode and is the default. In PORT mode you can choose different PIN's from different PORT's to connect to the upper 4 data lines of the LCD display. The RS and E can also be connected to a user selectable pin. This is very flexible since you can use pins that are not used by your design and makes the board layout simple. On the other hand, more software is necessary to drive the pins. **BUS** will drive the LCD in bus mode and in this mode is meant when you have external RAM and so have an address and data bus on your system. The RS and E line of the LCD display can be connected to an address decoder. Simply writing to an external memory location select the LCD and the data is sent to the LCD display. This means the data-lines of the LCD display are fixed to the data-bus lines. Use $LCD = address and $LCDRS = address, to specify the addresses that will enable the E and RS lines.

See also
CONFIG LCD , $LCD , $LCDRS

Example
```
Config LCDMODE = PORT 'the report will show the settings
Config LCDBUS = 4  '4 bit mode
LCD "hello"
```

CONFIG LCDPIN

Action
Override the LCD-PIN select options.

Syntax
CONFIG LCDPIN = PIN , DB4= PN,DB5=PN, DB6=PN, DB7=PN, E=PN, RS=PN
CONFIG LCDPIN = PIN , PORT=PORTx, E=PN, RS=PN

Remarks
PN	The name of the PORT pin such as PORTB.2 for example.
PORTX	When you want to use the LCD in 8 bit data, pin mode, you must specify the PORT to use.

You can override the PIN selection from the Compiler Settings with this statement, so a second configuration lets you not choose more pins for a second LCD display.

The config command is preferred over the menu settings since the code makes clear which pins are used. The CONFIG statement overrides the Options setting.

See also
CONFIG LCD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                       : lcd.bas
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR,
HOME
'                             CURSOR, DISPLAY
'micro                      : Mega8515
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8515.dat"                                      ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings


Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
```

```
Wait 1
Lowerline                                                    'select the lower
line
Wait 1
Lcd "Shift this."                                            'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                            'shift the text to
the right
   Wait 1                                                    'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                             'shift the text to
the left
   Wait 1                                                    'wait a moment
Next

Locate 2 , 1                                                 'set cursor
position
Lcd "*"                                                      'display this
Wait 1                                                       'wait a moment

Shiftcursor Right                                            'shift the cursor
Lcd "@"                                                      'display this
Wait 1                                                       'wait a moment

Home Upper                                                   'select line 1 and
return home
Lcd "Replaced."                                              'replace the text
Wait 1                                                       'wait a moment

Cursor Off Noblink                                           'hide cursor
Wait 1                                                       'wait a moment
Cursor On Blink                                              'show cursor
Wait 1                                                       'wait a moment
Display Off                                                  'turn display off
Wait 1                                                       'wait a moment
Display On                                                   'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                   'goto home on line
three
Home Fourth
Home F                                                       'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                          'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                          'print the special
```

```
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                  'value into ACC
!rCall _write_lcd                                           'put it on LCD
End
```

CONFIG PORT

Action
Sets the port or a port pin to the right data direction.

Syntax
CONFIG PORTx = state
CONFIG PINx.y = state

Remarks

state	A numeric constant that can be INPUT or OUTPUT. INPUT will set the data direction register to input for port X. OUTPUT will set the data direction to output for port X. You can also use a number for state. &B0001111, will set the upper nibble to input and the lower nibble to output. You can also set one port pin with the CONFIG PIN = state, statement. Again, you can use INPUT, OUTPUT or a number. In this case the number can be only zero or one.

The best way to set the data direction for more than 1 pin, is to use the CONFIG PORT, statement and not multiple lines with CONFIG PIN statements.

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : port.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: PortB and PortD
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space
```

```
Dim A As Byte , Count As Byte

'configure PORT D for input mode
Config Portd = Input

'reading the PORT, will read the latch, that is the value
'you have written to the PORT.
'This is not the same as reading the logical values on the pins!
'When you want to know the logical state of the attached hardware,
'you MUST use the PIN register.
A = Pind

'a port or SFR can be treated as a byte
A = A And Portd

Print A                                                 'print it

Bitwait Pind.7 , Reset                                  'wait until bit is
low


'We will use port B for output
Config Portb = Output

'assign value
Portb = 10                                              'set port B to 10
Portb = Portb And 2

Set Portb.0                                             'set bit 0 of port
B to 1

Incr Portb

'Now a light show on the STK200
Count = 0
Do
  Incr Count
  Portb = 1
  For A = 1 To 8
    Rotate Portb , Left                                 'rotate bits left
    Wait 1
  Next
  'the following 2 lines do the same as the previous loop
  'but there is no delay
'  Portb = 1
'  Rotate Portb , Left , 8
Loop Until Count = 10
Print "Ready"

'Again, note that the AVR port pins have a data direction register
'when you want to use a pin as an input it must be set low first
'you can do this by writing zeros to the DDRx:
'DDRB =&B11110000  'this will set portb1.0,portb.1,portb.2 and portb.3 to use
as inputs.

'So : when you want to use a pin as an input set it low first in the DDRx!
'     and read with PINx
'     and when you want to use the pin as output, write a 1 first
'     and write the value to PORTx

End
```

CONFIG PRINT

Action
Configure the UART to be used for RS-485

Syntax
CONFIG PRINT0 = pin
CONFIG PRINT1 = pin

Remarks

pin	The name of the PORT pin that is used to control the direction of an RS-485 driver.
mode	SET or RESET

Use PRINT or PRINT0 for the first serial port. Use PRINT1 for the second serial port.

When you use RS-485 half duplex communication you need a pin for the direction of the data. The CONFIG PRINT automates the manual setting/resetting. It will either SET or RESET the logic level of the specified pin before data is printed with the BASCOM print routines. After the data is sent, it will inverse the pin so it goes into receive mode.

You need to set the direction of the used pin to outputmode yourself.

See also
CONFIG PRINTBIN

Example
```
'-----------------------------------------------------------------------------
'name                     : rs485.bas
'copyright                : (c) 1995-2006, MCS Electronics
'purpose                  : demonstrates
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
$regfile = "m48def.dat"                                     ' we use the M48
$crystal = 8000000
$baud = 19200

$hwstack = 32
$swstack = 32
$framesize = 32

Config Print0 = Portb.0 , Mode = Set
Config Pinb.0 = Output                                      'set the direction
yourself

Dim Resp As String * 10
Do
   Print "test message"
   Input Resp                                               ' get response
Loop
```

CONFIG PRINTBIN

Action
Configure PRINTBIN behavior

Syntax
CONFIG PRINTBIN = extended

Remarks

extended	This mode is the only mode. It allows to send huge arrays(more then 255 elements) to the serial port. Without the CONFIG PRINTBIN option, the maximum number of elements is 255. Because support for big arrays cost more code, it is made optional.

See also
CONFIG PRINT

Example
```
$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Config Printbin = Extended
Dim A(1000)
Printbin A(1) ; 1000
```

CONFIG PS2EMU

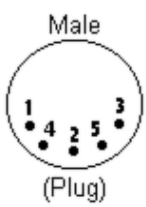
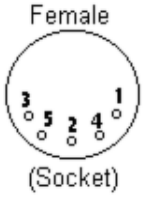
Action
Configures the PS2 mouse data and clock pins.

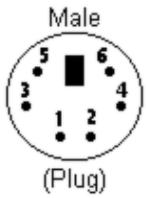
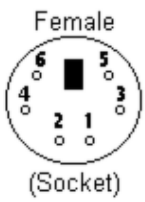
Syntax
CONFIG PS2EMU= int , DATA = data, CLOCK=clock

Remarks

Int	The interrupt used such as INT0 or INT1.

DATA	The pin that is connected to the DATA line. This must be the same pin as the used interrupt.
CLOCK	The pin that is connected to the CLOCK line.

		5-pin DIN (AT/XT): 1 - Clock 2 - Data 3 - Not Implemented 4 - Ground 5 - +5v

		6-pin Mini-DIN (PS/2): 1 - Data 2 - Not Implemented 3 - Ground 4 - +5v 5 - Clock 6 - Not Implemented

Old PC's are equipped with a 5-pin DIN female connector. Newer PC's have a 6-pin mini DIN female connector.
The male sockets must be used for the connection with the micro.

Besides the DATA and CLOCK you need to connect from the PC to the micro, you need to connect ground. You can use the +5V from the PC to power your microprocessor.

The config statement will setup an ISR that is triggered when the INT pin goes low. This routine you can find in the library.
The ISR will retrieve a byte from the PC and will send the proper commands back to the PC.

The SENDSCAN and PS2MOUSEXY statements allow you to send mouse commands.

Note that the mouse emulator is only recognized after you have booted your PC. Mouse devices can not be plugged into your PC once it has booted. Inserting a mouse or mouse device when the PC is already booted, may damage your PC.

See also
SENDSCAN, PS2MOUSEXY

Example
```
'-----------------------------------------------------------------------------
'name                    : ps2_emul.bas
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PS2 Mouse emulator
'micro                    : 90S2313
'suited for demo          : NO, commercial addon needed
'commercial addon needed  : yes
'-------------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

$lib "mcsbyteint.lbx"                                       ' use optional lib
since we use only bytes

'configure PS2 pins
Config Ps2emu = Int1 , Data = Pind.3 , Clock = Pinb.0
'                 ^------------------------ used interrupt
'                               ^----------- pin connected to DATA
'                                         ^-- pin connected to clock
'Note that the DATA must be connected to the used interrupt pin


Waitms 500                                                  ' optional delay

Enable Interrupts                                           ' you need to turn
on interrupts yourself since an INT is used

Print "Press u,d,l,r,b, or t"
Dim Key As Byte
Do
    Key = Waitkey()                                         ' get key from
terminal
    Select Case Key
      Case "u" : Ps2mousexy 0 , 10 , 0                      ' up
      Case "d" : Ps2mousexy 0 , -10 , 0                     ' down
      Case "l" : Ps2mousexy -10 , 0 , 0                     ' left
      Case "r" : Ps2mousexy 10 , 0 , 0                      ' right
      Case "b" : Ps2mousexy 0 , 0 , 1                       ' left button
pressed
                 Ps2mousexy 0 , 0 , 0                       ' left button
released
      Case "t" : Sendscan Mouseup                           ' send a scan code
      Case Else
    End Select
Loop


Mouseup:
Data 3 , &H08 , &H00 , &H01                                 ' mouse up by 1
unit
```

CONFIG RC5

Action
Overrides the RC5 pin assignment from the Option Compiler Settings.

Syntax
CONFIG RC5 = pin [,TIMER=2]

Remarks

Pin	The port pin to which the RC5 receiver is connected.
TIMER	Must be 2. The micro must have a timer2 when you want to use this option. This additional parameter will cause that TIMER2 will be used instead of the default TIMER0.

When you use different pins in different projects, you can use this statement to override the Options Compiler setting for the RC5 pin. This way you will remember which pin you used because it is in your code and you do not have to change the settings from the options. In BASCOM-AVR the settings are also stored in the project.CFG file.

See also
GETRC5

Example
```
CONFIG RC5 = PIND.5  'PORTD.5 is the RC5 input line
```

CONFIG SDA

Action
Overrides the SDA pin assignment from the Option Compiler Settings.

Syntax
CONFIG SDA = pin

Remarks

Pin	The port pin to which the I2C-SDA line is connected.

When you use different pins in different projects, you can use this statement to override the Options Compiler setting for the SDA pin. This way you will remember which pin you used because it is in your code and you do not have to change the settings from the options. In BASCOM-AVR the settings are also stored in the project.CFG file.

See also
CONFIG SCL , CONFIG I2CDELAY

Example
```
CONFIG SDA = PORTB.7  'PORTB.7 is the SDA line
```

CONFIG SCL

Action
Overrides the SCL pin assignment from the Option Compiler Settings.

Syntax
CONFIG SCL = pin

Remarks

Pin	The port pin to which the I2C-SCL line is connected.

When you use different pins in different projects, you can use this statement to override the Options Compiler setting for the SCL pin. This way you will remember which pin you used because it is in your code and you do not have to change the settings from the options. Of course BASCOM-AVR also stores the settings in a project.CFG file.

See also
CONFIG SDA , CONFIG I2CDELAY

Example
```
CONFIG SCL = PORTB.5  'PORTB.5 is the SCL line
```

CONFIG SERIALIN

Action
Configures the hardware UART to use a buffer for input

Syntax
CONFIG SERIALIN = BUFFERED , SIZE = size [, BYTEMATCH=ALL|BYTE] [,CTS=pin, RTS=pin , Threshold_full=num , Threshold_empty=num]

Remarks

size	A numeric constant that specifies how large the input buffer should be. The space is taken from the SRAM.
bytematch	The ASCII value of the byte that will result in calling the user label. When you specify ALL, the user label will be called for every byte that is received.
CTS	The pin used for the CTS.(Clear to send). For example PIND.6
RTS	The pin used for RTS. (Ready to send). For example PIND.7
Threshold_full	The number of bytes that will cause RTS to be set to '1'. This is an indication to the sender, that the buffer is full.

Threshold_empty	The number of free bytes that must be in the buffer before CTS may be made '0' again.

The following internal variables will be generated :
_RS_HEAD_PTR0 , a byte counter that stores the head of the buffer
_RS_TAIL_PTR0 , a byte counter that stores the tail of the buffer.
_RS232INBUF0 , an array of bytes that serves as a ring buffer for the received characters.
_RS_BUFCOUNTR0, a byte that holds the number of bytes that are in the buffer.

The optional BYTEMATCH can be used to monitor the incoming bytes and call a label when the specified label is found.
This way you can determine the start of a serial stream.

While bytematch allows you to trap the incoming bytes, take care that you do not delay the program execution too much. After all the serial input interrupt is used in order not to miss incoming data. When you add delays or code that will delay execution too much you will loose incoming data.

To clear the buffer, use CLEAR SERIALIN. Do not read and write the internal buffer variables yourself.

CTS-RTS is hardware flow control. Both the sender and receiver need to use CTS-RTS when CTS-RTS is used. When on of the partie's does not use CTS-RTS, no communication will be possible.
CTS-RTS use two extra lines. The receiver must check the CTS pin to see if it may send. The CTS pin is a input pin as the receiver looks at the level that the sender can change.

The receiver can set the RTS pin to indicate to the sender that it can accept data.
In the start condition, RTS is made '0' by the receiver. The sender will then check this logic level with it's cts pin, and will start to send data. The receiver will store the data into the buffer and when the buffer is almost full, or better said, when the Threshold_full is the same as the number of bytes in the receive buffer, the receiver will make RTS '1' to signal to the sender, that the buffer is full. The sender will stop sending data. And will continue when the RTS is made '0' again.

The receiver can send data to the sender and it will check the CTS pin to see if it may send data.

In order to work with CTS-RTS, you need both a serial input buffer, and a serial output buffer. So use both CONFIG SERIALIN and CONFIG SERIALOUT to specify the buffers.
The CTS-RTS can only be configured with the CONFIG SERIALIN statement.

The thresholds are needed for high baud rates where it will take some time to react on a CTS-RTS.
You need to experiment with the thresholds but good start values are 80% full, and 20% empty.

ASM

Routines called from MCS.LIB :

_GotChar. This is an ISR that gets called when ever a character is received.
When there is no room for the data it will not be stored.
So the buffer must be emptied periodic by reading from the serial port using the normal statements like INKEY() and INPUT.

Since URXC interrupt is used by _GotChar, you can not use this interrupt anymore. Unless you modify the _gotchar routine of course.

See also

CONFIG SERIALOUT , ISCHARWAITING , CLEAR

Example

```
'-----------------------------------------------------------------------------
'name                     : rs232buffer.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example shows the difference between normal and
buffered
'                          serial INPUT
'micro                    : Mega161
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m161def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 9600                                                ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'first compile and run this program with the line below remarked
Config Serialin = Buffered , Size = 20


Dim Na As String * 10

'the enabling of interrupts is not needed for the normal serial mode
'So the line below must be remarked to for the first test
Enable Interrupts

Print "Start"
Do
   'get a char from the UART

   If Ischarwaiting() = 1 Then                              'was there a char?
      Input Na$
      Print Na                                              'print it
   End If

   Wait 1                                                   'wait 1 second
Loop

'You will see that when you slowly enter characters in the terminal emulator
'they will be received/displayed.
'When you enter them fast you will see that you loose some chars

'NOW remove the remarks from line 11 and 18
'and compile and program and run again
'This time the chars are received by an interrupt routine and are
'stored in a buffer. This way you will not loose characters providing that
'you empty the buffer
```

```
'So when you fast type abcdefg, they will be printed after each other with the
'1 second delay

'Using the CONFIG SERIAL=BUFFERED, SIZE = 10 for example will
'use some SRAM memory
'The following internal variables will be generated :
'_Rs_head_ptr0   BYTE , a pointer to the location of the start of the buffer
'_Rs_tail_ptr0   BYTE , a pointer to the location of tail of the buffer
'_RS232INBUF0 BYTE ARRAY , the actual buffer with the size of SIZE
```

CONFIG SERIALIN1

Action

Configures the second hardware UART to use a buffer for input

Syntax

CONFIG SERIALIN1 = BUFFERED , SIZE = size [,CTS=pin, RTS=pin , Threshold_full=num , Threshold_empty=num]

Remarks

Size	A numeric constant that specifies how large the input buffer should be. The space is taken from the SRAM.
CTS	The pin used for the CTS.(Clear to send). For example PIND.6
RTS	The pin used for RTS. (Ready to send). For example PIND.7
Threshold_full	The number of bytes that will cause RTS to be set to '1'. This is an indication to the sender, that the buffer is full.
Threshold_empty	The number of free bytes that must be in the buffer before CTS may be made '0' again.

The following internal variables will be generated :
_RS_HEAD_PTR1 , a byte counter that stores the head of the buffer
_RS_TAIL_PTR1 , a byte counter that stores the tail of the buffer.
_RS232INBUF1 , an array of bytes that serves as a ring buffer for the received characters.
_RS_BUFCOUNTR1, a byte that holds the number of bytes that are in the buffer.

To clear the buffer, use CLEAR SERIALIN1. Do not read and write the internal buffer variables yourself.

CTS-RTS is hardware flow control. Both the sender and receiver need to use CTS-RTS when CTS-RTS is used. When on of the partie's does not use CTS-RTS, no communication will be possible.
CTS-RTS use two extra lines. The receiver must check the CTS pin to see if it may send. The CTS pin is a input pin as the receiver looks at the level that the sender can change.

The receiver can set the RTS pin to indicate to the sender that it can accept data.
In the start condition, RTS is made '0' by the receiver. The sender will then check this logic level with it's cts pin, and will start to send data. The receiver will store the data into the buffer and when the buffer is almost full, or better said, when the Threshold_full is the same as the number of bytes in the receive buffer, the receiver will make RTS '1' to signal to the sender, that the buffer is full. The sender will stop sending data. And will continue when the RTS is made '0' again.

The receiver can send data to the sender and it will check the CTS pin to see if it may send data.

In order to work with CTS-RTS, you need both a serial input buffer, and a serial output buffer. So use both CONFIG SERIALIN1 and CONFIG SERIALOUT1 to specify the buffers.
The CTS-RTS can only be configured with the CONFIG SERIALIN1 statement.

The thresholds are needed for high baud rates where it will take some time to react on a CTS-RTS.
You need to experiment with the thresholds but good start values are 80% full, and 20% empty.

ASM

Routines called from MCS.LIB :
_GotChar1. This is an ISR that gets called when ever a character is received.
When there is no room for the data it will not be stored.
So the buffer must be emptied periodic by reading from the serial port using the normal statements like INKEY() and INPUT.

Since URXC1 interrupt is used by _GotChar1, you can not use this interrupt anymore. Unless you modify the _gotchar1 routine of course.

See also

CONFIG SERIALOUT1 , ISCHARWAITING , CLEAR

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : rs232buffer1.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows the difference between normal and buffered
'                          serial INPUT
'micro                    : Mega161
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m161def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 6900                                                ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

' Works only for chips with 2 UARTS

'first compile and run this program with the line below remarked
Config Serialin1 = Buffered , Size = 20


'dim a variable
```

```
Dim Na As String * 10

Open "com1:" For Binary As #1
'the enabling of interrupts is not needed for the normal serial mode
'So the line below must be remarked to for the first test
Enable Interrupts

Print "Start"
Do
   If Ischarwaiting(#1) = 1 Then                          'was there a char?
      na$ = Waitkey(#1)
      Print #1 , Na                                      'print it
   End If

   Wait 1                                                 'wait 1 second
Loop
Close #1

'You will see that when you slowly enter characters in the terminal emulator
'they will be received/displayed.
'When you enter them fast you will see that you loose some chars

'NOW remove the remarks from line 11 and 18
'and compile and program and run again
'This time the chars are received by an interrupt routine and are
'stored in a buffer. This way you will not loose characters providing that
'you empty the buffer
'So when you fast type abcdefg, they will be printed after each other with the
'1 second delay

'Using the CONFIG SERIAL1=BUFFERED, SIZE = 10 for example will
'use some SRAM memory
'The following internal variables will be generated :
'_Rs_head_ptr1   BYTE , a pointer to the location of the start of the buffer
'_Rs_tail_ptr1   BYTE , a pointer to the location of tail of the buffer
'_RS232INBUF1 BYTE ARRAY , the actual buffer with the size of SIZE
```

CONFIG SERIALOUT

Action

Configures the hardware UART to use a buffer for output

Syntax

CONFIG SERIALOUT = BUFFERED , SIZE = size

Remarks

size	A numeric constant that specifies how large the output buffer should be. The space is taken from the SRAM.

The following internal variables will be used when you use CONFIG SERIALOUT

_RS_HEAD_PTRW0 , byte that stores the head of the buffer
_RS_TAIL_PTRW0 , byte that stores the tail of the buffer
_RS232OUTBUF0, array of bytes for the ring buffer that stores the printed data.
_RS_BUFCOUNTW0, a byte that holds the number of bytes in the buffer.

Serial buffered output can be used when you use a low baud rate. It would take relatively

much time to print all data without a buffer. When you use a buffer, the data is printed on the background when the micro UART byte buffer is empty. It will get a byte from the buffer then and transmit it.
As with any buffer you have, you must make sure that it is emptied at one moment in time. You can not keep filling it as it will become full. When you do not empty it, you will have the same situation as without a buffer !!! When the roof is leaking and you put a bucket on the floor and in the morning you empty it, it will work. But when you will go away for a day, the bucket will overflow and the result is that the floor is still wet.

Another important consideration is data loss. When you print a long string of 100 bytes, and there is only room in the buffer for 80 bytes, there is still a wait evolved since after 80 bytes, the code will wait for the buffer to become empty. When the buffer is empty it will continue to print the data. The advantage is that you do not loose any data, the disadvantage is that it blocks program execution just like a normal un-buffered PRINT would do.

ASM

Routines called from MCS.LIB :
_CHECKSENDCHAR. This is an ISR that gets called when ever the transmission buffer is empty.
Since UDRE interrupt is used , you can not use this interrupt anymore. Unless you modify the _CheckSendChar routine of course.

When you use the PRINT statement to send data to the serial port, the UDRE interrupt will be enabled. And so the _CheckSendChar routine will send the data from the buffer.

See also

CONFIG SERIALIN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : rs232bufferout.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates how to use a serial output buffer
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 9600                                                ' use baud rate
$hwstack = 40                                               ' default use 32
for the hardware stack
$swstack = 40                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


'setup to use a serial output buffer
```

```
'and reserve 20 bytes for the buffer
Config Serialout = Buffered , Size = 254

'It is important since UDRE interrupt is used that you enable the interrupts
Enable Interrupts
Print "Hello world"
Print "test1"
Do
 Wait 1
 'notice that using the UDRE interrupt will slown down execution of waiting
loops like waitms
 Print "test"
Loop
End
```

CONFIG SERIALOUT1

Action
Configures the second hardware UART to use a buffer for output

Syntax
CONFIG SERIALOUT1 = BUFFERED , SIZE = size

Remarks

Size	A numeric constant that specifies how large the output buffer should be. The space is taken from the SRAM.

The following internal variables will be used when you use CONFIG SERIALOUT

_RS_HEAD_PTRW1 , byte that stores the head of the buffer
_RS_TAIL_PTRW1 , byte that stores the tail of the buffer
_RS232OUTBUF1, array of bytes for the ring buffer that stores the printed data.
_RS_BUFCOUNTW1, a byte that holds the number of bytes in the buffer.

Serial buffered output can be used when you use a low baud rate. It would take relatively much time to print all data without a buffer. When you use a buffer, the data is printed on the background when the micro UART byte buffer is empty. It will get a byte from the buffer then and transmit it.
As with any buffer you have, you must make sure that it is emptied at one moment in time. You can not keep filling it as it will become full. When you do not empty it, you will have the same situation as without a buffer !!! When the roof is leaking and you put a bucket on the floor and in the morning you empty it, it will work. But when you will go away for a day, the bucket will overflow and the result is that the floor is still wet.

Another important consideration is data loss. When you print a long string of 100 bytes, and there is only room in the buffer for 80 bytes, there is still a wait evolved since after 80 bytes, the code will wait for the buffer to become empty. When the buffer is empty it will continue to print the data. The advantage is that you do not loose any data, the disadvantage is that it blocks program execution just like a normal un-buffered PRINT would do.

ASM
Routines called from MCS.LIB :
_CHECKSENDCHAR1. This is an ISR that gets called when ever the transmission buffer is empty.

Since UDRE1 interrupt is used , you can not use this interrupt anymore. Unless you modify the _CheckSendChar1 routine of course.
When you use the PRINT statement to send data to the serial port, the UDRE1 interrupt will be enabled. And so the _CheckSendChar1 routine will send the data from the buffer.

See also
CONFIG SERIALIN1

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : rs232bufferout1.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : how to use a serial output buffer on the second
UART
'                          this sample will only work for chips with a seond
UART like
'                          the M161 and M128
'micro                    : Mega161
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m162def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 9600                                                ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


'setup to use a serial output buffer
'and reserve 20 bytes for the buffer
Config Serialout1 = Buffered , Size = 20
Open "Com1:" For Binary As #1

'It is important since UDRE interrupt is used that you enable the interrupts
Enable Interrupts
Print #1 , "Hello world"
Do
 Wait 1
 'notice that using the UDRE interrupt will slown down execution of waiting
loops like waitms
 Print #1 , "test"
Loop
End


Close #1
```

CONFIG SINGLE

Action
Instruct the compiler to use an alternative conversion routine for representation of a single.

Syntax
CONFIG SINGLE = SCIENTIFIC , DIGITS = value

Remarks

Digits	A numeric constant with a value between 0 and 7. A value of 0 will result in no trailing zero's. A value between 1-7 can be used to specify the number of digits behind the comma.

When a conversion is performed from numeric single variable, to a string, for example when you PRINT a single, or when you use the STR() function to convert a single into a string, a special conversion routine is used that will convert into human readable output. You will get an output of digits and a decimal point.
This is well suited for showing the value on an LCD display. But there is a downside also. The routine is limited in the way that it can not shown very big or very small numbers correct.

The CONFIG SINGLE will instruct the compiler to use a special version of the conversion routine. This version will use scientific notation such as : 12e3.
You can specify how many digits you want to be included after the decimal point.

See also
NONE

ASM
Uses single.lbx library

Example
```
'-----------------------------------------------------------------
'                          (c) 1995-2005, MCS
'                 single_scientific.bas
' demonstation of scientific , single output
'-----------------------------------------------------------------

$regfile = "m88def.dat"
$crystal = 8000000
$baud = 19200

'you can view the difference by compiling and simulating  this sample with the
'line below remarked and active
Config Single = Scientific , Digits = 7

Dim S As Single
S = 1
Do
  S = S / 10
  Print S
Loop
```

CONFIG SPI

Action
Configures the SPI related statements.

Syntax for software SPI
CONFIG SPI = SOFT, DIN = PIN, DOUT = PIN , SS = PIN|NONE, CLOCK = PIN

Syntax for hardware SPI
CONFIG SPI = HARD, DINTERRUPT=ON|OFF, ATA ORDER = LSB|MSB , MASTER = YES|NO , POLARITY = HIGH|LOW , PHASE = 0|1, CLOCKRATE = 4|16|64|128 , NOSS=1|0

Remarks

SPI	SOFT for software emulation of SPI, this allows you to choose the PINS to use. Only works in master mode. HARD for the internal SPI hardware, that will use fixed pins of the microprocessor.
DIN	Data input or MISO. Pin is the pin number to use such as PINB.0
DOUT	Data output or MOSI. Pin is the pin number to use such as PORTB.1
SS	Slave Select. Pin is the pin number to use such as PORTB.2 Use NONE when you do not want the SS signal to be generated. See remarks
CLOCK	Clock. Pin is the pin number to use such as PORTB.3
DATA ORDER	Selects if MSB or LSB is transferred first.
MASTER	Selects if the SPI is run in master or slave mode.
POLARITY	Select HIGH to make the CLOCK line high while the SPI is idle. LOW will make clock LOW while idle.
PHASE	Refer to a data sheet to learn about the different settings in combination with polarity.
CLOCKRATE	The clock rate selects the division of the of the oscillator frequency that serves as the SPI clock. So with 4 you will have a clockrate of 4.000000 / 4 = 1 MHz , when a 4 MHZ XTAL is used.
NOSS	1 or 0. Use 1 when you do not want the SS signal to be generated in master mode.
INTERRUPT	Specify ON or OFF. ON will enable the SPI interrupts to occur. While OFF disables SPI interrupts. ENABLE SPI and DISABLE SPI will accomplish the same.

The default setting for hardware SPI when set from the Compiler, Options, SPI menu is MSB first, POLARITY = HIGH, MASTER = YES, PHASE = 0, CLOCKRATE = 4

When you use CONFIG SPI = HARD alone without the other parameters, the SPI will only be enabled. It will work in slave mode then with CPOL =0 and CPH=0.

In hardware mode the SPIINIT statement will set the SPI pins to :
sbi DDRB,7 ; SCK output

```
cbi DDRB,6 ; MISO input
sbi DDRB,5 ; MOSI output
```

In softmode the SPIINIT statement will set the SPI pins for example to :

```
sbi PORTB,5 ;set latch bit hi (inactive)SS
sbi DDRB,5 ;make it an output SS
cbi PORTB,4 ;set clk line lo
sbi DDRB,4 ;make it an output
cbi PORTB,6 ;set data-out lo MOSI
sbi DDRB,6 ;make it an output MOSI
cbi DDRB,7 ;MISO input
Ret
```

When you want to address multiple slaves with the software SPI you need multiple pins to select/activate the slave chip. Specify NONE for SS in that case. This also means that before every SPI command you need to set the logic level to 0 to address the chip and after the SPI command you need to set it back to a logic high level.

The hardware SPI also has this option. The NOSS parameter with a value of 1, will not set the SS line to logic 0 when the SPI operation begins. You need to set SS or any other pin of your choice to a logic 0 yourself. After the SPI command(s) are used you need to set it back to a logic 1 to deselect the slave chip.

All SPI routines are SPI-master routines. Example 2 below demonstrates how to create a soft SPI slave. In the samples directory you will also find a SPI hardware master and SPI hardware slave sample.

See also

SPIIN , SPIOUT , SPIINIT , SPI , SPIMOVE

Example

```
Config SPI = SOFT, DIN = PINB.0 , DOUT = PORTB.1, SS = PORTB.2, CLOCK = PORTB.3
Dim var As Byte
SPIINIT  'Init SPI state and pins.
SPIOUT var , 1 'send 1 byte
```

Example2

```
'-----------------------------------------------------------------------------
-----------
'name                     : rs232bufferout1.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : how to use a serial output buffer on the second
UART
'                          this sample will only work for chips with a seond
UART like
'                          the M161 and M128
'micro                    : Mega161
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m162def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
```

```
$baud = 9600                                                ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0
Config Com2 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


'setup to use a serial output buffer
'and reserve 20 bytes for the buffer
Config Serialout1 = Buffered , Size = 20
Open "Com1:" For Binary As #1

'It is important since UDRE interrupt is used that you enable the interrupts
Enable Interrupts
Print #1 , "Hello world"
Do
 Wait 1
 'notice that using the UDRE interrupt will slown down execution of waiting
loops like waitms
 Print #1 , "test"
Loop
End


Close #1
```

CONFIG SERVOS

Action

Configures how much servo's will be controlled.

Syntax

CONFIG SERVOS = X , Servo1 = Portb.0 , Servo2 = Portb.1 , Reload = rl

Remarks

Servo's need a variable pulse in order to operate. The CONFIG SERVOS directive will set up a byte array with the servo pulse width values and will initialize an ISR that uses TIMER0.

X	The number of servo's you want to control. Each used servo will use one byte of SRAM.
PORT	The port pin the servo is attached too.
RL	The reload value for the ISR in uS.

When you use for example :
Config Servos = 2 , Servo1 = Portb.0 , Servo2 = Portb.1 , Reload = 10
The internal ISR will execute every 10 uS.

An arrays named SERVO() will be created and it can hold 2 bytes : servo(1) and servo(2).

By setting the value of the servo() array you control how long the positive pulse will last.
After it has reached this value it will be reset to 0.

The reload value should be set to 10. After 20 mS, a new pulse will be generated.
You can use other reload values but it will also mean that the repeat value will change.

The PORT pins specified must be set to work as an output pin by the user.
CONFIG PINB.0 = OUTPUT
Will set a pin to output mode.

Resources used
TIMER0 is used to create the ISR.

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : servos.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates the SERVO option
'micro                    : 90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'Servo's need a pulse in order to operate
'with the config statement CONFIG SERVOS we can specify how many servo's we
'will use and which port pins are used
'A maximum of 14 servos might be used
'The SERVO statements use one byte for an interrupt counter and the TIMER0
'This means that you can not use TIMER0 anymore
'The reload value specifies the interval of the timer in uS
'Config Servos = 2 , Servo1 = Portb.0 , Servo2 = Portb.1 , Reload = 10

Config Servos = 1 , Servo1 = Portb.0 , Reload = 10
'as an option you can use TIMER1
'Config Servos = 2 , Servo1 = Portb.0 , Servo2 = Portb.1 , Reload = 10 , Timer
= Timer1

'we use 2 servos with 10 uS resolution(steps)

'we must configure the port pins used to act as output
Config Portb = Output

'finally we must turn on the global interrupt
```

```
Enable Interrupts

'the servo() array is created automatic. You can used it to set the
'time the servo must be on
Servo(1) = 10                                                    '10 times 10 = 100
uS on
'Servo(2) = 20                                                    '20 times 10 = 200
uS on
Do
Loop

Dim I As Byte
Do
 For I = 0 To 100
   Servo(1) = I
   Waitms 1000
 Next

 For I = 100 To 0 Step -1
 '  Servo(1) = I
   Waitms 1000
 Next
Loop
End
```

CONFIG TCPIP

Action

Configures the TCP/IP W3100A chip.

Syntax

CONFIG TCPIP = int , MAC = mac , IP = ip, SUBMASK = mask, GATEWAY = gateway, LOCALPORT= port, TX= tx, RX= rx , NOINIT= 0|1 , TWI=address , Clock = speed [, baseaddress = address]

Remarks

Int	The interrupt to use such as INT0 or INT1. For the Easy TCP/IP PCB, use INT0.
MAC	The MAC address you want to assign to the W3100A. The MAC address is a unique number that identifies your chip. You must use a different address for every W3100A chip in your network. Example : 123.00.12.34.56.78 You need to specify 6 bytes that must be separated by dots. The bytes must be specified in decimal notation.
IP	The IP address you want to assign to the W3100A. The IP address must be unique for every W3100A in your network. When you have a LAN, 192.168.0.10 can be used. 192.168.0.x is used for LAN's since the address is not an assigned internet address.
SUBMASK	The submask you want to assign to the W3100A. The submask is in most cases 255.255.255.0

GATEWAY	This is the gateway address of the W3100A. The gateway address you can determine with the IPCONFIG command at the command prompt : C:\>ipconfig Windows 2000 IP Configuration Ethernet adapter Local Area Connection 2: Connection-specific DNS Suffix . : IP Address. . . . . : 192.168.0.3 Subnet Mask . . . . . : 255.255.255.0 Default Gateway . . . . . : 192.168.0.1 Use 192.168.0.1 in this case.
LOCALPORT	A word value that is assigned to the LOCAL_PORT internal variable. See also Getsocket. As a default you can assign a value of 5000.
TX	A byte which specifies the transmit buffer size of the W3100A. The W3100A has 4 sockets. A value of 00 will assign 1024 bytes, a value of 01 will assign 2048 bytes. A value of 10 will assign 4096 bytes and a value of 11 will assign 8192 bytes. This is binary notation. And the Msbits specify the size of socket 3. For example, you want to assign 2048 bytes to each socket for transmission : TX = &B01010101 Since the transmission buffer size may be 8KB in total, you can split them up in 4 parts of 2048 bytes : 01. When you want to use 1 socket with 8KB size, you would use : TX = &B11. You can use only 1 socket in that case : socket 0.
RX	A byte which specifies the receive buffer size of the W3100A. The W3100A has 4 sockets. A value of 00 will assign 1024 bytes, a value of 01 will assign 2048 bytes. A value of 10 will assign 4096 bytes and a value of 11 will assign 8192 bytes. This is binary notation. And the Msbits specify the size of socket 3. For example, you want to assign 2048 bytes to each socket for reception : RX = &B01010101 Since the receive buffer size may be 8KB in total, you can split them up in 4 parts of 2048 bytes : 01. When you want to use 1 socket with 8KB size, you would use : RX = &B11. You can use only 1 socket in that case : socket 0. Consult the W3100A pdf for more info.

Noinit	Make this 1 when you want to configure the TCP, MAC, Subnetmask and GateWay dymanic. Noinit will only make some important settings and you need to use SETTCP in order to finish the setup.
TWI	The slave address of the W3100A/NM7010. When you specify TWI, your micro must have a TWI interface such as Mega128, Mega88, Mega32.
Clock	The clock frequency to use with the TWI interface
Baseaddress	An optional value for the chip select of the W3100A. This is default &H8000 when not specified. When you create your own board, you can override it.

The CONFIG TCPIP statement may be used only once.
Interrupts must be enabled before you use CONFIG TCPIP.
Configuring the W3100A will init the chip.
After the CONFIG TCPIP, you can already PING the chip!

The TWI mode works only when your micro support the TWI mode. You need to have 4k7 pull up resistors.
MCS Electronics has a small adapter PCB and KIT available that can be connected easily to your microprocessor.
The new TWI mode makes your PCB design much simpler. TWI is not as fast as bus mode. While you can use every supported TCP/IP function, it will run at a lower speed.

See also
GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Syntax Example
```
Config Tcpip = Int0 , Mac = 00.00.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

'Now use PING at the command line to send a ping:

PING 192.168.0.8
```

Or use the easytcp application to ping the chip.

CONFIG TIMER0

Action
Configure TIMER0.

Syntax
```
CONFIG TIMER0 = COUNTER , PRESCALE= 1|8|64|256|1024 ,
EDGE=RISING/FALLING , CLEAR TIMER = 1|0
CONFIG TIMER0 = TIMER , PRESCALE= 1|8|64|256|1024
```

Remarks
TIMER0 is a 8 bit counter. See the hardware description of TIMER0.

When configured as a COUNTER:

EDGE	You can select whether the TIMER will count on the falling or rising edge.

When configured as a TIMER:

PRESCALE	The TIMER is connected to the system clock in this case. You can select the division of the system clock with this parameter. Valid values are 1 , 8, 64, 256 or 1024

Note that some new AVR chips have different prescale values. You can use these.

Notice that the Help was written with the AT90S2313 and AT90S8515 timers in mind.

When you use the CONFIG TIMER0 statement, the mode is stored by the compiler and the TCCR0 register is set.
When you use the STOP TIMER0 statement, the TIMER is stopped.
When you use the START TIMER0 statement, the TIMER TCCR0 register is loaded with the last value that was configured with the CONFIG TIMER0 statement.

So before using the START and STOP TIMER0 statements, use the CONFIG statement first.

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : timer0.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to use TIMER0 related statements
'micro                    : 90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


'First you must configure the timer to operate as a counter or as a timer
'Lets configure it as a COUNTER now
'You must also specify if it will count on a rising or falling edge

Config Timer0 = Counter , Edge = Rising
'Config Timer0 = Counter , Edge = falling
'unremark the line aboven to use timer0 to count on falling edge

'To get/set the value from the timer access the timer/counter register
'lets reset it to 0
Tcnt0 = 0

Do
  Print Tcnt0
```

```
Loop Until Tcnt0 >= 10
'when 10 pulses are count the loop is exited
'or use the special variable TIMER0
Timer0 = 0


'Now configire it as a TIMER
'The TIMER can have the systemclock as an input or the systemclock divided
'by 8,64,256 or 1024
'The prescale parameter excepts 1,8,64,256 or 1024
Config Timer0 = Timer , Prescale = 1

'The TIMER is started now automaticly
'You can STOP the timer with the following statement :
Stop Timer0

'Now the timer is stopped
'To START it again in the last configured mode, use :
Start Timer0

'Again you can access the value with the tcnt0 register
Print Tcnt0
'or
Print Timer0
'when the timer overflows, a flag named TOV0 in register TIFR is set
'You can use this to execute an ISR
'To reset the flag manual in non ISR mode you must write a 1 to the bit
position
'in TIFR:
Set Tifr.1



'The following code shows how to use the TIMER0 in interrupt mode
'The code is block remarked with '(  en ')

'(

'Configute the timer to use the clock divided by 1024
Config Timer0 = Timer , Prescale = 1024

'Define the ISR handler
On Ovf0 Tim0_isr
'you may also use TIMER0 for OVF0, it is the same

Enable Timer0                                                ' enable the timer
interrupt
Enable Interrupts                                            'allow interrupts
to occur
Do
   'your program goes here
Loop

'the following code is executed when the timer rolls over
Tim0_isr:
  Print "*";
Return

')

End
```

CONFIG TIMER1

Action
Configure TIMER1.

Syntax
CONFIG TIMER1 = COUNTER | TIMER | PWM ,
EDGE=RISING | FALLING , PRESCALE= 1|8|64|256|1024 ,
NOISE CANCEL=0 |1, CAPTURE EDGE = RISING | FALLING ,
CLEAR TIMER = 1|0,
COMPARE A = CLEAR | SET | TOGGLE I DISCONNECT ,
COMPARE B = CLEAR | SET | TOGGLE I DISCONNECT ,
PWM = 8 | 9 10 ,
COMPARE A PWM = CLEAR UP| CLEAR DOWN | DISCONNECT
COMPARE B PWM = CLEAR UP| CLEAR DOWN | DISCONNECT

Remarks
The TIMER1 is a 16 bit counter. See the hardware description of TIMER1.
It depends on the chip if COMPARE B is available or not.
Some chips even have a COMARE C.

The syntax shown above must be on one line. Not all the options need to be selected.

Here is the effect of the various options.

EDGE	You can select whether the TIMER will count on the falling or rising edge. Only for COUNTER mode.
CAPTURE EDGE	You can choose to capture the TIMER registers to the INPUT CAPTURE registers With the CAPTURE EDGE = FALLING/RISING, you can specify to capture on the falling or rising edge of pin ICP
NOISE CANCELING	To allow noise canceling you can provide a value of 1.
PRESCALE	The TIMER is connected to the system clock in this case. You can select the division of the system clock with this parameter. Valid values are 1 , 8, 64, 256 or 1024

The TIMER1 also has two compare registers A and B

When the timer value matches a compare register, an action can be performed

COMPARE A	The action can be: SET will set the OC1X pin CLEAR will clear the OC1X pin TOGGLE will toggle the OC1X pin DISCONNECT will disconnect the TIMER from output pin OC1X

And the TIMER can be used in PWM mode.
You have the choice between 8, 9 or 10 bit PWM mode

Also you can specify if the counter must count UP or down after a match to the compare registers

Note that there are two compare registers A and B

PWM	Can be 8, 9 or 10.
COMPARE A PWM	PWM compare mode. Can be CLEAR UP or CLEAR DOWN

Using COMPARE A, COMPARE B, COMPARE A PWM or COMPARE B PWM will set the corresponding pin for output. When this is not wanted you can use the alternative NO_OUTPUT version that will not alter the output pin.

For example : COMPARE A NO_OUTPUT , COMPARE A PWM NO_OUTPUT

Example

```
'-----------------------------------------------------------------------
-----------
'name                       : timer1.bas
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : show using Timer1
'micro                      : 90S8515
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------
-----------

$regfile = "8515def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


Dim W As Word

'The TIMER1 is a versatile 16 bit TIMER.
'This example shows how to configure the TIMER

'First like TIMER0 , it can be set to act as a TIMER or COUNTER
'Lets configute it as a TIMER that means that it will count and that
'the input is provided by the internal clock.
'The internal clock can be divided by 1,8,64,256 or 1024
Config Timer1 = Timer , Prescale = 1024


'You can read or write to the timer with the COUNTER1 or TIMER1 variable
W = Timer1
Timer1 = W


'To use it as a COUNTER, you can choose on which edge it is trigereed
Config Timer1 = Counter , Edge = Falling , Prescale = 1
'Config Timer1 = Counter , Edge = Rising

'Also you can choose to capture the TIMER registers to the INPUT CAPTURE
registers
'With the CAPTURE EDGE = , you can specify to capture on the falling or rising
edge of
'pin ICP
```

```
Config Timer1 = Counter , Edge = Falling , Capture Edge = Falling , Prescale =
1024
'Config Timer1 = Counter , Edge = Falling , Capture Edge = Rising

'To allow noise canceling you can also provide :
Config Timer1 = Counter , Edge = Falling , Capture Edge = Falling , Noise
Cancel = 1 , Prescale = 1

'to read the input capture register :
W = Capture1
'to write to the capture register :
Capture1 = W




'The TIMER also has two compare registers A and B
'When the timer value matches a compare register, an action can be performed
Config Timer1 = Counter , Edge = Falling , Compare A = Set , Compare B = Toggle
 , , Clear Timer = 1
'SET , will set the OC1X pin
'CLEAR, will clear the OC1X pin
'TOGGLE, will toggle the OC1X pin
'DISCONNECT, will disconnect the TIMER from output pin OC1X
'CLEAR TIMER will clear the timer on a compare A match

'To read write the compare registers, you can use the COMPARE1A and COMPARE1B
variables
Compare1a = W
W = Compare1a


'And the TIMER can be used in PWM mode
'You have the choice between 8,9 or 10 bit PWM mode
'Also you can specify if the counter must count UP or down after a match
'to the compare registers
'Note that there are two compare registers A and B
Config Timer1 = Pwm , Pwm = 8 , Compare A Pwm = Clear Up , Compare B Pwm =
Clear Down , Prescale = 1

'to set the PWM registers, just assign a value to the compare A and B registers
Compare1a = 100
Compare1b = 200

'Or for better reading :
Pwm1a = 100
Pwm1b = 200

End
```

CONFIG TIMER2

Action

Configure TIMER2.

Syntax for the 8535

CONFIG TIMER2 = TIMER | PWM , ASYNC=ON |OFF,
PRESCALE = 1 | 8 | 32 | 64 | 128 | 256 | 1024 ,
COMPARE = CLEAR | SET | TOGGLE I DISCONNECT ,
PWM = ON | OFF ,

COMPARE PWM = CLEAR UP| CLEAR DOWN | DISCONNECT ,
CLEAR TIMER = 1|0

Syntax for the M103

CONFIG TIMER2 = COUNTER| TIMER | PWM ,
EDGE= FALLING |RISING,
PRESCALE = 1 | 8 | 64 | 256 | 1024 ,
COMPARE = CLEAR | SET | TOGGLE I DISCONNECT ,
PWM = ON | OFF ,
COMPARE PWM = CLEAR UP| CLEAR DOWN | DISCONNECT ,
CLEAR TIMER = 1|0

Remarks

The TIMER2 is an 8 bit counter.
It depends on the chip if it can work as a counter or not.
The syntax shown above must be on one line. Not all the options need to be selected.

Here is the effect of the various options.

EDGE	You can select whether the TIMER will count on the falling or rising edge. Only for COUNTER mode.

PRESCALE	The TIMER is connected to the system clock in this case. You can select the division of the system clock with this parameter. Valid values are 1 , 8, 64, 256 or 1024 or 1 , 8, 32 , 64 , 256 or 1024 for the M103

The TIMER2 also has a compare registers

When the timer value matches a compare register, an action can be performed

COMPARE	The action can be: SET will set the OC2 pin CLEAR will clear the OC2 pin TOGGLE will toggle the OC2 pin DISCONNECT will disconnect the TIMER from output pin OC2

And the TIMER can be used in 8 bit PWM mode

You can specify if the counter must count UP or down after a match to the compare registers

COMPARE PWM	PWM compare mode. Can be CLEAR UP or CLEAR DOWN

Example

```
Dim W As Byte
Config Timer2 = Timer , ASYNC = 1 , Prescale = 128
```

```
On TIMER2 Myisr
ENABLE INTERRUPTS
ENABLE TIMER2
DO

LOOP


MYISR:
'get here every second with a 32768 KHz xtal
RETURN


'You can read or write to the timer with the COUNTER2 or TIMER2 variable
W = Timer2
Timer2 = W
```

CONFIG TWI

Action
Configure the TWI (two wire serial interface).

Syntax
CONFIG TWI = clockspeed

Remarks

clockspeed	The desired clock frequency for SCL

CONFIG TWI will set TWSR prescaler bits 0 and 1, and TWBR depending on the used $CRYSTAL frequency and the desired SCL clock speed.
Typical you need a speed of 400 KHz. Some devices will work on 100 KHz as well.

When TWI is used in SLAVE mode, you need to have a faster clock speed as the master.

It is important that you specify the proper crystal frequency. Otherwise it will result in a wrong TWI clock frequency.

See also
$CRYSTAL

Example

```
'------------------------------------------------------------------
' (c) 2004 MCS Electronics
' This demo shows an example of the TWI
' Not all AVR chips have TWI (hardware I2C)
'------------------------------------------------------------------
```

```
'The chip will work in TWI/I2C master mode
'Connected is a PCF8574A 8-bits port extender


$regfile="M8def.dat"' the used chip
$crystal= 4000000 ' frequency used
$baud= 19200 ' baud rate


$lib"i2c_twi.lbx"' we do not use software emulated I2C but the TWI

Config Scl =Portc.5 ' we need to provide the SCL pin name
Config Sda =Portc.4 ' we need to provide the SDA pin name

'On the Mega8, On the PCF8574A
'scl=PC5 , pin 28 pin 14
'sda=PC4 , pin 27 pin 15


I2cinit' we need to set the pins in the proper state


Config Twi = 100000 ' wanted clock frequency
'will set TWBR and TWSR
'Twbr = 12 'bit rate register
'Twsr = 0 'pre scaler bits

Dim B AsByte, X AsByte
Print"TWI master"
Do
Incr B ' increase value
I2csend&B01110000 , B ' send the value
Print"Error : ";Err' show error status
I2creceive&B01110000 , X ' get a byte
Print X ;" ";Err' show error
Waitms 500 'wait a bit
Loop
End
```

CONFIG TWISLAVE

Action

Configure the TWI Slave address and bitrate

Syntax

CONFIG TWISLAVE = address , BTR = value , BITRATE = value SAVE=option

Remarks

Address	The slave address that is assigned to the slave chip. This must be an Even number. The address 0 is the general call address.
BTR	Bytes to receive. With this constant you specify how many bytes will be expected when the slave receives bytes.

Bitrate	This is the I2C/TWI clock frequency. Most chips support 400 KHz (400000) but all I2C chips support 100000.
SAVE	SAVE = NOSAVE : this can be used when you do not change a lot of registers in the interrupt. SAVE : SAVE : this is best to be used when you do not use ASM in the TWI interrupt. See the explanation below.

The variables Twi , Twi_btr and Twi_btw are created by the compiler. These are all bytes
The TWI interrupt is enabled but you need to enabled the global interrupt

The TWI Slave code is running as an interrupt process. Each time there is a TWI interrupt some slave code is executed. Your BASIC code is called from the low level slave code under a number of events. You must include all these labels in your Slave application. You do not need to write code in all these sub routines.

Label	Event
Twi_stop_rstart_received	The Master sent a stop(i2CSTOP) or repeated start. Typical you do not need to do anything here.
Twi_addressed_goread	The master has addressed the slave and will now continue to send data to the slave. You do not need to take action here.
Twi_addressed_gowrite	The master has addressed the slave and will now continue to receive data from the slave. You do not need to take action here.
Twi_gotdata	The master has sent data. The variable **TWI** holds the received value. The byte **TWI_BTW** is an index that holds the value of the number of received bytes. The first received byte will have an index value of 1.
Twi_master_needs_byte	The master reads from the slave and needs a value. The variable TWI_BTR can be inspected to see which index byte was needed. With the CONFIG BTR, you specify how many bytes the master will read.

The TWI Slave code will save all used registers. But as it will call your BASIC application as the TWI interrupt occurs, your BASIC code could be in the middle of a PRINT statements. When you then execute another PRINT statement , you will destroy registers.
So keep the code in the sub routines to a minimum, and use SAVE option to save all registers.
While two printing commands will give odd results (print 12345 and 456 in the middle of the first print will give 1234545) at least no register is destroyed.

See also
CONFIG TWI

ASM
NONE

Example
```
'-------------------------------------------------------------------------
-
'                        (c) 1995-2006 MCS Electronics
'                This demo shows an example of the TWI in SLAVE mode
```

```
'                       Not all AVR chips have TWI (hardware I2C)
'  This demo is a Mega8 I2C A/D converter slave chip
' NOTICE that this demo will only work with the TWI slave library which is
avaialble as an add on
' SDA pin is PORTC.4 (pin 27)
' SCL pin is PORTC.5 (pin 28)
'-------------------------------------------------------------------------
-
$regfile = "M8def.dat"                                      ' the chip we use
$crystal = 8000000                                          ' crystal
oscillator value
$baud = 19200                                               ' baud rate

$lib "i2c_twi-slave.lbx"

Print "MCS Electronics M8 TWI-slave demo"
Print "Use with M8-TWI master demo"

Config Adc = Single , Prescaler = Auto
'Now give power to the chip
Start Adc

Dim W As Word
Config Portb = Output

Dim Status As Byte                                          'only for debug
'Print Hex(status)

Config Twislave = &H70 , Btr = 2 , Bitrate = 100000
'                    ^--- slave address
'                         ^---------- 2 bytes to receive
'                                     ^--- bitrate is 100 KHz


'The variables  Twi , Twi_btr and Twi_btw are created by the compiler. These
are all bytes
'The TWI interrupt is enabled but you need to enabled the global interrupt


Enable Interrupts

'this is just an empty loop but you could perform other tasks there
Do
  'Print Getadc(0)
  'Waitms 500
  nop
Loop
End



'The following labels are called from the library. You need to insert code in
these subroutines
'Notice that the PRINT commands are remarked.
'You can unmark them and see what happens, but it will result in occasional
errors in the transmission
'The idea is that you write your code in the called labels. And this code must
execute in as little time
'as possible. So when you slave must read the A/D converter, you can best do it
in the main program
'then the data is available when the master needs it, and you do not need to do
the conversion which cost time.


'A master can send or receive bytes.
'A master protocol can also send some bytes, then receive some bytes
'The master and slave must match.

'the following labels are called from the library  when master send stop or
start
Twi_stop_rstart_received:
```

```
 ' Print "Master sent stop or repeated start"
Return

'master sent our slave address and will not send data
Twi_addressed_goread:
 ' Print "We were addressed and master will send data"
Return


Twi_addressed_gowrite:
 ' Print "We were addressed and master will read data"
Return

'this label is called when the master sends data and the slave has received the
byte
'the variable TWI holds the received value
Twi_gotdata:
  ' Print "received : " ; Twi ; " byte no : " ; Twi_btw
   Select Case Twi_btw
     Case 1 : Portb = Twi                                    ' first byte
     Case 2:                                                 'you can set
another port here for example
   End Select
Return

'this label is called when the master receives data and needs a byte
'the variable twi_btr is a byte variable that holds the index of the needed
byte
'so when sending multiple bytes from an array, twi_btr can be used for the
index
Twi_master_needs_byte:
  'Print "Master needs byte : " ; Twi_btr
  Select Case Twi_btr
    Case 1:                                                  ' first byte
              W = Getadc(0)                                  'in this example
the conversion is done here
              ' but a better option would have been to just pass the value of W
and do the conversion in the main loop
              Twi = Low(w)
    Case 2                                                   ' send second byte
              Twi = High(w)
  End Select
Return


'when the mast has all bytes received this label will be called
Twi_master_need_nomore_byte:
 ' Print "Master does not need anymore bytes"
Return
```

CONFIG WAITSUART

Action

Compiler directive that specifies that software UART waits after sending the last byte.

Syntax

CONFIG WAITSUART = value

Remarks

value	A numeric value in the range of 1-255. A higher value means a longer delay in mS.

When the software UART routine are used in combination with serial LCD displays it can be convenient to specify a delay so the display can process the data.

See also
OPEN

Example
See OPEN example for more details.

CONFIG WATCHDOG

Action
Configures the watchdog timer.

Syntax
CONFIG WATCHDOG = time

Remarks

Time	The interval constant in mS the watchdog timer will count to before it will reset your program. Possible settings : 16 , 32, 64 , 128 , 256 , 512 , 1024 and 2048. Some chips : 4098, 8192.

Note that some new AVR's might have additional reset values such as 4098 and 8192.

When the WD is started, a reset will occur after the specified number of mS.
With 2048, a reset will occur after 2 seconds, so you need to reset the WD in your programs periodically with the RESET WATCHDOG statement.

Some AVR's might have the WD timer enabled by default. You can change this with the Fuse Bits.

See also
START WATCHDOG , STOP WATCHDOG , RESET WATCHDOG

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : watchd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates the watchdog timer
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
```

```
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Watchdog = 2048                                     'reset after 2048
mSec
Start Watchdog                                             'start the watchdog
timer
Dim I As Word
For I = 1 To 1000

  Print I                                                  'print value
  'Reset Watchdog
  'you will notice that the for next doesnt finish because of the reset
  'when you unmark the RESET WATCHDOG statement it will finish because the
  'wd-timer is reset before it reaches 2048 msec
Next
End
```

CONFIG X10

Action

Configures the pins used for X10.

Syntax

CONFIG X10 = pinZC , TX = portpin

Remarks

PinZC	The pin that is connected to the zero cross output of the TW-523. This is a pin that will be used as INPUT.
Portpin	The pin that is connected to the TX pin of the Tw-523. TX is used to send X10 data to the TW-523. This pin will be used in output mode.

The TW-523 RJ-11 connector has the following pinout:

Pin	Description	Connect to micro
1	Zero Cross	Input pin. Add 5.1K pull up.
2	GND	GND
3	RX	Not used.
4	TX	Output pin. Add 1K pull up.

See also

X10DETECT , X10SEND

Example

```
'-------------------------------------------------------------------------
-----------
'name                     : x10.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example needs a TW-523 X10 interface
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


'define the house code
Const House = "M"                                          ' use code A-P

Waitms 500                                                 ' optional delay
not really needed

'dim the used variables
Dim X As Byte

'configure the zero cross pin and TX pin
Config X10 = Pind.4 , Tx = Portb.0
'             ^--zero cross
'                          ^--- transmission pin

'detect the TW-523
X = X10detect()
Print X                                                    ' 0 means error, 1
means 50 Hz, 2 means 60 Hz

Do
   Input "Send (1-32) " , X
   'enter a key code from 1-31
   '1-16 to address a unit
   '17 all units off
   '18 all lights on
   '19 ON
   '20 OFF
   '21 DIM
   '22 BRIGHT
   '23 All lights off
   '24 extended code
   '25 hail request
   '26 hail acknowledge
   '27 preset dim
   '28 preset dim
   '29 extended data analog
   '30 status on
```

```
   '31 status off
   '32 status request

   X10send House , X                                          ' send the code
Loop

Dim Ar(4) As Byte
X10send House , X , Ar(1) , 4                                 ' send 4 additional
bytes

End
```

CONST

Action
Declares a symbolic constant.

Syntax
CONST symbol = numconst
CONST symbol = stringconst
CONST symbol = expression

Remarks

Symbol	The name of the symbol.
Numconst	The numeric value to assign to the symbol.
Stringconst	The string to assign to the symbol
Expression	An expression that returns a value to assign the constant

Assigned constants consume no program memory because they only serve as a reference to the compiler.
The compiler will replace all occurrences of the symbol with the assigned value.

You can use a constant to give a value a more meaningful name.
For example : variable = 1

```
const optHeaterOn = 1
variable = optHeaterOn
```

The source code is better to read when you assign a constant. Even better when the values change later, for example when HeaterOn becomes 2, you only need to replace 1 line of code.

See also
ALIAS

Example
```
'-----------------------------------------------------------------------
-----------
'name                  : const.bas
'copyright             : (c) 1995-2005, MCS Electronics
'purpose               : demo for constants
```

```
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'dimension some variables
Dim Z As String * 10
Dim B As Byte

'assign some constants
'constants dont use program memory
Const S = "test"
Const A = 5                                                'declare a as a
constant
Const B1 = &B1001

'or use an expression to assign a constant
Const X =(b1 * 3) + 2
Const Ssingle = Sin(1)


Print X
Print Ssingle


B = A
'the same as b = 5

Z = S
'the same as Z = "test"

Print A
Print B1
Print S


'you can use constants with conditional compilation
#if A = 5                                                  ' note there is no
then
  Print "constant a is 5"
  #if S = "test"
    Print "nested example"
  #else                                                    ' else is optional
  #endif
#else
#endif

End
```

Action
Returns the cosine of a single

Syntax
var = **COS**(single)

Remarks

Var	A numeric variable that is assigned with cosine of variable single.
Single	The single variable to get the cosine of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , ATN , SIN , TAN

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
S = 0.5 : X = Tan(s) : Print X                             ' prints
0.546302195
S = 0.5 : X = Sin(s) : Print X                             ' prints
0.479419108
S = 0.5 : X = Cos(s) : Print X                             ' prints
0.877588389

End
```

COSH

Action
Returns the cosine hyperbole of a single

Syntax
var = **COSH**(single)

Remarks

Var	A numeric variable that is assigned with cosine hyperbole of variable single.
Single	The single or double variable to get the cosine hyperbole of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also

RAD2DEG , DEG2RAD , ATN , COS , SIN , TANH , SINH

Example

Show sample

COUNTER0 and COUNTER1

Action

Set or retrieve the internal 16 bit hardware register.

Syntax

COUNTER0 = var var = COUNTER0	TIMER0 can also be used
COUNTER1 = var var = COUNTER1	TIMER1 can also be used
CAPTURE1 = var var = CAPTURE1	TIMER1 capture register
COMPARE1A = var var = COMPARE1A	TIMER1 COMPARE A register
COMARE1B = var var = COMPARE1B	TIMER1 COMPARE B register
PWM1A = var var = PWM1A	TIMER1 COMPAREA register. (Is used for PWM)
PWM1B = var var = PRM1B	TIMER1 COMPARE B register. (Is used for PWM)

Remarks

Var	A byte, Integer/Word variable or constant that is assigned to the register or is read from the register.

Because the above 16 bit register pairs must be accessed somewhat differently than you may expect, they are implemented as variables.

The exception is TIMER0/COUNTER0, this is a normal 8 bit register and is supplied for compatibility with the syntax.

When the CPU reads the low byte of the register, the data of the low byte is sent to the CPU

and the data of the high byte is placed in a temp register. When the CPU reads the data in the high byte, the CPU receives the data in the temp register.

When the CPU writes to the high byte of the register pair, the written data is placed in a temp register. Next when the CPU writes the low byte, this byte of data is combined with the byte data in the temp register and all 16 bits are written to the register pairs. So the MSB must be accessed first.

All of the above is handled automatically by BASCOM when accessing the above registers.

Note that the available registers may vary from chip to chip.

The BASCOM documentation used the 90S8515 to describe the different hardware registers.

CPEEK

Action
Returns a byte stored in code memory.

Syntax
var = **CPEEK**(address)

Remarks

Var	Numeric variable that is assigned with the content of the program memory at address
Address	Numeric variable or constant with the address location

There is no CPOKE statement because you can not write into program memory.
Cpeek(0) will return the first byte of the file. Cpeek(1) will return the second byte of the binary file.

See also
PEEK , POKE , INP , OUT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : peek.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates PEEk, POKE, CPEEK, INP and OUT
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Dim I As Integer , B1 As Byte
'dump internal memory
For I = 0 To 31                                              'only 32 registers
in AVR
  B1 = Peek(i)                                               'get byte from
internal memory
  Print Hex(b1) ; "  ";
  'Poke I , 1                              'write a value into memory
Next
Print                                                        'new line
'be careful when writing into internal memory !!

'now dump a part ofthe code-memory(program)
For I = 0 To 255
  B1 = Cpeek(i)                                              'get byte from
internal memory
  Print Hex(b1) ; "  ";
Next
'note that you can not write into codememory!!

Out &H8000 , 1                                               'write 1 into XRAM
at address 8000
B1 = Inp(&H8000)                                             'return value from
XRAM
Print B1

End
```

CPEEKH

Action

Returns a byte stored in upper page of code memory of micro with more then 64KB such as M103, M128.

Syntax

var = **CPEEKH**(address)

Remarks

Var	Numeric variable that is assigned with the content of the program memory at address
Address	Numeric variable or constant with the address location

CpeekH(0) will return the first byte of the upper 64KB.
Since the M103 has 64K words of code space the LPM instruction can not access the 64 upper Kbytes.
The CpeekH() function peeks in the upper 64 KB.
This function should be used with the M103 or M128 only.

See also
PEEK , POKE , INP , OUT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                      : peek.bas
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : demonstrates PEEk, POKE, CPEEK, INP and OUT
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim I As Integer , B1 As Byte
'dump internal memory
For I = 0 To 31                                             'only 32 registers
in AVR
  B1 = Peek(i)                                              'get byte from
internal memory
  Print Hex(b1) ; "  ";
  'Poke I , 1                            'write a value into memory
Next
Print                                                       'new line
'be careful when writing into internal memory !!

'now dump a part ofthe code-memory(program)
For I = 0 To 255
  B1 = Cpeek(i)                                             'get byte from
internal memory
  Print Hex(b1) ; "  ";
Next
'note that you can not write into codememory!!

Out &H8000 , 1                                              'write 1 into XRAM
at address 8000
B1 = Inp(&H8000)                                            'return value from
XRAM
Print B1

End
```

CRC8

Action

Returns the CRC8 value of a variable or array.

Syntax
Var = **CRC8**(source , L)

Remarks

Var	The variable that is assigned with the CRC8 of variable source.
Source	The source variable or first element of the array to get the CRC8 of.
L	The number of bytes to check.

CRC8 is used in communication protocols to check if there are no transmission errors.
The 1wire for example returns a crc byte as the last byte from it's ID.

The code below shows a VB function of crc8

```
Function Docrc8(s As String) As Byte
Dim j As Byte
Dim k As Byte
Dim crc8 As Byte
crc8 = 0
For m = 1 To Len(s)
  x = Asc(Mid(s, m, 1))
  For k = 0 To 7
   j = 1 And (x Xor crc8)
   crc8 = Fix(crc8 / 2) And &HFF
   x = Fix(x / 2) And &HFF
   If j <> 0 Then
   crc8 = crc8 Xor &H8C
   End If
  Next k
Next
Docrc8 = crc8
End Function
```

See also
CHECKSUM , CRC16, CRC32 , TCPCHECKSUM

ASM
The following routine is called from mcs.lib : _CRC8
The routine must be called with Z pointing to the data and R24 must contain the number of bytes to check.
On return, R16 contains the CRC8 value.
The used registers are : R16-R19, R25.

```
;##### X = Crc8(ar(1) , 7)
Ldi R24,$07     ; number of bytes
Ldi R30,$64     ; address of ar(1)
Ldi R31,$00     ; load constant in register
Rcall _Crc8     ; call routine
```

```
Ldi R26,$60     ; address of X
St X,R16      ; store crc8
```

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim Ar(10) As Byte
Dim J As Byte

Ar(1) = 1
Ar(2) = 2
Ar(3) = 3

J = Crc8(ar(1) , 3)                                        'calculate value
which is 216
Print J
End
```

CRC16

Action

Returns the CRC16 value of a variable or array.

Syntax

Var = **CRC16**(source , L)

Remarks

Var	The variable that is assigned with the CRC16 of variable source. Should be a word or integer variable.
Source	The source variable or first element of the array to get the CRC16 value from.
L	The number of bytes to check.

CRC16 is used in communication protocols to check if there are no transmission errors.
The 1wire for example returns a crc byte as the last byte from it's ID.
Use CRC8 for the 1wire routines.

There are a lot of different CRC16 routines. There is no real standard since the polynomial will vary from manufacture to manufacture.

See also
CHECKSUM , CRC8, CRC32 , TCPCHECKSUM

ASM
The following routine is called from mcs.lib : _CRC16
The routine must be called with X pointing to the data. The soft stack –Y must contain the number of bytes to scan.
On return, R16 and R17 contain the CRC16 value.
The used registers are : R16-R19, R25.

```
;##### X = Crc16(ar(1) , 7)

Ldi R24,$07     ; number of bytes
St –y, R24
Ldi R26,$64     ; address of ar(1)
Ldi R27,$00     ; load constant in register
Rcall _Crc16     ; call routine
Ldi R26,$60     ; address of X
St X+,R16     ; store crc16 LSB
St X , R17     ; store CRC16 MSB
```

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim Ar(10) As Byte
Dim J As Byte
Dim W As Word
Dim L As Long

Ar(1) = 1
Ar(2) = 2
Ar(3) = 3

J = Crc8(ar(1) , 3)                                        'calculate value
which is 216
W = Crc16(ar(1) , 3)                                       '24881
L = Crc32(ar(1) , 3)                                       '494976085

End
```

CRC32

Action
Returns the CRC32 value of a variable.

Syntax
Var = **CRC32**(source , L)

Remarks

Var	The LONG variable that is assigned with the CRC32 of variable source.
Source	The source variable or first element of the array to get the CRC 32 value from.
L	The number of bytes to check.

CRC32 is used in communication protocols to check if there are no transmission errors.

See also
CHECKSUM , CRC8, CRC16 , TCPCHECKSUM

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim Ar(10) As Byte
Dim J As Byte
Dim W As Word
Dim L As Long

Ar(1) = 1
Ar(2) = 2
Ar(3) = 3

J = Crc8(ar(1) , 3)                                        'calculate value
which is 216
W = Crc16(ar(1) , 3)                                       '24881
L = Crc32(ar(1) , 3)                                       '494976085

End
```

Action
Special byte variable that can be used with software UART routine to change the baudrate during runtime.

Syntax
CRYSTAL = var (old option do not use !!)

___CRYSTAL1 = var
BAUD #1, 2400

Remarks
With the software UART you can generate good baud rates. But chips such as the ATtiny22 have an internal 1 MHz clock. The clock frequency can change during runtime by influence of temperature or voltage.

The crystal variable can be changed during runtime to change the baud rate.

The above has been changed in version 1.11
Now you still can change the baud rate with the crystal variable.
But you don't need to dimension it. And the name has been changed:

___CRYSTALx where x is the channel number.

When you opened the channel with #1, the variable will be named ___CRYSTAL1

But a better way is provided now to change the baud rate of the software uart at run time.
You can use the BAUD option now:

Baud #1 , 2400 'change baud rate to 2400 for channel 1

When you use the baud # option, you must specify the baud rate before you print or use input on the channel. This will dimension the ___CRYSTALx variable and load it with the right value.

When you don't use the BAUD # option the value will be loaded from code and it will not use 2 bytes of your SRAM.

The ___CRYSTALx variable is hidden in the report file because it is a system variable. But you may assign a value to it after BAUD #x, zzzz has dimensioned it.

The old CRYSTAL variable does not exist anymore.

Some values for 1 MHz internal clock :

66 for 2400 baud

31 for 4800 baud

14 for 9600 baud

See also

OPEN , CLOSE

Example
```
Dim B asbyte
Open"comd.1:9600,8,n,1,inverted"ForOutputAs#1
Print#1 , B
Print#1 ,"serial output"
baud#1, 4800 'use 4800 baud now
Print#1,"serial output"
___CRYSTAL1 = 255
Close#1
End
```

CURSOR

Action
Set the LCD Cursor State.

Syntax
CURSOR ON / OFF BLINK / NOBLINK

Remarks
You can use both the ON or OFF and BLINK or NOBLINK parameters.
At power up the cursor state is ON and NOBLINK.

See also
DISPLAY , LCD

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : lcd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR,
HOME
'                          CURSOR, DISPLAY
'micro                    : Mega8515
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8515.dat"                                      ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
```

```
$framesize = 40                                             ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings


Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
Wait 1
Lowerline                                                   'select the lower
line
Wait 1
Lcd "Shift this."                                           'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                           'shift the text to
the right
   Wait 1                                                   'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                            'shift the text to
the left
   Wait 1                                                   'wait a moment
Next

Locate 2 , 1                                                'set cursor
position
Lcd "*"                                                     'display this
Wait 1                                                      'wait a moment

Shiftcursor Right                                           'shift the cursor
```

```
Lcd "@"                                                    'display this
Wait 1                                                     'wait a moment

Home Upper                                                 'select line 1 and
return home
Lcd "Replaced."                                            'replace the text
Wait 1                                                     'wait a moment

Cursor Off Noblink                                         'hide cursor
Wait 1                                                     'wait a moment
Cursor On Blink                                            'show cursor
Wait 1                                                     'wait a moment
Display Off                                                'turn display off
Wait 1                                                     'wait a moment
Display On                                                 'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                 'goto home on line
three
Home Fourth
Home F                                                     'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                        'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                        'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                 'value into ACC
!rCall _write_lcd                                          'put it on LCD
End
```

DATA

Action

Specifies constant values to be read by subsequent READ statements.

Syntax

DATA var [, varn]

Remarks

Var	Numeric or string constant.

The DATA related statements use the internal registers pair R8 and R9 to store the data pointer.

To store a " sign on the data line, you can use :
DATA $34

The $-sign tells the compiler that the ASCII value will follow of the character.
You can use this also to store special characters that can't be written by the editor such as chr(7)

Another way to include special ASCII characters in your string constant is to use {XXX}. You need to include exactly 3 digits representing the ASCII character. For example 65 is the ASCII number for the character A.

DATA "TEST{065}"

Will be read as TESTA.

While :
DATA "TEST{65}" will be read as :

TEST{65}. This because only 2 digits were included instead of 3.

{xxx} works only for string constants. It will also work in a normal string assignment :

s = "{065}" . This will assign A to the string s.

Because the DATA statements allows you to generate an EEP file to store in EEPROM, the $DATA and $EEPROM directives have been added. Read the description of these directives to learn more about the DATA statement.

The DATA statements must not be accessed by the flow of your program because the DATA statements are converted to the byte representation of the DATA.

When your program flow enters the DATA lines, unpredictable results will occur.
So as in QB, the DATA statement is best be placed at the end of your program or in a place that program flow will no enter.

For example this is fine:

```
Print "Hello"
Goto jump
DATA "test"

Jump:
'because we jump over the data lines there is no problem.
```

The following example will case some problems:

```
Dim S As String * 10
Print "Hello"
Restore lbl
Read S

DATA "test"

Print S
```

When the END statement is used it must be placed BEFORE the DATA lines.

Difference with QB

Integer and Word constants must end with the **%**-sign.
Long constants must end with the **&**-sign.
Single constants must end with the **!**-sign.
Double constants must end with the **#**-sgin.

See also

READ , RESTORE , $DATA , $EEPROM

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : readdata.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : READ,RESTORE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim A As Integer , B1 As Byte , Count As Byte
Dim S As String * 15
Dim L As Long
Restore Dta1                                                'point to stored
data
For Count = 1 To 3                                          'for number of data
items
   Read B1 : Print Count ; "  " ; B1
Next

Restore Dta2                                                'point to stored
data
For Count = 1 To 2                                          'for number of data
items
   Read A : Print Count ; "  " ; A
Next

Restore Dta3
Read S : Print S
Read S : Print S


Restore Dta4
```

```
Read L : Print L                                                    'long type


'demonstration of readlabel
Dim W As Iram Word At 8 Overlay                                     ' location is used
by restore pointer
'note that W does not use any RAM it is an overlayed pointer to the data
pointer
W = Loadlabel(dta1)                                                 ' loadlabel expects
the labelname
Read B1
Print B1


End


Dta1:
Data &B10 , &HFF , 10
Dta2:
Data 1000% , -1%

Dta3:
Data "Hello" , "World"
'Note that integer values (>255 or <0) must end with the %-sign
'also note that the data type must match the variable type that is
'used for the READ statement

Dta4:
Data 123456789&
'Note that LONG values must end with the &-sign
'Also note that the data type must match the variable type that is used
'for the READ statement
```

DAYOFWEEK

Action

Returns the Day of the Week of a Date.

Syntax

Target = **DayOfWeek**()
Target = **DayOfWeek**(bDayMonthYear)
Target = **DayOfWeek**(strDate)
Target = **DayOfWeek**(wSysDay)
Target = **DayOfWeek**(lSysSec)

Remarks

Target	A Byte – variable, that is assigned with the day of the week
BDayMonthYear	A Byte – variable, which holds the Day-value followed by Month(Byte) and Year (Byte)
StrDate	A String, which holds a Date-String in the format specified in the CONFIG DATE statement
WSysDay	A Word – variable, which holds the System Day (SysDay)
LSysSec	A Long – variable, which holds the System Second (SysSec)

The Function can be used with five different kind of Input:

1. Without any parameter. The internal Date-values of SOFTCLOCK (_day, _month, _year) are used.
2. With a user defined date array. It must be arranged in same way (Day, Month, Year) as the internal SOFTCLOCK date. The first Byte (Day) is the input by this kind of usage. So the Day of the Week can be calculated of every date.
3. With a Date-String. The date-string must be in the Format specified in the Config Date Statement
4. With a System Day – Number.
5. With a System Second - Number

The Return-Value is in the range of 0 to 6, Monday starts with 0.

The Function is valid in the 21th century (from 2000-01-01 to 2099-12-31).

See Also

Date and Time routines , CONFIG DATE , CONFIG CLOCK, SYSDAY, SYSSEC

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : datetime_test1,bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : show how to use the Date-Time routines from the
DateTime.Lib
'micro                    : Mega103
'suited for demo          : no
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Clockmode = 1
'use i2c for the clock

#if Clockmode = 1
  Config Clock = Soft                                       ' we use build in
clock
  Disable Interrupts
#else
  Config Clock = User                                       ' we use I2C for
the clock
  'configure the scl and sda pins
  Config Sda = Portd.6
  Config Scl = Portd.5

  'address of ds1307
  Const Ds1307w = &HD0                                      ' Addresses of
```

```
Ds1307 clock
  Const Ds1307r = &HD1
#endif


'configure the date format
Config Date = Ymd , Separator = -                           ' ANSI-Format
'This sample does not have the clock started so interrupts are not enabled
' Enable Interrupts

'dim the used variables
Dim Lvar1 As Long
Dim Mday As Byte
Dim Bweekday As Byte , Strweekday As String * 10
Dim Strdate As String * 8
Dim Strtime As String * 8
Dim Bsec As Byte , Bmin As Byte , Bhour As Byte
Dim Bday As Byte , Bmonth As Byte , Byear As Byte
Dim Lsecofday As Long
Dim Wsysday As Word
Dim Lsyssec As Long
Dim Wdayofyear As Word



' ================== DayOfWeek ============================================
' Example 1 with internal RTC-Clock

_day = 4 : _month = 11 : _year = 2                          ' Load RTC-Clock
for example - testing
Bweekday = Dayofweek()
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of " ; Date$ ; " is " ; Bweekday ; " = " ; Strweekday


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 26 : Bmonth = 11 : Byear = 2
Bweekday = Dayofweek(bday)
Strweekday = Lookupstr(bweekday , Weekdays)
Strdate = Date(bday)
Print "Weekday-Number of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ;
 " is " ; Bweekday ; " (" ; Date(bday) ; ") = " ; Strweekday


' Example 3 with System Day
Wsysday = 2000                                              ' that is
2005-06-23
Bweekday = Dayofweek(wsysday)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of System Day " ; Wsysday ; " (" ; Date(wsysday) ; ") is
" ; Bweekday ; " = " ; Strweekday



' Example 4 with System Second
Lsyssec = 123456789                                         ' that is
2003-11-29 at 21:33:09
Bweekday = Dayofweek(lsyssec)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ")
is " ; Bweekday ; " = " ; Strweekday
```

```
' Example 5 with Date-String
Strdate = "04-11-02"                                    ' we have
configured Date in ANSI
Bweekday = Dayofweek(strdate)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of " ; Strdate ; " is " ; Bweekday ; " = " ; Strweekday



' ================= Second of Day ============================================
' Example 1 with internal RTC-Clock
_sec = 12 : _min = 30 : _hour = 18                      ' Load RTC-Clock
for example - testing

Lsecofday = Secofday()
Print "Second of Day of " ; Time$ ; " is " ; Lsecofday


' Example 2 with defined Clock - Bytes (Second / Minute / Hour)
Bsec = 20 : Bmin = 1 : Bhour = 7
Lsecofday = Secofday(bsec)
Print "Second of Day of Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; " ("
 ; Time(bsec) ; ") is " ; Lsecofday


' Example 3 with System Second
Lsyssec = 1234456789
Lsecofday = Secofday(lsyssec)
Print "Second of Day of System Second " ; Lsyssec ; "(" ; Time(lsyssec) ; ") is
" ; Lsecofday


' Example 4 with Time - String
Strtime = "04:58:37"
Lsecofday = Secofday(strtime)
Print "Second of Day of " ; Strtime ; " is " ; Lsecofday



' ================= System Second ============================================

' Example 1 with internal RTC-Clock
                        ' Load RTC-Clock for example - testing
_sec = 17 : _min = 35 : _hour = 8 : _day = 16 : _month = 4 : _year = 3

Lsyssec = Syssec()
Print "System Second of " ; Time$ ; " at " ; Date$ ; " is " ; Lsyssec


' Example 2 with with defined Clock - Bytes (Second, Minute, Hour, Day / Month
/ Year)
Bsec = 20 : Bmin = 1 : Bhour = 7 : Bday = 22 : Bmonth = 12 : Byear = 1
Lsyssec = Syssec(bsec)
Strtime = Time(bsec)
Strdate = Date(bday)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec


' Example 3 with System Day

Wsysday = 2000
Lsyssec = Syssec(wsysday)
Print "System Second of System Day " ; Wsysday ; " (" ; Date(wsysday) ; "
00:00:00) is " ; Lsyssec
```

```
' Example 4 with Time and Date String
Strtime = "10:23:50"
Strdate = "02-11-29"                                    ' ANSI-Date
Lsyssec = Syssec(strtime , Strdate)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec
 ' 91880630



' ==================== Day Of Year ========================================
' Example 1 with internal RTC-Clock
_day = 20 : _month = 11 : _year = 2                     ' Load RTC-Clock
for example - testing
Wdayofyear = Dayofyear()
Print "Day Of Year of " ; Date$ ; " is " ; Wdayofyear


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 24 : Bmonth = 5 : Byear = 8
Wdayofyear = Dayofyear(bday)
Print "Day Of Year of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
(" ; Date(bday) ; ") is " ; Wdayofyear



' Example 3 with Date - String
Strdate = "04-10-29"                                    ' we have
configured ANSI Format
Wdayofyear = Dayofyear(strdate)
Print "Day Of Year of " ; Strdate ; " is " ; Wdayofyear


' Example 4 with System Second

Lsyssec = 123456789
Wdayofyear = Dayofyear(lsyssec)
Print "Day Of Year of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ") is
" ; Wdayofyear


' Example 5 with System Day
Wsysday = 3000
Wdayofyear = Dayofyear(wsysday)
Print "Day Of Year of System Day " ; Wsysday ; " (" ; Date(wsysday) ; ") is " ;
Wdayofyear




' ==================== System Day =========================================
' Example 1 with internal RTC-Clock
_day = 20 : _month = 11 : _year = 2                     ' Load RTC-Clock
for example - testing
Wsysday = Sysday()
Print "System Day of " ; Date$ ; " is " ; Wsysday


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 24 : Bmonth = 5 : Byear = 8
Wsysday = Sysday(bday)
Print "System Day of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
(" ; Date(bday) ; ") is " ; Wsysday


' Example 3 with Date - String
```

```
Strdate = "04-10-29"
Wsysday = Sysday(strdate)
Print "System Day of " ; Strdate ; " is " ; Wsysday

' Example 4 with System Second
Lsyssec = 123456789
Wsysday = Sysday(lsyssec)
Print "System Day of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ") is "
 ; Wsysday



' ================== Time ================================================
' Example 1: Converting defined Clock - Bytes (Second / Minute / Hour) to Time
- String
Bsec = 20 : Bmin = 1 : Bhour = 7
Strtime = Time(bsec)
Print "Time values: Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; "
converted to string " ; Strtime


' Example 2: Converting System Second  to Time - String
Lsyssec = 123456789
Strtime = Time(lsyssec)
Print "Time of Systemsecond " ; Lsyssec ; " is " ; Strtime


' Example 3: Converting Second of Day to Time - String
 Lsecofday = 12345
Strtime = Time(lsecofday)
Print "Time of Second of Day " ; Lsecofday ; " is " ; Strtime


' Example 4: Converting System Second to defined Clock - Bytes (Second / Minute
/ Hour)

Lsyssec = 123456789
Bsec = Time(lsyssec)
Print "System Second " ; Lsyssec ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour ; " (" ; Time(lsyssec) ; ")"



' Example 5: Converting Second of Day to defined Clock - Bytes (Second / Minute
/ Hour)
Lsecofday = 12345
Bsec = Time(lsecofday)
Print "Second of Day " ; Lsecofday ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour ; " (" ; Time(lsecofday) ; ")"

' Example 6: Converting Time-string to defined Clock - Bytes (Second / Minute /
Hour)
Strtime = "07:33:12"
Bsec = Time(strtime)
Print "Time " ; Strtime ; " converted to Sec=" ; Bsec ; " Min=" ; Bmin ; "
Hour=" ; Bhour



' ============================ Date ========================================

' Example 1: Converting defined Clock - Bytes (Day / Month / Year) to Date -
String
Bday = 29 : Bmonth = 4 : Byear = 12
Strdate = Date(bday)
Print "Dat values: Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
converted to string " ; Strdate
```

```
' Example 2: Converting from System Day to Date - String
Wsysday = 1234
Strdate = Date(wsysday)
Print "System Day " ; Wsysday ; " is " ; Strdate


' Example 3: Converting from System Second to Date String
Lsyssec = 123456789
Strdate = Date(lsyssec)
Print "System Second " ; Lsyssec ; " is " ; Strdate


' Example 4: Converting SystemDay to defined Clock - Bytes (Day / Month / Year)

Wsysday = 2000
Bday = Date(wsysday)
Print "System Day " ; Wsysday ; " converted to Day=" ; Bday ; " Month=" ;
Bmonth ; " Year=" ; Byear ; " (" ; Date(wsysday) ; ")"


' Example 5: Converting Date - String to defined Clock - Bytes (Day / Month /
Year)
Strdate = "04-08-31"
Bday = Date(strdate)
Print "Date " ; Strdate ; " converted to Day=" ; Bday ; " Month=" ; Bmonth ; "
Year=" ; Byear


' Example 6: Converting System Second to defined Clock - Bytes (Day / Month /
Year)
Lsyssec = 123456789
Bday = Date(lsyssec)
Print "System Second " ; Lsyssec ; " converted to Day=" ; Bday ; " Month=" ;
Bmonth ; " Year=" ; Byear ; " (" ; Date(lsyssec) ; ")"



' ================ Second of Day elapsed

Lsecofday = Secofday()
_hour = _hour + 1
Lvar1 = Secelapsed(lsecofday)
Print Lvar1

Lsyssec = Syssec()
_day = _day + 1
Lvar1 = Syssecelapsed(lsyssec)
Print Lvar1




Looptest:

' Initialising for testing
_day = 1
_month = 1
_year = 1
_sec = 12
_min = 13
_hour = 14
```

```
Do
   If _year > 50 Then
      Exit Do
   End If

  _sec = _sec + 7
  If _sec > 59 Then
     Incr _min
     _sec = _sec - 60
  End If

  _min = _min + 2
  If _min > 59 Then
     Incr _hour
     _min = _min - 60
  End If

  _hour = _hour + 1
  If _hour > 23 Then
     Incr _day
     _hour = _hour - 24
  End If

  _day = _day + 1


  If _day > 28 Then
     Select Case _month
        Case 1
           Mday = 31
        Case 2
           Mday = _year And &H03
           If Mday = 0 Then
              Mday = 29
           Else
              Mday = 28
           End If
        Case 3
           Mday = 31
        Case 4
           Mday = 30
        Case 5
           Mday = 31
        Case 6
           Mday = 30
        Case 7
           Mday = 31
        Case 8
           Mday = 31
        Case 9
           Mday = 30
        Case 10
           Mday = 31
        Case 11
           Mday = 30
        Case 12
           Mday = 31
     End Select
     If _day > Mday Then
        _day = _day - Mday
        Incr _month
        If _month > 12 Then
           _month = 1
           Incr _year
        End If
```

```
    End If
  End If
  If _year > 99 Then
    Exit Do
  End If

Lsecofday = Secofday()
Lsyssec = Syssec()
Bweekday = Dayofweek()
Wdayofyear = Dayofyear()
Wsysday = Sysday()


Print Time$ ; " " ; Date$ ; " " ; Lsecofday ; " " ; Lsyssec ; " " ; Bweekday ;
" " ; Wdayofyear ; " " ; Wsysday


Loop
End


'only when we use I2C for the clock we need to set the clock date time
#if Clockmode = 0
'called from datetime.lib
Dim Weekday As Byte
Getdatetime:
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
  I2cwbyte 0                                              ' start address in
1307

  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307r                                        ' send address
  I2crbyte _sec , Ack
  I2crbyte _min , Ack                                     ' MINUTES
  I2crbyte _hour , Ack                                    ' Hours
  I2crbyte Weekday , Ack                                  ' Day of Week
  I2crbyte _day , Ack                                     ' Day of Month
  I2crbyte _month , Ack                                   ' Month of Year
  I2crbyte _year , Nack                                   ' Year
  I2cstop
  _sec = Makedec(_sec) : _min = Makedec(_min) : _hour = Makedec(_hour)
  _day = Makedec(_day) : _month = Makedec(_month) : _year = Makedec(_year)
Return

Setdate:
  _day = Makebcd(_day) : _month = Makebcd(_month) : _year = Makebcd(_year)
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
  I2cwbyte 4                                              ' starting address
in 1307
  I2cwbyte _day                                           ' Send Data to
SECONDS
  I2cwbyte _month                                         ' MINUTES
  I2cwbyte _year                                          ' Hours
  I2cstop
Return

Settime:
  _sec = Makebcd(_sec) : _min = Makebcd(_min) : _hour = Makebcd(_hour)
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
```

```
  I2cwbyte 0                                          ' starting address
in 1307
  I2cwbyte _sec                                       ' Send Data to
SECONDS
  I2cwbyte _min                                       ' MINUTES
  I2cwbyte _hour                                      ' Hours
  I2cstop
Return

#endif


Weekdays:
Data "Monday" , "Tuesday" , "Wednesday" , "Thursday" , "Friday" , "Saturday" ,
"Sunday"
```

DAYOFYEAR

Action

Returns the Day of the Year of a Date

Syntax

Target = **DayOfYear**()
Target = **DayOfYear**(bDayMonthYear)
Target = **DayOfYear**(strDate)
Target = **DayOfYear**(wSysDay)
Target = **DayOfYear**(lSysSec)

Remarks

Target	A Integer, that is assigned with the Day of the Year
BDayMonthYear	A Byte, which holds the Day-value followed by Month(Byte) and Year (Byte)
StrDate	A String, which holds a Date-String in the format specified in the CONFIG DATE statement
WSysDay	A Variable (Word) which holds a System Day (SysDay)
LsysSec	A Variable (Long) which holds a System Second (SysSec)

The Function can be used with five different kind of Input:

1. Without any parameter. The internal Date-values of SOFTCLOCK (_day, _month, _year) are used.
2. With a user defined date array. It must be arranged in same way (Day, Month, Year) as the internal SOFTCLOCK date. The first Byte (Day) is the input by this kind of usage. So the Day of the Year can be calculated of every date.
3. With a Date-String. The date-string must be in the Format specified in the Config Date Statement.
4. With a System Day Number (WORD)
5. With a System Second Number (LONG)

The Return-Value is in the Range of 0 to 364 (365 in a leap year). January the first starts with 0.

The function is valid in the 21th century (from 2000-01-01 to 2099-12-31).

See also
Date and Time Routines , SysSec , SysDay

Example
See DayOfWeek

DATE$

Action
Internal variable that holds the date.

Syntax
DATE$ = "mm/dd/yy"
var = **DATE$**

Remarks
The DATE$ variable is used in combination with the CONFIG CLOCK directive.

The CONFIG CLOCK statement will use the TIMER0 or TIMER2 in asynchrone mode to create an interrupt that occurs every second. In this interrupt routine the *_Sec*, *_Min* and *_Hour* variables are updated. The *_dat*, *_month* and *_year* variables are also updated. The date format is in the same format as in VB.

When you assign DATE$ to a string variable these variables are assigned to the DATE$ variable.
When you assign the DATE$ variable with a constant or other variable, the _day, _month and _year variables will be changed to the new date.
The only difference with VB is that all data must be provided when assigning the date. This is done for minimal code. You can change this behavior of course.

The async timer is only available in the M103, 90S8535, M163 and M32(3), Mega128, Mega64, Mega8. For other chips it will not work.

As new chips are launched by Atmel, and support is added by MCS, the list above might not be complete. It is intended to serve as an example for chips with a timer that can be used in asynchrone mode. So when your micro has a timer that can be used in asynchrone mode, it should work.

Do not confuse DATE$ with the DATE function.

ASM
The following ASM routines are called.
When assiging DATE$: _set_date (calls _str2byte)
When reading DATE$: _make_dt (calls _byte2str)

See also

TIME$, CONFIG CLOCK , DATE

Example

```
'-----------------------------------------------------------------------
-----------
'name                       : megaclock.bas
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : shows the new TIME$ and DATE$ reserved variables
'micro                      : Mega103
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------
-----------

$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'With the 8535 and timer2 or the Mega103 and TIMER0 you can
'easily implement a clock by attaching a 32768 Hz xtal to the timer
'And of course some BASCOM code

'This example is written for the STK300 with M103
Enable Interrupts

'[configure LCD]
$lcd = &HC000                                               'address for E and
RS
$lcdrs = &H8000                                             'address for only E
Config Lcd = 20 * 4                                         'nice display from
bg micro
Config Lcdbus = 4                                           'we run it in bus
mode and I hooked up only db4-db7
Config Lcdmode = Bus                                        'tell about the bus
mode

'[now init the clock]
Config Date = Mdy , Separator = /                           ' ANSI-Format

Config Clock = Soft                                         'this is how simple
it is
'The above statement will bind in an ISR so you can not use the TIMER anymore!
'For the M103 in this case it means that TIMER0 can not be used by the user
anymore

'assign the date to the reserved date$
'The format is MM/DD/YY
Date$ = "11/11/00"

'assign the time, format in hh:mm:ss military format(24 hours)
'You may not use 1:2:3 !! adding support for this would mean overhead
'But of course you can alter the library routines used
```

```
Time$ = "02:20:00"

'-----------------------------------------------------

'clear the LCD display
Cls

Do
  Home                                                    'cursor home
  Lcd Date$ ; "  " ; Time$                                'show the date and
time
Loop

'The clock routine does use the following internal variables:
'_day , _month, _year , _sec, _hour, _min
'These are all bytes. You can assign or use them directly
_day = 1
'For the _year variable only the year is stored, not the century
End
```

DATE

Action

Returns a date-value (String or 3 Bytes for Day, Month and Year) depending of the Type of the Target

Syntax

bDayMonthYear = **Date**(lSysSec)
bDayMonthYear = **Date**(lSysDay)
bDayMonthYear = **Date**(strDate)

strDate = **Date**(lSysSec)
strDate = **Date**(lSysDay)
strDate = **Date**(bDayMonthYear)

Remarks

StrDate	A Date-String in the format specified in the CONFIG DATE statement
LsysSec	A LONG – variable which holds the System Second (SysSec = TimeStamp)
LsysDay	A WORD – variable, which holds then System Day (SysDay)
BDayMonthYear	A BYTE – variable, which holds Days, followed by Month (Byte) and Year (Byte)

Converting to String:

The target string must have a length of at least 8 Bytes, otherwise SRAM after the target-string will be overwritten.

Converting to Soft clock date format (3 Bytes for Day, Month and Year):

Three Bytes for Day, Month and Year must follow each other in SRAM. The variable-name of

the first Byte, the one for Day must be passed to the function.

See also

Date and Time Routines , DAYOFYEAR, SYSDAY

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : datetime_test1,bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : show how to use the Date-Time routines from the
DateTime.Lib
'micro                    : Mega103
'suited for demo          : no
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m103def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Clockmode = 1
'use i2c for the clock

#if Clockmode = 1
  Config Clock = Soft                                       ' we use build in
clock
  Disable Interrupts
#else
  Config Clock = User                                       ' we use I2C for
the clock
  'configure the scl and sda pins
  Config Sda = Portd.6
  Config Scl = Portd.5

  'address of ds1307
  Const Ds1307w = &HD0                                      ' Addresses of
Ds1307 clock
  Const Ds1307r = &HD1
#endif


'configure the date format
Config Date = Ymd , Separator = -                           ' ANSI-Format
'This sample does not have the clock started so interrupts are not enabled
' Enable Interrupts

'dim the used variables
Dim Lvar1 As Long
Dim Mday As Byte
Dim Bweekday As Byte , Strweekday As String * 10
Dim Strdate As String * 8
Dim Strtime As String * 8
```

```
Dim Bsec As Byte , Bmin As Byte , Bhour As Byte
Dim Bday As Byte , Bmonth As Byte , Byear As Byte
Dim Lsecofday As Long
Dim Wsysday As Word
Dim Lsyssec As Long
Dim Wdayofyear As Word



' ================== DayOfWeek ============================================
' Example 1 with internal RTC-Clock

_day = 4 : _month = 11 : _year = 2                          ' Load RTC-Clock
for example - testing
Bweekday = Dayofweek()
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of " ; Date$ ; " is " ; Bweekday ; " = " ; Strweekday


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 26 : Bmonth = 11 : Byear = 2
Bweekday = Dayofweek(bday)
Strweekday = Lookupstr(bweekday , Weekdays)
Strdate = Date(bday)
Print "Weekday-Number of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ;
 " is " ; Bweekday ; " (" ; Date(bday) ; ") = " ; Strweekday


' Example 3 with System Day
Wsysday = 2000                                              ' that is
2005-06-23
Bweekday = Dayofweek(wsysday)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of System Day " ; Wsysday ; " (" ; Date(wsysday) ; ") is
" ; Bweekday ; " = " ; Strweekday


' Example 4 with System Second
Lsyssec = 123456789                                         ' that is
2003-11-29 at 21:33:09
Bweekday = Dayofweek(lsyssec)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ")
is " ; Bweekday ; " = " ; Strweekday



' Example 5 with Date-String
Strdate = "04-11-02"                                        ' we have
configured Date in ANSI
Bweekday = Dayofweek(strdate)
Strweekday = Lookupstr(bweekday , Weekdays)
Print "Weekday-Number of " ; Strdate ; " is " ; Bweekday ; " = " ; Strweekday



' ================ Second of Day ==========================================
' Example 1 with internal RTC-Clock
_sec = 12 : _min = 30 : _hour = 18                          ' Load RTC-Clock
for example - testing

Lsecofday = Secofday()
Print "Second of Day of " ; Time$ ; " is " ; Lsecofday
```

```
' Example 2 with defined Clock - Bytes (Second / Minute / Hour)
Bsec = 20 : Bmin = 1 : Bhour = 7
Lsecofday = Secofday(bsec)
Print "Second of Day of Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; " ("
 ; Time(bsec) ; ") is " ; Lsecofday


' Example 3 with System Second
Lsyssec = 1234456789
Lsecofday = Secofday(lsyssec)
Print "Second of Day of System Second " ; Lsyssec ; "(" ; Time(lsyssec) ; ") is
" ; Lsecofday


' Example 4 with Time - String
Strtime = "04:58:37"
Lsecofday = Secofday(strtime)
Print "Second of Day of " ; Strtime ; " is " ; Lsecofday



' ================= System Second ==========================================

' Example 1 with internal RTC-Clock
                        ' Load RTC-Clock for example - testing
_sec = 17 : _min = 35 : _hour = 8 : _day = 16 : _month = 4 : _year = 3

Lsyssec = Syssec()
Print "System Second of " ; Time$ ; " at " ; Date$ ; " is " ; Lsyssec


' Example 2 with with defined Clock - Bytes (Second, Minute, Hour, Day / Month
/ Year)
Bsec = 20 : Bmin = 1 : Bhour = 7 : Bday = 22 : Bmonth = 12 : Byear = 1
Lsyssec = Syssec(bsec)
Strtime = Time(bsec)
Strdate = Date(bday)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec


' Example 3 with System Day

Wsysday = 2000
Lsyssec = Syssec(wsysday)
Print "System Second of System Day " ; Wsysday ; " (" ; Date(wsysday) ; "
00:00:00) is " ; Lsyssec


' Example 4 with Time and Date String
Strtime = "10:23:50"
Strdate = "02-11-29"                                    ' ANSI-Date
Lsyssec = Syssec(strtime , Strdate)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec
 ' 91880630



' ==================== Day Of Year ========================================
' Example 1 with internal RTC-Clock
_day = 20 : _month = 11 : _year = 2                     ' Load RTC-Clock
for example - testing
Wdayofyear = Dayofyear()
Print "Day Of Year of " ; Date$ ; " is " ; Wdayofyear
```

```
' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 24 : Bmonth = 5 : Byear = 8
Wdayofyear = Dayofyear(bday)
Print "Day Of Year of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
(" ; Date(bday) ; ") is " ; Wdayofyear


' Example 3 with Date - String
Strdate = "04-10-29"                                        ' we have
configured ANSI Format
Wdayofyear = Dayofyear(strdate)
Print "Day Of Year of " ; Strdate ; " is " ; Wdayofyear


' Example 4 with System Second

Lsyssec = 123456789
Wdayofyear = Dayofyear(lsyssec)
Print "Day Of Year of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ") is
" ; Wdayofyear


' Example 5 with System Day
Wsysday = 3000
Wdayofyear = Dayofyear(wsysday)
Print "Day Of Year of System Day " ; Wsysday ; " (" ; Date(wsysday) ; ") is " ;
Wdayofyear




' ================== System Day ======================================
' Example 1 with internal RTC-Clock
_day = 20 : _month = 11 : _year = 2                         ' Load RTC-Clock
for example - testing
Wsysday = Sysday()
Print "System Day of " ; Date$ ; " is " ; Wsysday


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 24 : Bmonth = 5 : Byear = 8
Wsysday = Sysday(bday)
Print "System Day of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
(" ; Date(bday) ; ") is " ; Wsysday


' Example 3 with Date - String
Strdate = "04-10-29"
Wsysday = Sysday(strdate)
Print "System Day of " ; Strdate ; " is " ; Wsysday

' Example 4 with System Second
Lsyssec = 123456789
Wsysday = Sysday(lsyssec)
Print "System Day of System Second " ; Lsyssec ; " (" ; Date(lsyssec) ; ") is "
 ; Wsysday



' ================== Time ============================================
' Example 1: Converting defined Clock - Bytes (Second / Minute / Hour) to Time
- String
Bsec = 20 : Bmin = 1 : Bhour = 7
Strtime = Time(bsec)
```

```
Print "Time values: Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; "
converted to string " ; Strtime


' Example 2: Converting System Second  to Time - String
Lsyssec = 123456789
Strtime = Time(lsyssec)
Print "Time of Systemsecond " ; Lsyssec ; " is " ; Strtime


' Example 3: Converting Second of Day to Time - String
 Lsecofday = 12345
Strtime = Time(lsecofday)
Print "Time of Second of Day " ; Lsecofday ; " is " ; Strtime


' Example 4: Converting System Second to defined Clock - Bytes (Second / Minute
/ Hour)

Lsyssec = 123456789
Bsec = Time(lsyssec)
Print "System Second " ; Lsyssec ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour ; " (" ; Time(lsyssec) ; ")"



' Example 5: Converting Second of Day to defined Clock - Bytes (Second / Minute
/ Hour)
Lsecofday = 12345
Bsec = Time(lsecofday)
Print "Second of Day " ; Lsecofday ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour ; " (" ; Time(lsecofday) ; ")"

' Example 6: Converting Time-string to defined Clock - Bytes (Second / Minute /
Hour)
Strtime = "07:33:12"
Bsec = Time(strtime)
Print "Time " ; Strtime ; " converted to Sec=" ; Bsec ; " Min=" ; Bmin ; "
Hour=" ; Bhour



' ============================ Date ========================================

' Example 1: Converting defined Clock - Bytes (Day / Month / Year) to Date -
String
Bday = 29 : Bmonth = 4 : Byear = 12
Strdate = Date(bday)
Print "Dat values: Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
converted to string " ; Strdate


' Example 2: Converting from System Day to Date - String
Wsysday = 1234
Strdate = Date(wsysday)
Print "System Day " ; Wsysday ; " is " ; Strdate


' Example 3: Converting from System Second to Date String
Lsyssec = 123456789
Strdate = Date(lsyssec)
Print "System Second " ; Lsyssec ; " is " ; Strdate


' Example 4: Converting SystemDay to defined Clock - Bytes (Day / Month / Year)

Wsysday = 2000
```

```
Bday = Date(wsysday)
Print "System Day " ; Wsysday ; " converted to Day=" ; Bday ; " Month=" ;
Bmonth ; " Year=" ; Byear ; " (" ; Date(wsysday) ; ")"


' Example 5: Converting Date - String to defined Clock - Bytes (Day / Month /
Year)
Strdate = "04-08-31"
Bday = Date(strdate)
Print "Date " ; Strdate ; " converted to Day=" ; Bday ; " Month=" ; Bmonth ; "
Year=" ; Byear


' Example 6: Converting System Second to defined Clock - Bytes (Day / Month /
Year)
Lsyssec = 123456789
Bday = Date(lsyssec)
Print "System Second " ; Lsyssec ; " converted to Day=" ; Bday ; " Month=" ;
Bmonth ; " Year=" ; Byear ; " (" ; Date(lsyssec) ; ")"



' ================ Second of Day elapsed

Lsecofday = Secofday()
_hour = _hour + 1
Lvar1 = Secelapsed(lsecofday)
Print Lvar1

Lsyssec = Syssec()
_day = _day + 1
Lvar1 = Syssecelapsed(lsyssec)
Print Lvar1




Looptest:

' Initialising for testing
_day = 1
_month = 1
_year = 1
_sec = 12
_min = 13
_hour = 14



Do
   If _year > 50 Then
      Exit Do
   End If

  _sec = _sec + 7
  If _sec > 59 Then
     Incr _min
     _sec = _sec - 60
  End If

  _min = _min + 2
  If _min > 59 Then
     Incr _hour
     _min = _min - 60
  End If
```

```
  _hour = _hour + 1
  If _hour > 23 Then
     Incr _day
     _hour = _hour - 24
  End If

  _day = _day + 1


  If _day > 28 Then
     Select Case _month
        Case 1
           Mday = 31
        Case 2
           Mday = _year And &H03
           If Mday = 0 Then
              Mday = 29
           Else
              Mday = 28
           End If
        Case 3
           Mday = 31
        Case 4
           Mday = 30
        Case 5
           Mday = 31
        Case 6
           Mday = 30
        Case 7
           Mday = 31
        Case 8
           Mday = 31
        Case 9
           Mday = 30
        Case 10
           Mday = 31
        Case 11
           Mday = 30
        Case 12
           Mday = 31
     End Select
     If _day > Mday Then
        _day = _day - Mday
        Incr _month
        If _month > 12 Then
           _month = 1
           Incr _year
        End If
     End If
  End If
  If _year > 99 Then
     Exit Do
  End If

Lsecofday = Secofday()
Lsyssec = Syssec()
Bweekday = Dayofweek()
Wdayofyear = Dayofyear()
Wsysday = Sysday()


Print Time$ ; " " ; Date$ ; " " ; Lsecofday ; " " ; Lsyssec ; " " ; Bweekday ;
" " ; Wdayofyear ; " " ; Wsysday
```

```
Loop
End


'only when we use I2C for the clock we need to set the clock date time
#if Clockmode = 0
'called from datetime.lib
Dim Weekday As Byte
Getdatetime:
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
  I2cwbyte 0                                              ' start address in
1307

  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307r                                        ' send address
  I2crbyte _sec , Ack
  I2crbyte _min , Ack                                     ' MINUTES
  I2crbyte _hour , Ack                                    ' Hours
  I2crbyte Weekday , Ack                                  ' Day of Week
  I2crbyte _day , Ack                                     ' Day of Month
  I2crbyte _month , Ack                                   ' Month of Year
  I2crbyte _year , Nack                                   ' Year
  I2cstop
  _sec = Makedec(_sec) : _min = Makedec(_min) : _hour = Makedec(_hour)
  _day = Makedec(_day) : _month = Makedec(_month) : _year = Makedec(_year)
Return

Setdate:
  _day = Makebcd(_day) : _month = Makebcd(_month) : _year = Makebcd(_year)
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
  I2cwbyte 4                                              ' starting address
in 1307
  I2cwbyte _day                                           ' Send Data to
SECONDS
  I2cwbyte _month                                         ' MINUTES
  I2cwbyte _year                                          ' Hours
  I2cstop
Return

Settime:
  _sec = Makebcd(_sec) : _min = Makebcd(_min) : _hour = Makebcd(_hour)
  I2cstart                                                ' Generate start
code
  I2cwbyte Ds1307w                                        ' send address
  I2cwbyte 0                                              ' starting address
in 1307
  I2cwbyte _sec                                           ' Send Data to
SECONDS
  I2cwbyte _min                                           ' MINUTES
  I2cwbyte _hour                                          ' Hours
  I2cstop
Return

#endif


Weekdays:
Data "Monday" , "Tuesday" , "Wednesday" , "Thursday" , "Friday" , "Saturday" ,
"Sunday"
```

DBG

Action
Prints debug info to the hardware UART

Syntax
DBG

Remarks
See $DBG for more information

DEBUG

Action
Instruct compiler to start or stop debugging, or print variable to serial port

Syntax
DEBUG ON | OFF | var

Remarks

ON	Enable debugging
OFF	Disable debugging
var	A variable which values must be printed to the serial port

During development of your program a common issue is that you need to know the value of a variable.
You can use PRINT to print the value but then it will be in the application as well.
You can use conditional compilation such as :

```
CONST TEST=1
#IF TEST
  print var
#ENDIF
```

But that will result in a lot of typing work. The DEBUG option is a combination of conditional compilation and PRINT. Whenever you activate DEBUG with the ON parameter, all 'DEBUG var' statements will be compiled.
When you turn DEBUG OFF, all 'DEBUG var' statements will not be compiled.

You can not nest the ON and OFF. The last statements wins.
Typical you will have only one DEBUG ON statement. And you set it to OFF when your program is working.

An example showing nesting is NOT supported:

```
DEBUG ON
DEBUG ON ' it is still ON
DEBUG OFF' it is OFF now
```

An example showing multiple DEBUG:
```
DEBUG ON
DEBUG var   ' this is printed
DEBUG var2 ' this is also printed

DEBUG OFF
DEBUG var3  'this is NOT printed
DEBUG var4  ' this is not printed

DEBUG ON    ' turn DEBUG ON
If A = 2 Then
  DEBUG A ' this is printed
End If
```

See also
DBG

ASM
NONE

Example
```
DEBUG ON
Dim A As Byte
DEBUG A
End
```

DEBOUNCE

Action
Debounce a port pin connected to a switch.

Syntax
DEBOUNCE Px.y , state , label [, SUB]

Remarks

Px.y	A port pin like PINB.0 , to examine.
State	0 for jumping when PINx.y is low , 1 for jumping when PINx.y is high
Label	The label to GOTO when the specified state is detected
SUB	The label to GOSUB when the specified state is detected

When you specify the optional parameter SUB, a GOSUB to label is performed instead of a GOTO.

The DEBOUNCE statement tests the condition of the specified pin and if true there will be a delay for 25 mS and the condition will be checked again. (eliminating bounce of a switch)

When the condition is still true and there was no branch before, it branches to specified the

label.

When the condition is not true, or the logic level on the pin is not of the specified level, the code on the next line will be executed.

When DEBOUNCE is executed again, the state of the switch must have gone back in the original position before it can perform another branch. So if you are waiting for a pin to go low, and the pin goes low, the pin must change to high, before a new low level will result in another branch.

Each DEBOUNCE statement, which uses a different port, uses 1 BIT of the internal memory to hold its state. And as the bits are stored in SRAM, it means that even while you use only 1 pin/bit, a byte is used for storage of the bit.

DEBOUNCE will not wait for the input value to met the specified condition. You need to use BITWAIT if you want to wait until a bit will have a certain value.

So DEBOUNCE will not halt your program while a BITWAIT can halt your program if the bit will never have the specified value. You can combine BITWAIT and DEBOUNCE statements by preceding a DEBOUNCE with a BITWAIT statement.

See also

CONFIG DEBOUNCE , BITWAIT

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : deboun.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates DEBOUNCE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Debounce = 30                                        'when the config
statement is not used a default of 25mS will be used but we override to use 30
mS


  'Debounce Pind.0 , 1 , Pr 'try this for branching when high(1)
  Debounce Pind.0 , 0 , Pr , Sub
  Debounce Pind.0 , 0 , Pr , Sub
  '                    ^----- label to branch to
  '                ^---------- Branch when P1.0 goes low(0)
  '          ^---------------- Examine P1.0
```

```
  'When Pind.0 goes low jump to subroutine Pr
  'Pind.0 must go high again before it jumps again
  'to the label Pr when Pind.0 is low

  Debounce Pind.0 , 1 , Pr                                    'no branch
  Debounce Pind.0 , 1 , Pr                                    'will result in a
return without gosub
End

Pr:
  Print "PIND.0 was/is low"
Return
```

DECR

Action
Decrements a variable by one.

Syntax
DECR var

Remarks
There are often situations where you want a number to be decreased by 1. It is simpler to write :
DECR var
compared to :
var = var - 1

See also
INCR

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : decr.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demostrate decr
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                       ' specify the used
micro
$crystal = 4000000                                            ' used crystal
frequency
$baud = 19200                                                 ' use baud rate
$hwstack = 32                                                 ' default use 32
for the hardware stack
$swstack = 10                                                 ' default use 10
for the SW stack
$framesize = 40                                               ' default use 40
for the frame space
```

```
Dim A As Byte , I As Integer

A = 5                                                    'assign value to a
Decr A                                                   'decrease (by one)
Print A                                                  'print it


I = 1000
Decr I
Print I
End
```

DECLARE FUNCTION

Action
Declares a user function.

Syntax
DECLARE FUNCTION TEST[([BYREF/BYVAL] var as type)] As type

Remarks

test	Name of the function.
Var	Name of the variable(s).
Type	Type of the variable(s) and of the result. Byte,Word, Integer, Long, Single or String. Bits are not supported.

When BYREF or BYVAL is not provided, the parameter will be passed by reference.
Use BYREF to pass a variable by reference with its address.
Use BYVAL to pass a copy of the variable.

See the CALL statement for more details.

You must declare each function before writing the function or calling the function. And the declaration must match the function.
Bits are global and can not be passed with functions or subs.

When you want to pass a string, you pass it with it's name : string. So the size is not important. For example :
Declare function Test(s as string, byval z as string) as byte

See also
CALL, SUB

Example
```
'-----------------------------------------------------------------------------
-----------
'name                    : function.bas
'copyright               : (c) 1995-2005, MCS Electronics
```

```
'purpose                    : demonstration of user function
'micro                      : Mega48
'suited for demo            : yes
'commercial addon needed    : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                          ' specify the used
micro
$crystal = 4000000                                               ' used crystal
frequency
$baud = 19200                                                    ' use baud rate
$hwstack = 32                                                    ' default use 32
for the hardware stack
$swstack = 10                                                    ' default use 10
for the SW stack
$framesize = 40                                                  ' default use 40
for the frame space

'A user function must be declare before it can be used.
'A function must return a type
Declare Function Myfunction(byval I As Integer , S As String) As Integer
'The byval paramter will pass the parameter by value so the original value
'will not be changed by the function

Dim K As Integer
Dim Z As String * 10
Dim T As Integer
'assign the values
K = 5
Z = "123"

T = Myfunction(k , Z)
Print T
End


Function Myfunction(byval I As Integer , S As String) As Integer
  'you can use local variables in subs and functions
  Local P As Integer

  P = I

  'because I is passed by value, altering will not change the original
  'variable named k
  I = 10

  P = Val(s) + I

  'finally assign result
  'Note that the same data type must be used !
  'So when declared as an Integer function, the result can only be
  'assigned with an Integer in this case.
  Myfunction = P
End Function
```

DECLARE SUB

Action

Declares a subroutine.

Syntax
DECLARE SUB TEST[([BYREF/BYVAL] var as type)]

Remarks

test	Name of the procedure.
Var	Name of the variable(s).
Type	Type of the variable(s). Byte, Word, Integer, Long, Single or String.

When BYREF or BYVAL is not provided, the parameter will be passed by reference.
Use BYREF to pass a variable by reference with its address.
Use BYVAL to pass a copy of the variable.

See the CALL statement for more details.

You must declare each function before writing the function or calling the function. And the declaration must match the function.
Bits are global and can not be passed with functions or subs.

See also
CALL, SUB , FUNCTION

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : declare.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrate using declare
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' Note that the usage of SUBS works different in BASCOM-8051
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


' First the SUB programs must be declared

'Try a SUB without parameters
Declare Sub Test2

'SUB with variable that can not be changed(A) and
'a variable that can be changed(B1), by the sub program
'When BYVAL is specified, the value is passed to the subprogram
'When BYREF is specified or nothing is specified, the address is passed to
```

```
'the subprogram

Declare Sub Test(byval A As Byte , B1 As Byte)
Declare Sub Testarray(byval A As Byte , B1 As Byte)
'All variable types that can be passed
'Notice that BIT variables can not be passed.
'BIT variables are GLOBAL to the application
Declare Sub Testvar(b As Byte , I As Integer , W As Word , L As Long , S As
String)

'passing string arrays needs a different syntax because the length of the
strings must be passed by the compiler
'the empty () indicated that an array will be passed
Declare Sub Teststr(b As Byte , Dl() As String)

Dim Bb As Byte , I As Integer , W As Word , L As Long , S As String * 10
'dim used variables
Dim Ar(10) As Byte
Dim Sar(10) As String * 8                                   'strng array

For Bb = 1 To 10
  Sar(bb) = Str(bb)                                         'fill the array
Next
Bb = 1
'now call the sub and notice that we always must pass the first address with
index 1
Call Teststr(bb , Sar(1))


Call Test2                                                  'call sub
Test2                                                       'or use without
CALL
'Note that when calling a sub without the statement CALL, the enclosing
parentheses must be left out
Bb = 1
Call Test(1 , Bb)                                           'call sub with
parameters
Print Bb                                                    'print value that
is changed

'now test all the variable types
Call Testvar(bb , I , W , L , S )
Print Bb ; I ; W ; L ; S

'now pass an array
'note that it must be passed by reference
Testarray 2 , Ar(1)
Print "ar(1) = " ; Ar(1)
Print "ar(3) = " ; Ar(3)

$notypecheck                                                ' turn off type
checking
Testvar Bb , I , I , I , S
'you can turn off type checking when you want to pass a block of memory
$typecheck                                                  'turn it back on
End

'End your code with the subprograms
'Note that the same variables and names must be used as the declared ones

Sub Test(byval A As Byte , B1 As Byte)                      'start sub
    Print A ; " " ; B1                                      'print passed
variables
    B1 = 3                                                  'change value
    'You can change A, but since a copy is passed to the SUB,
    'the change will not reflect to the calling variable
End Sub
```

```
Sub Test2                                                    'sub without
parameters
    Print "No parameters"
End Sub



Sub Testvar(b As Byte , I As Integer , W As Word , L As Long , S As String)
    Local X As Byte

    X = 5                                                    'assign local

    B = X
    I = -1
    W = 40000
    L = 20000
    S = "test"
End Sub

Sub Testarray(byval A As Byte , B1 As Byte)                  'start sub
    Print A ; " " ; B1                                       'print passed
variables
    B1 = 3                                                   'change value of
element with index 1
    B1(1) = 3                                                'specify the index
which does the same as the line above
    B1(3) = 3                                                'modify other
element of array
    'You can change A, but since a copy is passed to the SUB,
    'the change will not reflect to the calling variable
End Sub

'notice the empty() to indicate that a string array is passed
Sub Teststr(b As Byte , Dl() As String)
  Dl(b) = Dl(b) + "add"
End Sub
```

DEFxxx

Action

Declares all variables that are not dimensioned of the DefXXX type.

Syntax

DEFBIT b	Define BIT
DEFBYTE c	Define BYTE
DEFINT I	Define INTEGER
DEFWORD x	Define WORD
DEFLNG l	Define LONG
DEFSNG s	Define SINGLE
DEFDBL z	Define DOUBLE

Remarks

While you can DIM each individual variable you use, you can also let the compiler handle it for you.
All variables that start with a certain letter will then be dimmed as the specified type.

Example

```
Defbit b : DefInt c  'default type for bit and integers

Set b1        'set bit to 1

c = 10        'let c = 10
```

DEFLCDCHAR

Action

Define a custom LCD character.

Syntax

DEFLCDCHAR char,r1,r2,r3,r4,r5,r6,r7,r8

Remarks

char	Constant representing the character (0-7).
r1-r8	The row values for the character.

You can use the LCD designer to build the characters.

It is important that a CLS follows the DEFLCDCHAR statement(s).
So make sure you use the DEFLCDCHAR before your CLS statement.

Special characters can be printed with the Chr() function.

LCD Text displays have a 64 byte memory that can be used to show your own custom characters. Each character uses 8 bytes as the character is an array from 8x8 pixels. You can create a maximum of 8 characters this way. Or better said : you can show a maximum of 8 custom characters at the same time. You can redefine characters in your program but with the previous mentioned restriction.
A custom character can be used to show characters that are not available in the LCD font table. For example a Û.
You can also use custom characters to create a bar graph or a music note.

See also

Tools LCD designer

Partial Example

```
Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                    'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                    'print the special
character
```

DEG2RAD

Action
Converts an angle in to radians.

Syntax
var = **DEG2RAD**(Source)

Remarks

Var	A numeric variable that is assigned with the degrees of variable Source.
Source	The single or double variable to get the degrees of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG

Example
```
'-----------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates DEG2RAD function

'-----------------------------------------------------------------------
-
Dim S As Single
S = 90

S = Deg2Rad(s)
Print S
S = Rad2deg(s)
Print S
End
```

DELAY

Action
Delay program execution for a short time.

Syntax
DELAY

Remarks
Use DELAY to wait for a short time.
The delay time is ca. 1000 microseconds.

Interrupts that occur frequently and/or take a long time to process, will let the delay last longer.
When you need a very accurate delay, you need to use a timer.

See also
WAIT , WAITMS

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : delay.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: DELAY, WAIT, WAITMS
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Ddrb = &HFF                                                'port B as output
Portb = 255
Print "Starting"
Delay                                                      'lets wait for a
very short time
Print "Now wait for 3 seconds"
Portb = 0
Wait 3
Print "Ready"
Waitms 10                                                  'wait 10
milliseconds
Portb = 255
End
```

DIM

Action
Dimension a variable.

Syntax
DIM var AS [XRAM/SRAM/ERAM]type [AT location/variable] [OVERLAY]

Remarks

Var	Any valid variable name such as b1, i or longname. var can also be an array : ar(10) for example.
Type	Bit, Byte, Word, Integer, Long, Single, Double or String
XRAM	Specify XRAM to store variable into external memory
SRAM	Specify SRAM to store variable into internal memory (default)
ERAM	Specify ERAM to store the variable into EEPROM
OVERLAY	Specify that the variable is overlaid in memory.
location	The address of name of the variable when OVERLAY is used.

A string variable needs an additional length parameter:
*Dim s As XRAM String * 10*

In this case, the string can have a maximum length of 10 characters. Internally one additional byte is needed to store the end of string marker. Thus in the example above, 11 bytes will be used to store the string.

Note that BITS can only be stored in internal memory.

SCOPE
The scope for DIM is global. So no matter where you use the DIM statements, the variable will end up as a global visible variable that is visible in all modules, procedures and functions. When you need a LOCAL variable that is local to the procedure or function, you can use LOCAL.
Since LOCAL variables are stored on the frame, it takes more code to dynamic generate and clean up these variables.

AT
The optional **AT** parameter lets you specify where in memory the variable must be stored. When the memory location already is occupied, the first free memory location will be used. You need to look in the report file to see where the variable is located in memory.

OVERLAY
The **OVERLAY** option will not use any variable space. It will create a sort of phantom variable:

```
Dim x as Long at $60 'long uses 60,61,62 and 63 hex of SRAM

Dim b1 as Byte at $60 OVERLAY
Dim b2 as Byte at $61 OVERLAY
```

B1 and B2 are no real variables! They refer to a place in memory. In this case to &H60 and &H61. By assigning the phantom variable B1, you will write to memory location &H60 that is used by variable X.
So to define it better, OVERLAY does create a normal usable variable, but it will be stored at the sepcified memory location which could be already be occupied by another OVERLAY variable, or by a normal variable.

Take care with the OVERLAY option. Use it only when you understand it.

You can also read the content of B1: Print B1
This will print the content of memory location &H60.

By using a phantom variable you can manipulate the individual bytes of real variables.

Another example

Dim L as Long at &H60
Dim W as Word at &H62 OVERLAY

W will now point to the upper two bytes of the long.

Using variable name instead of address

As variables can be moved though the program during development it is not always convenient to specify an address. You can also use the name of the variable :

DIM W as WORD
Dim B as BYTE AT W OVERLAY

Now B is located at the same address as variable W.

For XRAM variables, you need additional hardware : an external RAM and address decoder chip.

For ERAM variables, it is important to understand that these are not normal variables. ERAM variables serve as a way to simple read and write the EEPROM memory. You can use READEEPROM and WRITEEEPROM for that purpose too.

ERAM variables only can be assigned to SRAM variables, and ERAM variables can be assigned to SRAM variables. You can not use an ERAM variable as you would use a normal variable.

Dim b as byte, bx as ERAM byte
B= 1
Bx=b ' write to EEPROM
B=bx ' read from EEPROM

See Also

CONST , LOCAL

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : dim.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: DIM
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
```

```
$hwstack = 32                                                    ' default use 32
for the hardware stack
$swstack = 10                                                    ' default use 10
for the SW stack
$framesize = 40                                                  ' default use 40
for the frame space

Dim B1 As Bit                                                    'bit can be 0 or 1
Dim A As Byte                                                    'byte range from
0-255
Dim C As Integer                                                 'integer range from
-32767 - +32768
Dim L As Long
Dim W As Word
Dim S As String * 11                                             'length can be up
to 11 characters

'new feature : you can specify the address of the variable
Dim K As Integer At &H120
'the next dimensioned variable will be placed after variable s
Dim Kk As Integer


'Assign bits
B1 = 1                                                           'or
Set B1                                                           'use set

'Assign bytes
A = 12
A = A + 1

'Assign integer
C = -12
C = C + 100
Print C

W = 50000
Print W

'Assign long
L = 12345678
Print L

'Assign string
S = "Hello world"
Print S

End
```

DIR

Action

Returns the filename that matches the specified filemask.

Syntax

sFile = **DIR**(mask)
sFile = **DIR**()

Remarks

SFile	A string variable that is assigned with the filename.
Mask	A file mask with a valid DOS filemask like *.TXT Use *.* to select all files.

The first function call needs a file mask. All other calls do not need the file mask. In fact when you want to get the next filename from the directory, you must not provide a mask after the first call.

Dir() returns an empty string when there are no more files or when no file name is found that matches the mask.

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT, FILELEN , FILEDATE , FILETIME , FILEDATETIME , WRITE , INPUT

ASM

Calls	_Dir ; with filemask	_Dir0 ; without filemask
Input	X : points to the string with the mask	Z : points to the target variable
Output		

Partial Example

```
'Lets have a look at the file we created
Print "Dir function demo"
S = Dir("*.*")
'The first call to the DIR() function must contain a file mask
' The * means everything.
'
WhileLen(s)> 0 ' if there was a file found
  Print S ;" ";Filedate();" ";Filetime();" ";Filelen()
' print file , the date the fime was created/changed , the time and the size of the file
  S = Dir()' get next
Wend
```

DISABLE

Action

Disable specified interrupt.

Syntax

DISABLE interrupt

Remarks

Interrupt	Description

INT0	External Interrupt 0
INT1	External Interrupt 1
OVF0,TIMER0, COUNTER0	TIMER0 overflow interrupt
OVF1,TIMER1, COUNTER1	TIMER1 overflow interrupt
CAPTURE1, ICP1	INPUT CAPTURE TIMER1 interrupt
COMPARE1A,OC1A	TIMER1 OUTPUT COMPARE A interrupt
COMPARE1B,OC1B	TIMER1 OUTPUT COMPARE B interrupt
SPI	SPI interrupt
URXC	Serial RX complete interrupt
UDRE	Serial data register empty interrupt
UTXC	Serial TX complete interrupt
SERIAL	Disables URXC, UDRE and UTXC
ACI	Analog comparator interrupt
ADC	A/D converter interrupt

By default all interrupts are disabled.
To disable all interrupts specify INTERRUPTS.

To enable the enabling and disabling of individual interrupts use ENABLE INTERRUPTS.
The ENABLE INTERRUPTS serves as a master switch. It must be enabled/set in order for the individual interrupts to work.

The interrupts that are available will depend on the used microprocessor.

See also
ENABLE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                       : serint.bas
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : serial interrupt example for AVR
'micro                      : 90S8535
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------------
-----------

$regfile = "8535def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Cmaxchar = 20                                         'number of
characters
```

```
Dim B As Bit                                                'a flag for
signalling a received character
Dim Bc As Byte                                              'byte counter
Dim Buf As String * Cmaxchar                                'serial buffer
Dim D As Byte

'Buf = Space(20)
'unremark line above for the MID() function in the ISR
'we need to fill the buffer with spaces otherwise it will contain garbage

Print "Start"

On Urxc Rec_isr                                             'define serial
receive ISR
Enable Urxc                                                 'enable receive isr



Enable Interrupts                                           'enable interrupts
to occur

Do
  If B = 1 Then                                             'we received
something
     Disable Serial
     Print Buf                                              'print buffer
     Print Bc                                               'print character
counter


     'now check for buffer full
     If Bc = Cmaxchar Then                                  'buffer full
        Buf = ""                                            'clear
        Bc = 0                                              'rest character
counter
     End If

     Reset B                                                'reset receive flag
     Enable Serial
  End If
Loop

Rec_isr:
  Print "*"
  If Bc < Cmaxchar Then                                     'does it fit into
the buffer?
     Incr Bc                                                'increase buffer
counter


     If Udr = 13 Then                                       'return?
        Buf = Buf + Chr(0)
        Bc = Cmaxchar
     Else
        Buf = Buf + Chr(udr)                                'add to buffer
     End If


    ' Mid(buf , Bc , 1) = Udr
    'unremark line above and remark the line with Chr() to place
    'the character into a certain position
     'B = 1                                                    'set flag
  End If
  B = 1                                                     'set flag
Return
```

DISKFREE

Action
Returns the free size of the Disk

Syntax
lFreeSize = **DISKFREE**()

Remarks

lFreeSize	A Long Variable, which is assigned with the available Bytes on the Disk in Bytes

This functions returns the free size of the disk in Bytes.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_GetDiskFreeSize
Input	none
Output	r16-r19: Long-Value of free Bytes

Partial Example
```
Dim Gbtemp1 As Byte        ' scratch byte
Gbtemp1 =Initfilesystem(1) ' we must init the filesystem once
If Gbtemp1 > 0 Then
   Print#1 ,"Error "; Gbtemp1
Else
   Print#1 ," OK"
Print "Disksize : ";Disksize() ' show disk size in bytes
Print "Disk free: ";Diskfree() ' show free space too
End If
```

DISKSIZE

Action
Returns the size of the Disk

Syntax
lSize = **DISKSIZE**()

Remarks

lSize	A Long Variable, which is assigned with the capacity of the disk in Bytes

This functions returns the capacity of the disk.

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_GetDiskSize
Input	none
Output	16-r19: Long-Value of capacity in Bytes

Partial Example

```
Dim Gbtemp1 As Byte' scratch byte
Gbtemp1 = Initfilesystem(1)' we must init the filesystem once
If Gbtemp1 > 0 Then
   Print#1 ,"Error "; Gbtemp1
Else
   Print#1 ," OK"
Print "Disksize : "; Disksize()' show disk size in bytes
Print "Disk free: "; Diskfree()' show free space too
End If
```

DISPLAY

Action

Turn LCD display on or off.

Syntax

DISPLAY ON / OFF

Remarks

The display is turned on at power up.

See also

LCD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                          : lcd.bas
'copyright                     : (c) 1995-2005, MCS Electronics
```

```
'purpose                   : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR,
HOME
'                            CURSOR, DISPLAY
'micro                     : Mega8515
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m8515.dat"                                      ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings


Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines

'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                         'clear the LCD
display
Lcd "Hello world."                                          'display this at
the top line
Wait 1
Lowerline                                                   'select the lower
line
Wait 1
Lcd "Shift this."                                           'display this at
the lower line
Wait 1
```

```
For A = 1 To 10
   Shiftlcd Right                                          'shift the text to
the right
   Wait 1                                                  'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                           'shift the text to
the left
   Wait 1                                                  'wait a moment
Next

Locate 2 , 1                                               'set cursor
position
Lcd "*"                                                    'display this
Wait 1                                                     'wait a moment

Shiftcursor Right                                          'shift the cursor
Lcd "@"                                                    'display this
Wait 1                                                     'wait a moment

Home Upper                                                 'select line 1 and
return home
Lcd "Replaced."                                            'replace the text
Wait 1                                                     'wait a moment

Cursor Off Noblink                                         'hide cursor
Wait 1                                                     'wait a moment
Cursor On Blink                                            'show cursor
Wait 1                                                     'wait a moment
Display Off                                                'turn display off
Wait 1                                                     'wait a moment
Display On                                                 'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                                 'goto home on line
three
Home Fourth
Home F                                                     'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line

Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                        'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                        'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                 'value into ACC
!rCall _write_lcd                                          'put it on LCD
End
```

DO-LOOP

Action
Repeat a block of statements until condition is true.

Syntax
DO
  statements
LOOP [UNTIL expression]

Remarks
You can exit a DO..LOOP with the EXIT DO statement.
The DO-LOOP is always performed at least once.

The main part of your code can best be executed within a DO.. LOOP.
You could use a GOTO also but it is not as clear as the DO LOOP.
Main:
  ' code
GOTO Main

Do
  'Code
Loop

Of course in the example above, it is simple to see what happens, but when the code consist of a lot of lines of code, it is not so clear anymore what the GOTO Main does.

See also
EXIT , WHILE-WEND , FOR-NEXT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : do_loop.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: DO, LOOP
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space
```

```
Dim A As Byte

A = 1                                                    'assign a var
Do                                                       'begin a do..loop
  Print A                                                'print var
  Incr A                                                 'increase by one
Loop Until A = 10                                        'do until a=10
End

'You can write a never-ending loop with the following code
Do
  'Your code goes here
Loop
```

DriveCheck

Action
Checks the Drive, if it is ready for use

Syntax
bErrorCode = **DRIVECHECK**()

Remarks

bErrorCode	A Byte Variable, which is assigned with the return value of the function

This function checks the drive, if it is ready for use (for example, whether a compact flash card is inserted). The functions returns 0 if the drive can be used, otherwise an error code is returned. For Error code see section Error codes.

See also
DriveReset , DriveInit , DriveGetIdentity , DriveWriteSector , DriveReadSector

ASM

Calls	_DriveCheck	
Input	none	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example
```
Dim bError as Byte
bError = DriveCheck()
```

DriveGetIdentity

Action
Returns the Parameter information from the Card/Drive

Syntax
bErrorCode = **DRIVEGETIDENTIFY**(wSRAMPointer)

Remarks

BErrorCode	A Byte Variable, which is assigned with the errorcode of the function
wSRAMPointer	A Word Variable, which contains the SRAM address (pointer) , to which the information of the Drive should be written

The Identify Drive Function returns the parameter information (512 Bytes) from the CompactFlash Memory Card/Drive and writes it to SRAM starting at the address, to which the content of the variable wSRAMPointer is pointing. This information are for example number of sectors of the card, serial number and so on. Refer to the Card/Drive manual for further information. The functions returns 0 if no error occurred. For Error code see section Error codes.

Note: For meaning of wSRAMPointer see Note in DriveReadSector

See also
DriveCheck, DriveReset , DriveInit , DriveWriteSector , DriveReadSector

ASM

Calls	_DriveGetIdentity	
Input		Z: SRAM-Address of buffer *)
Output	r25: Errorcode	C-Flag: Set on Error

*) Please note: This is not the address of wSRAMPointer, it is its content, which is the starting-address of the buffer.

Partial Example
```
Dim bError as Byte
Dim aBuffer(512) as Byte' Hold Sector to and from CF-Card
Dim wSRAMPointer as Word' Address-Pointer for write

' give Address of first Byte of the 512 Byte Buffer to Word-Variable
wSRAMPointer =VarPtr(aBuffer(1))


' Now read the parameter Information from CF-Card
bError = DriveGetIdentity( wSRAMPointer)
```

DriveInit

Action

Sets the AVR-Hardware (PORTs, PINs) attached to the Drive and resets the Drive.

Syntax
bErrorCode = **DRIVEINIT**()

Remarks

BErrorCode	A Byte Variable, which is assigned with the errorcode of the function

Set the Ports and Pins attaching the Drive for Input/Output and give initial values to the output-pins. After that the Drive is reset. Which action is done in this function depends of the drive and its kind of connection to the AVR. The functions returns 0 if no error occured. For Errorcode see section Errorcodes.

See also
DriveCheck, DriveReset , DriveGetIdentity , DriveWriteSector , DriveReadSector

ASM

Calls	_DriveInit	
Input	none	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example
```
Dim bError as Byte
bError = DriveInit()
```

DriveReset

Action
Resets the Drive.

Syntax
bErrorCode = **DRIVERESET**()

Remarks

BErrorCode	A Byte Variable, which is assigned with the error code of the function

This function resets the drive and brings it to an initial state. The functions returns 0 if no error occurred. For Error code see section Error codes.

See also
DriveCheck, DriveInit , DriveGetIdentity , DriveWriteSector , DriveReadSector

ASM

Calls	_DriveReset	
Input	none	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example

```
Dim bError as Byte
bError = DriveReset()
```

DriveReadSector

Action

Read a Sector (512 Bytes) from the (Compact Flashcard-) Drive

Syntax

bErrorCode = **DRIVEREADSECTOR**(wSRAMPointer, lSectorNumber)

Remarks

bErrorCode	A Byte Variable, which is assigned with the error code of the function
wSRAMPointer	A Word Variable, which contains the SRAM address (pointer) , to which the Sector from the Drive should be written
lSectorNumber	A Long Variable, which give the sector number on the drive be transfer.

Reads a Sector (512 Bytes) from the Drive and write it to SRAM starting at the address, to which the content of the variable wSRAMPointer is pointing. The functions returns 0 if no error occurred. For Error code see section Error codes.

Note: wSRAMPointer is not the variable, to which the content of the desired drive-sector should be written, it is the Word-Variable/Value which contains the SRAM address of the range, to which 512 Bytes should be written from the Drive. This gives you the flexibility to read and write every SRAM-Range to and from the drive, even it is not declared as variable. If you know the SRAM-Address (from the compiler report) of a buffer you can pass this value directly, otherwise you can get the address with the BASCOM-function VARPTR (see example).

See also

DriveCheck, DriveReset , DriveInit , DriveGetIdentity , DriveWriteSector

ASM

Calls	_DriveReadSector	
Input	Z: SRAM-Address of buffer *)	X: Address of Long-variable with sectornumber
Output	r25: Errorcode	C-Flag: Set on Error

This is not the address of wSRAMPointer, it is its content, which is the starting-address of the buffer.

Partial Example

```
Dim bError as Byte
Dim aBuffer(512)as Byte' Hold Sector to and from CF-Card
Dim wSRAMPointer as Word' Address-Pointer for write
Dim lSectorNumber as Long' Sector Number

' give Address of first Byte of the 512 Byte Buffer to Word-Variable
wSRAMPointer =VarPtr(aBuffer(1))

' Set Sectornumber, sector 32 normally holds the Boot record sector of first partition
lSectorNumber = 32

' Now read in sector 32 from CF-Card
bError = DriveReadSector( wSRAMPointer , lSectorNumber)
' Now Sector number 32 is in Byte-Array bBuffer
```

DriveWriteSector

Action

Write a Sector (512 Bytes) to the (Compact Flashcard-) Drive

Syntax

bErrorCode = **DRIVEWRITESECTOR**(wSRAMPointer, lSectorNumber)

Remarks

bErrorCode	A Byte Variable, which is assigned with the error code of the function
wSRAMPointer	A Word Variable, which contains the SRAM address (pointer), from which the Sector to the Drive should be written
lSectorNumber	A Long Variable, which give the sector number on the drive to transfer.

Writes a Sector (512 Bytes) from SRAM starting at the address, to which the content of the variable wSRAMPointer is pointing to the Drive to sector number lSectornumber. The functions returns 0 if no error occurred. For Error code see section Error codes.

For the meaning of wSRAMPointer see Note in DriveReadSector

See also

DriveCheck, DriveReset , DriveInit , DriveGetIdentity , DriveReadSector

ASM

Calls	_DriveWriteSector	
Input	Z: SRAM-Address of buffer *)	X: Address of Long-variable with sectornumber

Output	r25: Errorcode	C-Flag: Set on Error

This is not the address of wSRAMPointer, it is its content, which is the starting-address of the buffer.

Partial Example

```
Dim bError as Byte
Dim aBuffer(512) as Byte' Hold Sector to and from CF-Card
Dim wSRAMPointer as Word' Address-Pointer for read
Dim lSectorNumber as Long' Sector Number


' give Address of first Byte of the 512 Byte Buffer to Word-Variable
wSRAMPointer =VarPtr(aBuffer(1))

' Set Sectornumber

lSectorNumber = 3

' Now Write in sector 3 from CF-Card
bError = DriveWriteSector( wSRAMPointer , lSectorNumber)
```

DTMFOUT

Action
Sends a DTMF tone to the compare1 output pin of timer 1.

Syntax
DTMFOUT number, duration
DTMFOUT string , duration

Remarks

Number	A variable or numeric constant that is equivalent with the number of your phone keypad.
Duration	Time in mS the tone will be generated.
string	A string variable that holds the digits to be dialed.

The DTMFOUT statement is based on an Atmel application note (314).

It uses TIMER1 to generate the dual tones. As a consequence, timer1 can not be used in interrupt mode by your application. You may use it for other tasks.

Since the TIMER1 is used in interrupt mode you must enable global interrupts with the statement ENABLE INTERRUPTS. The compiler could do this automatic but when you use other interrupts as well it makes more sense that you enable them at the point where you want them to be enabled.

The working range is from 4 MHz to 10 MHz system clock(xtal).

The DTMF output is available on the TIMER1 OCA1 pin. For a 2313 this is PORTB.3.

Take precautions when connecting the output to your telephone line.

Ring voltage can be dangerous!

System Resources used
TIMER1 in interrupt mode

See also
NONE

ASM
The following routine is called from mcs.lib : _DTMFOUT
R16 holds the number of the tone to generate, R24-R25 hold the duration time in mS.
Uses R9,R10,R16-R23

The DTMF table is remarked in the source and shown for completeness, it is generated by the compiler however with taking the used crystal in consideration.

Example
```
'-----------------------------------------------------------------------------
'name                     : dtmfout.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates DTMFOUT statement based on AN 314 from
Atmel
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'since the DTMFOUT statement uses the TIMER1 interrupt you must enable
'global interrupts
'This is not done by the compiler in case you have more ISRs
Enable Interrupts


'the first sample does dtmfout in a loop
Dim Btmp As Byte , Sdtmf As String * 10
```

```
Sdtmf = "12345678"                                          ' number to dial

Do

 Dtmfout Sdtmf , 50                                         ' lets dial a
number
 '               ^ duration is 50 mS for each digit
 Waitms 1000                                                ' wait for one
second


 ' As an alternative you can send single digits
 ' there are 16 dtmf tones
  For Btmp = 0 To 15
   Dtmfout Btmp , 50                                        ' dtmf out on
PORTB.3 for the 2313 for 500 mS
    'output is on the OC1A output pin
    Waitms 500                                              ' wait 500 msec
 Next
Loop
End

'the keypad of most phones looks like this :
'1  2  3    optional are A
'4  5  6                 B
'7  8  9                 C
'*  0  #                 D

'the DTMFOUT translates a numeric value from 0-15 into :
' numeric value    phone key
'   0                0
'   1                1
'   2                2
'   3                3
' etc.
'   9                9
'  10                *
'  11                #
'  12                A
'  13                B
'  14                C
'  15                D
```

ECHO

Action

Turns the ECHO on or off while asking for serial INPUT.

Syntax

ECHO value

Remarks

Value	ON to enable ECHO and OFF to disable ECHO.

When you use INPUT to retrieve values for variables, all info you type can be echoed back. In this case you will see each character you enter. When ECHO is OFF, you will not see the

characters you enter.

In versions 1.11.6.2 and earlier the ECHO options were controlled by an additional parameter on the INPUT statement line like : INPUT "Hello " , var NOECHO

This would suppress the ECHO of the typed data. The new syntax works by setting ECHO ON and OFF. For backwards compatibility, using NOECHO on the INPUT statement line will also work. In effect it will turn echo off and on automatic.

By default, ECHO is always ON.

See also
INPUT

ASM
The called routines from mcs.lib are _ECHO_ON and _ECHO_OFF

The following ASM is generated when you turn ECHO OFF.
Rcall Echo_Off
This will set bit 3 in R6 that holds the ECHO state.

When you turn the echo ON the following code will be generated
Rcall Echo_On

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : input.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: INPUT, INPUTHEX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim V As Byte , B1 As Byte
Dim C As Integer , D As Byte
Dim S As String * 15

Input "Use this to ask a question " , V
Input B1                                                   'leave out for no
question

Input "Enter integer " , C
```

```
Print C


Inputhex "Enter hex number (4 bytes) " , C
Print C
Inputhex "Enter hex byte (2 bytes) " , D
Print D

Input "More variables " , C , D
Print C ; " " ; D

Input C Noecho                                                  'supress echo

Input "Enter your name " , S
Print "Hello " ; S

Input S Noecho                                                  'without echo
Print S
End
```

ELSE

Action
Executed if the IF-THEN expression is false.

Syntax
ELSE

Remarks
You don't have to use the ELSE statement in an IF THEN .. END IF structure.
You can use the ELSEIF statement to test for another condition.

IF a = 1 THEN
...
ELSEIF a = 2 THEN
..
ELSEIF b1 > a THEN
...
ELSE
...
END IF

See also
IF , END IF , SELECT-CASE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                    : if_then.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : demo: IF, THEN, ELSE
'micro                   : Mega48
'suited for demo         : yes
```

```
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , B1 As Byte

Input "Number " , A                                        'ask for number
If A = 1 Then                                              'test number
   Print "You got it!"
End If

If A = 0 Then                                              'test again
   Print "Wrong"                                           'thats wrong
Else                                                       'print this if a is
not 0
   Print "Almost?"
End If

Rem You Can Nest If Then Statements Like This
B1 = 0
If A = 1 Then
  If B1 = 0 Then
     Print "B1=0"
  End If
Else
  Print "A is not 0"
End If

Input "Number " , A
If A = 1 Then                                              '
  Print "Ok"
Elseif A = 2 Then                                          'use elseif for
more tests
  Print "2" : A = 3
Elseif A = 3 Then
  Print "3"
End If

If A.1 = 1 Then Print "Bit 1 set"                          'test for  a bit

End
```

ENABLE

Action

Enable specified interrupt.

Syntax

ENABLE interrupt

Remarks

Interrupt	Description
INT0	External Interrupt 0
INT1	External Interrupt 1
OVF0,TIMER0, COUNTER0	TIMER0 overflow interrupt
OVF1,TIMER1, COUNTER1	TIMER1 overflow interrupt
CAPTURE1, ICP1	INPUT CAPTURE TIMER1 interrupt
COMPARE1A,OC1A or COMPARE1, OC1	TIMER1 OUTPUT COMPARE A interrupt In case of only one compare interrupt
COMPARE1B,OC1B	TIMER1 OUTPUT COMPARE B interrupt
SPI	SPI interrupt
URXC	Serial RX complete interrupt
UDRE	Serial data register empty interrupt
UTXC	Serial TX complete interrupt
SERIAL	Disables URXC, UDRE and UTXC
ACI	Analog comparator interrupt
ADC	A/D converter interrupt

By default all interrupts are disabled.
To enable the enabling and disabling of interrupts use ENABLE INTERRUPTS.

Other chips might have additional interrupt sources such as INT2, INT3 etc.

See also
DISABLE

Partial Example
```
Enable Interrupts       'allow interrupts to be set
Enable Timer1       'enables the TIMER1 interrupt
```

ENCODER

Action
Reads pulses from a rotary encoder.

Syntax
Var = **ENCODER**(pin1, pin2, LeftLabel, RightLabel , wait)

Remarks

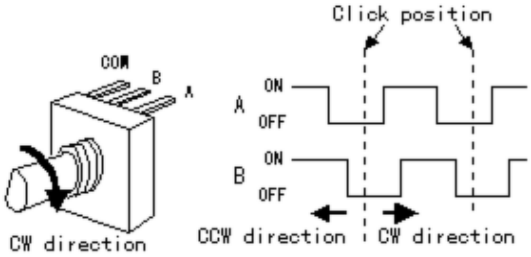
Var	The target variable that is assigned with the result
Pin1 and pin2	These are the names of the PIN registers to which the output of the encoder is connected. Both pins must be on the same PIN register. So Pinb.0 and Pinb.7 is valid while PinB.0 and PinA.0 is not.
LeftLabel	The name of the label that will be called/executed when a transition to the left is encoded.
RightLabel	The name of the label that will be called/executed when a transition to the right is encountered.
wait	A value of 0 will only check for a rotation/pulse. While a value of 1 will wait until a user actual turns the encoder. A value of 1 will thus halt your program.

There are some conditions you need to fulfill :

- The label that is called by the encoder must be terminated by a RETURN statement.
- The pin must work in the input mode. By default all pins work in input mode.
- The pull up resistors must be activated by writing a logic 1 to the port registers as the examples shows.

Rotary encoders come in many flavors. Some encoders also have a build in switch.

A sample of an encoder



Since the microprocessor has internal pull up resistors, you do not need external pull up resistors for most encoders.

Example

```
'------------------------------------------------------------------------------
-----------
'name                   : encoder.bas
'copyright              : (c) 1995-2005, MCS Electronics
'purpose                : demonstration of encoder function
'micro                  : Mega128
'suited for demo        : yes
```

```
'commercial addon needed  : no
'An encoder has 2 outputs and a ground
'We connect the outputs to pinb.0 and pinb.1
'You may choose different pins as long as they are at the same PORT
'The pins must be configured to work as input pins
'This function works for all PIN registers
'-------------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Print "Encoder test"
Dim B As Byte
'we have dimmed a byte because we need to maintain the state of the encoder

Portb = &B11                                                ' activate pull up
registers

Do
   B = Encoder(pinb.0 , Pinb.1 , Links , Rechts , 1)
   '                                                 ^--- 1 means wait for change
which blocks programflow
   '                           ^--------^---------- labels which are called
   '              ^-------^----------------------- port PINs
   Print B
  Waitms 10
Loop
End

'so while you can choose PINB0 and PINB7,they must be both member of PINB
'this works on all PIN registers

Links:
  Print "left rotation"
Return

Rechts:
  Print "right rotation"
Return


End
```

END

Action

Terminate program execution.

Syntax

END

Remarks
STOP can also be used to terminate a program.

When an END statement is encountered, all interrupts are disabled and a never-ending loop is generated.
When a STOP is encountered the interrupts will not be disabled. Only a never ending loop will be created.

In an embedded application you probably do not want to end the application. But there are cases where you do want to end the application. For example when you control some motors, and you determine a failure, you do not want to use a Watchdog reset because then the failure will occur again. In that case you want to display an error, and wait for service personal to fix the failure.

It is important to notice that without the END statement, your program can behave strange in certain cases. For example :
Print "Hello"

Note that there is no END statement. So what will happen? The program will print "Hello". But as the compiler places the library code behind the program code, the micro will execute the library code ! But without being called. As most library code are assembler sub routines that end with a RET, your program will most likely crash, or reset and repeat for ever.

See also
STOP

Example
```
Print "Hello"       'print this
End                 'end program execution and disable all interrupts
```

EOF

Action
Returns the End of File Status.

Syntax
bFileEOFStatus = **EOF**(#bFileNumber)

Remarks

bFileEOFStatus	(Byte) A Byte Variable, which assigned with the EOF Status
bFileNumber	(Byte) Number of the opened file

This functions returns information about the End of File Status

Return value	Status
0	NOT EOF

255	EOF

In case of an error (invalid file number) 255 (EOF) is returned too.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_FileEOF	
Input	r24: Filenumber	
Output	r24: EOF Status	r25: Error code
	C-Flag: Set on Error	

Partial Example

```
Ff =Freefile()' get file handle
Open "test.txt" For Input As #ff ' we can use a constant for the file too
Print Lof(#ff); " length of file"
Print Fileattr(#ff); " file mode"' should be 1 for input
Do
  LineInput #ff , S ' read a line
  ' line input is used to read a line of text from a file
  Print S ' print on terminal emulator
Loop Until Eof(#ff)<> 0
'The EOF() function returns a non-zero number when the end of the file is reached
'This way we know that there is no more data we can read
Close #ff
```

EXIT

Action
Exit a FOR..NEXT, DO..LOOP , WHILE ..WEND, SUB..END SUB or FUNCTION..END FUNCTION.

Syntax
EXIT FOR
EXIT DO
EXIT WHILE
EXIT SUB
EXIT FUNCTION

Remarks
With the EXIT statement you can exit a structure at any time.

Example

```
'-----------------------------------------------------------------------
-----------
'name                       : exit.bas
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : demo: EXIT
'micro                      : Mega48
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim B1 As Byte , A As Byte

B1 = 50                                                    'assign var
For A = 1 To 100                                           'for next loop
   If A = B1 Then                                          'decision
      Exit For                                             'exit loop
   End If
Next
Print "Exit the FOR..NEXT when A was " ; A

A = 1
Do
  Incr A
  If A = 10 Then
     Exit Do
  End If
Loop
Print "Loop terminated"
End
```

EXP

Action

Returns e(the base of the natural logarithm) to the power of a single or double variable.

Syntax

Target = **EXP**(source)

Remarks

Target	The single or double that is assigned with the Exp() of the target.
Source	The source to get the Exp of.

See also
LOG , LOG10

Example
```
'-----------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega88
'suited for demo          : no, but without the DOUBLE, it works for DEMO too
in M48
'commercial addon needed  : no
'purpose                  : demonstrates EXP function
'-----------------------------------------------------------------------
-

$regfile = "m88def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim X As Single

X = Exp(1.1)
Print X
'prints 3.004166124
X = 1.1
X = Exp(x)
Print X
'prints 3.004164931


Dim D As Double

D = Exp(1.1)
Print D
'prints 3.00416602394643
D = 1.1
D = Exp(d)
Print D
'prints 3.00416602394638

End
```

FILEATTR

Action
Returns the file open mode.

Syntax

bFileAttribut = **FILEATTR**(bFileNumber)

Remarks

bFileAttribut	(Byte) File open mode, See table
bFileNumber	(Byte) Number of the opened file

This functions returns information about the File open mode

Return value	Open mode
1	INPUT
2	OUTPUT
8	APPEND
32	BINARY

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT, FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN, WRITE , INPUT

ASM

Calls	_FileAttr	
Input	r24: Filenumber	
Output	24: File open mode	r25: Errorcode
	C-Flag: Set on Error	

Partial Example

```
'open the file in BINARY mode
Open "test.biN" For Binary As #2
Print Fileattr(#2); " file mode"' should be 32 for binary
Put #2 , Sn ' write a single
Put #2 , Stxt ' write a string
Close #2
```

FILEDATE

Action

Returns the date of a file

Syntax

sDate = **FILEDATE** ()
sDate = **FILEDATE** (file)

Remarks

Sdate	A string variable that is assigned with the date.
File	The name of the file to get the date of.

This function works on any file when you specify the filename. When you do not specify the filename, it works on the current selected file of the DIR() function.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE, GET , PUT, FILELEN , FILETIME , FILEDATETIME , DIR , WRITE , INPUT

ASM
Calls	_FileDateS ; with filename	_FileDateS0 ; for current file from DIR()
Input	X : points to the string with the mask	Z : points to the target variable
Output		

Partial Example
```
Print "File demo"
Print Filelen("josef.img");" length"    ' length of file
Print Filetime("josef.img");" time"     ' time file was changed
Print Filedate("josef.img");" date"    ' file date
```

FILEDATETIME

Action
Returns the file date and time of a file

Syntax
Var = **FILEDATETIME** ()
Var = **FILEDATETIME** (file)

Remarks
Var	A string variable or byte array that is assigned with the file datge and time of the specified file
File	The name of the file to get the date time of.

When the target variable is a string, it must be dimensioned with a length of at least 17 bytes.
When the target variable is a byte array, the array size must be at least 6 bytes.

When you use a numeric variable, the internal file date and time format will be used.

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILELEN , FILEDATE , FILETIME , DIR , WRITE , INPUT

ASM

Calls	_FileDateTimeS	_FileDateTimeS0
Input		
Output		

Calls	_FileDateTimeB	_FileDateTimeB0
Input		
Output		

Example
See fs_subfunc_decl_lib.bas in the samples dir.

FILELEN

Action
Returns the size of a file

Syntax
lSize = **FILELEN** ()
lSize = **FILELEN** (file)

Remarks

lSize	A Long Variable, which is assigned with the filesize in bytes of the file.
File	A string or string constant to get the file length of.

This function works on any file when you specify the filename. When you do not specify the filename, it works on the current selected file of the DIR() function.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , WRITE , INPUT

ASM

Calls	_FileLen	
Input		
Output		

Partial Example

```
Print "File demo"
Print Filelen("josef.img");" length" ' length of file
Print Filetime("josef.img");" time" ' time file was changed
Print Filedate("josef.img");" date" ' file date
```

FILETIME

Action
Returns the time of a file

Syntax
sTime = **FILETIME** ()
sTime = **FILETIME** (file)

Remarks

Stime	A string variable that is assigned with the file time.
File	The name of the file to get the time of.

This function works on any file when you specify the filename. When you do not specify the filename, it works on the current selected file of the DIR() function.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILELEN , FILEDATE , FILEDATETIME , DIR , WRITE , INPUT

ASM

Calls	_FileTimeS ; with file param	_FileTimeS0 ; current file
Input	X : points to the string with the mask	Z : points to the target variable
Output		

Example
```
Print "File demo"
Print Filelen("josef.img");" length" ' length of file
Print Filetime("josef.img");" time" ' time file was changed
Print Filedate("josef.img");" date" ' file date
```

FIX

Action
Returns for values greater then zero the next lower value, for values less then zero the next upper value.

Syntax
var = **FIX**(x)

Remarks

Var	A single variable that is assigned with the FIX of variable x.
X	The single to get the FIX of.

See Also
INT , ROUND , SGN

Example
```
'-----------------------------------------------------------------------------------------
'name                     : round_fix_int.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : ROUND,FIX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------------------

$regfile = "m48def.dat"                                    ' specify the used micro
$crystal = 4000000                                         ' used crystal frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32 for the hardware
stack
$swstack = 10                                              ' default use 10 for the SW stack
$framesize = 40                                            ' default use 40 for the frame space

Dim S As Single , Z As Single
For S = -10 To 10 Step 0.5
  Print S ; Spc(3) ; Round(s) ; Spc(3) ; Fix(s) ; Spc(3) ; Int(s)
Next
End
```

FLUSH

Action
Write current buffer of File to Card and updates Directory

Syntax
FLUSH #bFileNumber
FLUSH

Remarks

BFileNumber	Filenumber, which identifies an opened file such as #1 or #ff

This function writes all information of an open file, which is not saved yet to the Disk. Normally the Card is updated, if a file will be closed or changed to another sector.

When no file number is specified, all open files will be flushed.

See also

INITFILESYSTEM , OPEN , CLOSE, PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_FileFlush	_FilesAllFlush
Input	r24: filenumber	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example

```
$include "startup.inc"

'open the file in BINARY mode
Open "test.biN" For Binary As #2
Put #2 , B ' write a byte
Put #2 , W ' write a word
Put #2 , L ' write a long
Ltemp = Loc(#2) + 1 ' get the position of the next byte
Print Ltemp ;" LOC"' store the location of the file pointer
Print Lof(#2);" length of file"
Print Fileattr(#2);" file mode"' should be 32 for binary
Put #2 , Sn ' write a single
Put #2 , Stxt ' write a string

Flush #2 ' flush to disk
Close #2
```

FORMAT

Action

Formats a numeric string.

Syntax

target = **FORMAT**(source, "mask")

Remarks

target	The string that is assigned with the formatted string.
source	The source string that holds the number.

mask	The mask for formatting the string. When spaces are in the mask, leading spaces will be added when the length of the mask is longer than the source string. " " '8 spaces when source is "123" it will be " 123". When a + is in the mask (after the spaces) a leading + will be assigned when the number does not start with the - sign. "+" with number "123" will be "+123". When zero's are provided in the mask, the string will be filled with leading zero;s. " +00000" with 123 will be " +00123" An optional decimal point can be inserted too: "000.00" will format the number 123 to "001.23" Combinations can be made but the order must be : spaces, + , 0 an optional point and zero's.

When you do not want to use the overhead of the single or double, you can use the LONG.
You can scale the value by a factor 100.
Then use FORMAT to show the value.
For example : Dim L as Long, X as Long , Res as Long
L = 1
X = 2
Res = L / X
Now this would result in 0 because an integer or Long does not support floating point.
But when you scale L with a factor 100, you get :
L= 100
X = 2
Res = L / X

Now Res will be 50. To show it the proper way we can use FORMAT. Format works with strings so the variables need to be converted to string first.

Dim S1 as string * 16 : s1 = Str(Res)
Print Format(s1,"000.00")

See also
FUSING

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : format.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : FORMAT
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
```

```
$framesize = 40                                          ' default use 40
for the frame space

Dim S As String * 10
Dim I As Integer

S = "12345"
S = Format(s , "+")
Print S

S = "123"
S = Format(s , "00000")
Print S

S = "12345"
S = Format(s , "000.00")
Print S

S = "12345"
S = Format(s , " +000.00")
Print S


End
```

FOR-NEXT

Action

Execute a block of statements a number of times.

Syntax

FOR var = start **TO** end [**STEP** value]

Remarks

var	The variable counter to use
start	The starting value of the variable var
end	The ending value of the variable var
value	The value var is increased/decreased with each time NEXT is encountered.

- For incremental loops, you must use TO.
- For decremental loops, you must use a negative step size.
- You must end a FOR structure with the NEXT statement.
- The use of STEP is optional. By default, a value of 1 is used.

When you know in advance how many times a piece of code must be executed, the FOR..NEXT loop is convenient to use.
There are also other alternatives. You can use a Do.. Loop for example :

```
Dim Var As Byte
Do
  'code
   Incr Var
Loop Until Var = 10
```

There are various way to get the result you need.

See also
EXIT FOR

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : for_next.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: FOR, NEXT
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , B1 As Byte , C As Integer


For A = 1 To 10 Step 2
   Print "This is A " ; A
Next A

Print "Now lets count down"
For C = 10 To -5 Step -1
  Print "This is C " ; C
Next



Print "You can also nest FOR..NEXT statements."
For A = 1 To 10
  Print "This is A " ; A
  For B1 = 1 To 10
    Print "This is B1 " ; B1
  Next                                                     ' note that you do
not have to specify the parameter
Next A

End
```

FOURTHLINE

Action
Set LCD cursor to the start of the fourth line.

Syntax
FOURTHLINE

Remarks
Only valid for LCD displays with 4 lines.

See also
HOME , UPPERLINE , LOWERLINE , THIRDLINE, LOCATE

Example
```
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                          'goto home on line
three
Home Fourth
Home F                                          'first letter also works
```

FRAC

Action
Returns the fraction of a single.

Syntax
var = **FRAC**(single)

Remarks

var	A numeric single variable that is assigned with the fraction of variable single.
single	The single variable to get the fraction of.

The fraction is the right side after the decimal point of a single.

See Also
INT

Example
```
'-----------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates FRAC function
'-----------------------------------------------------------------------
```

```
_

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim X As Single

X = 1.123456
Print X
Print Frac(x)

End
```

FREEFILE

Action
Returns a free Filenumber.

Syntax
bFileNumber = **FREEFILE**()

Remarks

bFileNumber	A byte variable , which can be used for opening next file

This function gives you a free file number, which can be used for file – opening statements. In contrast to VB this file numbers start with 128 and goes up to 255. Use range 1 to 127 for user defined file numbers to avoid file number conflicts with the system numbers from FreeFile()

This function is implemented for compatility with VB.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_GetFreeFileNumber	
Input	none	
Output	r24: Filenumber	r25: Errorcode
	C-Flag: Set on Error	

Partial Example

```
Ff =Freefile() ' get file handle
Open"test.txt" For Input As #ff ' we can use a constant for the file too
Print Lof(#ff);" length of file"
Print Fileattr(#ff);" file mode" ' should be 1 for input
Do
   LineInput #ff , S ' read a line
  ' line input is used to read a line of text from a file
  Print S ' print on terminal emulator
Loop UntilEof(ff)<> 0
'The EOF() function returns a non-zero number when the end of the file is reached
'This way we know that there is no more data we can read
Close #ff
```

FUSING

Action

FUSING returns a formatted string of a single value.

Syntax

target = **FUSING**(source, "mask")

Remarks

target	The string that is assigned with the formatted string.
source	The source variable of the type SINGLE that will be converted
mask	The mask for formatting the string. The mask is a string constant that always must start with #. After the decimal point you can provide the number of digits you want the string to have: #.### will give a result like 123.456. Rounding is used when you use the # sign. So 123.4567 will be converted into 123.457 When no rounding must be performed, you can use the & sign instead of the # sign. But only after the DP. #.&&& will result in 123.456 when the single has the value 123.4567

When the single is zero, 0.0 will be returned, no matter how the mask is set up.

See also

FORMAT , STR

Example

```
'-----------------------------------------------------------------------------
-----------
'name                          : fusing.bas
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : FUSING
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim S As Single , Z As String * 10

'now assign a value to the single
S = 123.45678
'when using str() you can convert a numeric value into a string
Z = Str(s)
Print Z                                                    'prints
123.456779477

Z = Fusing(s , "#.##")

'now use some formatting with 2 digits behind the decimal point with rounding
Print Fusing(s , "#.##")                                   'prints 123.46

'now use some formatting with 2 digits behind the decimal point without
rounding
Print Fusing(s , "#.&&")                                   'prints 123.45

'The mask must start with #.
'It must have at least one # or & after the point.
'You may not mix & and # after the point.
End
```

GET

Action

Reads a byte from the hardware or software UART.
Reads data from a file opened in BINARY mode.

Syntax

GET #channel, var
GET #channel, var , [pos] [, length]

Remarks

GET in combination with the software/hardware UART reads one byte from the UART.
GET in combination with the AVR-DOS file system is very flexible and versatile. It works on files opened in BINARY mode and you can reads all data types.

#channel	A channel number, which identifies an opened file. This can be a hard coded constant or a variable.
Var	The variable or variable array that will be assigned with the data from the file
Pos	This is an optional parameter that may be used to specify the position where the reading must start from. This must be a long variable.
Length	This is an optional parameter that may be used to specify how many bytes must be read from the file.

By default you only need to provide the variable name. When the variable is a byte, 1 byte will be read. When the variable is a word or integer, 2 bytes will be read. When the variable is a long or single, 4 bytes will be read. When the variable is a string, the number of bytes that will be read is equal to the dimensioned size of the string. DIM S as string * 10 , would read 10 bytes.

Note that when you specify the length for a string, the maximum length is 254. The maximum length for a non-string array is 65535.

Partial Example :

```
GET #1 , var ,,2  ' read 2 bytes, start at current position
GET #1, var , PS ' start at position stored in long PS
GET #1, var , PS, 2 ' start at position stored in long PS and read 2 bytes
```

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

current position

Byte:

_FileGetRange_1

Input:

r24: File number

X: Pointer to variable

T-Flag cleared

Word/Integer:

goto new position first

_FileGetRange_1

Input:

r24: File number

X: Pointer to variable

r16-19 (A): New position (1-based)

T-Flag Set

_FileGetRange_2

Input:

r24: File number

X: Pointer to variable

T-Flag cleared

_FileGetRange_2

Input:

r24: File number

X: Pointer to variable

r16-19 (A): New position (1-based)

T-Flag Set

Long/Single:

_FileGetRange_4

Input:

r24: File number

X: Pointer to variable

T-Flag cleared

_FileGetRange_4

Input:

r24: File number

X: Pointer to variable

r16-19 (A): New position (1-based)

T-Flag Set

String (<= 255 Bytes) with fixed length

_FileGetRange_Bytes

Input:

r24: File number

r20: Count of Bytes

X: Pointer to variable

T-Flag cleared

_FileGetRange_Bytes

Input:

r24: File number

r20: Count of bytes

X: Pointer to variable

r16-19 (A): New position (1-based)

T-Flag Set

Array (> 255 Bytes) with fixed length

_FileGetRange

Input:

r24: File number

r20/21: Count of Bytes

X: Pointer to variable

T-Flag cleared

_FileGetRange

Input:

r24: File number

r20/21: Count of bytes

X: Pointer to variable

r16-19 (A): New position (1-based)

T-Flag Set

Output from all kind of usage:
r25: Error Code
C-Flag on Error
X: requested info

Partial Example

```
'for the binary file demo we need some variables of different types
Dim B As Byte , W As Word , L As Long , Sn As Single , Ltemp As Long
Dim Stxt As String * 10
B = 1 : W = 50000 : L = 12345678 : Sn = 123.45 : Stxt = "test"

'open the file in BINARY mode
Open "test.biN"for Binary As #2
Put#2 , B ' write a byte
Put#2 , W ' write a word
Put#2 , L ' write a long
Ltemp = Loc(#2) + 1                                    ' get the position
of the next byte
Print Ltemp ; " LOC"                                   ' store the
location of the file pointer
Print Seek(#2) ; " = LOC+1"

Print Lof(#2) ; " length of file"
Print Fileattr(#2) ; " file mode"                      ' should be 32 for
binary
Put #2 , Sn                                            ' write a single
Put #2 , Stxt                                          ' write a string

Flush #2                                               ' flush to disk
Close #2

'now open the file again and write only the single
Open "test.bin" For Binary As #2
L = 1 'specify the file position
B = Seek(#2 , L)                                       ' reset is the same
as using SEEK #2,L
Get#2 , B ' get the byte
Get#2 , W ' get the word
Get#2 , L ' get the long
Get#2 , Sn ' get the single
Get#2 , Stxt ' get the string
Close #2
```

GETADC

Action

Retrieves the analog value from channel 0-7.

Syntax

var = **GETADC**(channel [,offset])

Remarks

Var	The variable that is assigned with the A/D value
Channel	The channel to measure. Might be higher then 7 on some chips.
Offset	An optional numeric variable of constant that specifies gain or mode. This option has effect on newer AVR micro's only. The offset will be added by the channel value and inserted into the ADMUX register.

The GETADC() function only will work on microprocessors that have an A/D converter.

The pins of the A/D converter input can be used for digital I/O too.
But it is important that no I/O switching is done while using the A/D converter.

Make sure you turn on the AD converter with the START ADC statement or by setting the proper bit in the ADC configuration register.

Some micro's have more then 7 channels. This is supported as well.
GetADC() returns a word variable since the A/D converter data registers consist of 2 registers. The resolution depends on the chip.
The variable ADCD can be used to access the data register directly. The compiler will handle access to the byte registers automatically.

See also
CONFIG ADC

Example
```
'-----------------------------------------------------------------------------
--
'name                     : adc.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of GETADC() function for 8535 or M163
micro
'micro                    : Mega163
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space


'configure single mode and auto prescaler setting
'The single mode must be used with the GETADC() function

'The prescaler divides the internal clock by 2,4,8,16,32,64 or 128
'Because the ADC needs a clock from 50-200 KHz
'The AUTO feature, will select the highest clockrate possible
Config Adc = Single , Prescaler = Auto
'Now give power to the chip
Start Adc

'With STOP ADC, you can remove the power from the chip
'Stop Adc

Dim W As Word , Channel As Byte

Channel = 0
'now read A/D value from channel 0
Do
  W = Getadc(channel)
  Print "Channel " ; Channel ; " value " ; W
  Incr Channel
  If Channel > 7 Then Channel = 0
Loop
```

```
End

'The new M163 has options for the reference voltage
'For this chip you can use the additional param :
'Config Adc = Single , Prescaler = Auto, Reference = Internal
'The reference param may be :
'OFF      : AREF, internal reference turned off
'AVCC     : AVCC, with external capacitor at AREF pin
'INTERNAL : Internal 2.56 voltage reference with external capacitor ar AREF pin

'Using the additional param on chip that do not have the internal reference
will have no effect.
```

GETATKBD

Action
Reads a key from a PC AT keyboard.

Syntax
var = **GETATKBD**()

Remarks

var	The variable that is assigned with the key read from the keyboard. It may be a byte or a string variable. When no key is pressed a 0 will be returned.

The GETAKBD() function needs 2 input pins and a translation table for the keys. You can read more about this at the CONFIG KEYBOARD compiler directive.

The Getatkbd function will wait for a pressed key. When you want to escape from the waiting loop you can set the ERR bit from an interrupt routine for example.

Getatkbd is using 2 bits from register R6 : bit 4 and 5 are used to hold the shift and control key status.

AT KEYBOARD SCANCODES

Table reprinted with permission of Adam Chapweske

http://panda.cs.ndsu.nodak.edu/~achapwes

KEY	MAKE	BREAK	KEY	MAKE	BREAK	KEY	MAKE	BREAK
A	1C	F0,1C	9	46	F0,46	[	54	FO,54
B	32	F0,32	`	0E	F0,0E	INSERT	E0,70	E0,F0,70
C	21	F0,21	-	4E	F0,4E	HOME	E0,6C	E0,F0,6C
D	23	F0,23	=	55	FO,55	PG UP	E0,7D	E0,F0,7D

E	24	F0,24	\	5D	F0,5D	DELETE	E0,71	E0,F0,71
F	2B	F0,2B	BKSP	66	F0,66	END	E0,69	E0,F0,69
G	34	F0,34	SPACE	29	F0,29	PG DN	E0,7A	E0,F0,7A
H	33	F0,33	TAB	0D	F0,0D	U ARROW	E0,75	E0,F0,75
I	43	F0,43	CAPS	58	F0,58	L ARROW	E0,6B	E0,F0,6B
J	3B	F0,3B	L SHFT	12	FO,12	D ARROW	E0,72	E0,F0,72
K	42	F0,42	L CTRL	14	FO,14	R ARROW	E0,74	E0,F0,74
L	4B	F0,4B	L GUI	E0,1F	E0,F0,1F	NUM	77	F0,77
M	3A	F0,3A	L ALT	11	F0,11	KP /	E0,4A	E0,F0,4A
N	31	F0,31	R SHFT	59	F0,59	KP *	7C	F0,7C
O	44	F0,44	R CTRL	E0,14	E0,F0,14	KP -	7B	F0,7B
P	4D	F0,4D	R GUI	E0,27	E0,F0,27	KP +	79	F0,79
Q	15	F0,15	R ALT	E0,11	E0,F0,11	KP EN	E0,5A	E0,F0,5A
R	2D	F0,2D	APPS	E0,2F	E0,F0,2F	KP .	71	F0,71
S	1B	F0,1B	ENTER	5A	F0,5A	KP 0	70	F0,70
T	2C	F0,2C	ESC	76	F0,76	KP 1	69	F0,69
U	3C	F0,3C	F1	05	F0,05	KP 2	72	F0,72
V	2A	F0,2A	F2	06	F0,06	KP 3	7A	F0,7A
W	1D	F0,1D	F3	04	F0,04	KP 4	6B	F0,6B
X	22	F0,22	F4	0C	F0,0C	KP 5	73	F0,73
Y	35	F0,35	F5	03	F0,03	KP 6	74	F0,74
Z	1A	F0,1A	F6	0B	F0,0B	KP 7	6C	F0,6C
0	45	F0,45	F7	83	F0,83	KP 8	75	F0,75
1	16	F0,16	F8	0A	F0,0A	KP 9	7D	F0,7D
2	1E	F0,1E	F9	01	F0,01	]	5B	F0,5B
3	26	F0,26	F10	09	F0,09	;	4C	F0,4C
4	25	F0,25	F11	78	F0,78	'	52	F0,52
5	2E	F0,2E	F12	07	F0,07	,	41	F0,41
6	36	F0,36	PRNT SCRN	E0,12, E0,7C	E0,F0, 7C,E0, F0,12	.	49	F0,49
7	3D	F0,3D	SCROLL	7E	F0,7E	/	4A	F0,4A
8	3E	F0,3E	PAUSE	E1,14, 77, E1,F0, 14, F0,77	-NONE-			

These are the usable scan codes from the keyboard. If you want to implement F1 , you look at the generated scan code : 05 hex. So in the table, at position 5+1=6, you write the value

for F1.

In the sample program below, you can find the value 200. When you now press F1, the value form the table will be used so 200 will be returned.

See also

CONFIG KEYBOARD , GETATKBDRAW

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : getatkbd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PC AT-KEYBOARD Sample
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "8535def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'For this example :
'connect PC AT keyboard clock to PIND.2 on the 8535
'connect PC AT keyboard data to PIND.4 on the 8535

'The GetATKBD() function does not use an interrupt.
'But it waits until a key was pressed!

'configure the pins to use for the clock and data
'can be any pin that can serve as an input
'Keydata is the label of the key translation table
Config Keyboard = Pind.2 , Data = Pind.4 , Keydata = Keydata

'Dim some used variables
Dim S As String * 12
Dim B As Byte

'In this example we use SERIAL(COM) INPUT redirection
$serialinput = Kbdinput

'Show the program is running
Print "hello"

Do
  'The following code is remarked but show how to use the GetATKBD() function
  ' B = Getatkbd()      'get a byte and store it into byte variable
  'When no real key is pressed the result is 0
  'So test if the result was > 0
  ' If B > 0 Then
  '    Print B ; Chr(b)
  ' End If
```

```
  'The purpose of this sample was how to use a PC AT keyboard
  'The input that normally comes from the serial port is redirected to the
  'external keyboard so you use it to type
  Input "Name " , S
  'and show the result
  Print S
  'now wait for the F1 key , we defined the number 200 for F1 in the table
  Do
    B = Getatkbd()
  Loop Until B <> 0
  Print B
Loop
End

'Since we do a redirection we call the routine from the redirection routine
'
Kbdinput:
 'we come here when input is required from the COM port
 'So we pass the key into R24 with the GetATkbd function
' We need some ASM code to save the registers used by the function
$asm
 push r16           ; save used register
 push r25
 push r26
 push r27

Kbdinput1:
 rCall _getatkbd    ; call the function
 tst r24            ; check for zero
 breq Kbdinput1     ; yes so try again
 pop r27            ; we got a valid key so restore registers
 pop r26
 pop r25
 pop r16
 $end Asm
 'just return
Return

'The tricky part is that you MUST include a normal call to the routine
'otherwise you get an error
'This is no clean solution and will be changed
B = Getatkbd()

'This is the key translation table

Keydata:
'normal keys lower case
Data 0 , 0 , 0 , 0 , 0 , 200 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , &H5E , 0
Data 0 , 0 , 0 , 0 , 0 , 113 , 49 , 0 , 0 , 0 , 122 , 115 , 97 , 119 , 50 , 0
Data 0 , 99 , 120 , 100 , 101 , 52 , 51 , 0 , 0 , 32 , 118 , 102 , 116 , 114 ,
53 , 0
Data 0 , 110 , 98 , 104 , 103 , 121 , 54 , 7 , 8 , 44 , 109 , 106 , 117 , 55 ,
56 , 0
Data 0 , 44 , 107 , 105 , 111 , 48 , 57 , 0 , 0 , 46 , 45 , 108 , 48 , 112 ,
43 , 0
Data 0 , 0 , 0 , 0 , 0 , 92 , 0 , 0 , 0 , 0 , 13 , 0 , 0 , 92 , 0 , 0
Data 0 , 60 , 0 , 0 , 0 , 0 , 8 , 0 , 0 , 49 , 0 , 52 , 55 , 0 , 0 , 0
Data 48 , 44 , 50 , 53 , 54 , 56 , 0 , 0 , 0 , 43 , 51 , 45 , 42 , 57 , 0 , 0

'shifted keys UPPER case
Data 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0
Data 0 , 0 , 0 , 0 , 0 , 81 , 33 , 0 , 0 , 0 , 90 , 83 , 65 , 87 , 34 , 0
Data 0 , 67 , 88 , 68 , 69 , 0 , 35 , 0 , 0 , 32 , 86 , 70 , 84 , 82 , 37 , 0
Data 0 , 78 , 66 , 72 , 71 , 89 , 38 , 0 , 0 , 76 , 77 , 74 , 85 , 47 , 40 , 0
Data 0 , 59 , 75 , 73 , 79 , 61 , 41 , 0 , 0 , 58 , 95 , 76 , 48 , 80 , 63 , 0
Data 0 , 0 , 0 , 0 , 0 , 96 , 0 , 0 , 0 , 0 , 13 , 94 , 0 , 42 , 0 , 0
```

```
Data 0 , 62 , 0 , 0 , 0 , 8 , 0 , 0 , 49 , 0 , 52 , 55 , 0 , 0 , 0 , 0
Data 48 , 44 , 50 , 53 , 54 , 56 , 0 , 0 , 0 , 43 , 51 , 45 , 42 , 57 , 0 , 0
```

GETATKBDRAW

Action
Reads a key from a PC AT keyboard.

Syntax
var = **GETATKBDRAW**()

Remarks

var	The variable that is assigned with the key read from the keyboard. It may be a byte or a string variable. When no key is pressed a 0 will be returned.

The GETATKBDRAW() function needs 2 input pins and a translation table for the keys. You can read more about this at the CONFIG KEYBOARD compiler directive.

The GetatkbdRAW function will return RAW data from a PS/2 keyboard or Mouse.

While GetatKBD is intended to wait for pressed keys, GetATkbdRAW just returns raw PS/2 data so you can use your own code to process the data.

See Also
GETATKBD , CONFIG KEYBOARD

Example
See GETATKBD.BAS

GETDSTIP

Action
Returns the IP address of the peer.

Syntax
Result = **GETDSTIP**(socket)

Remarks

Result	A LONG variable that will be assigned with the IP address of the peer or destination IP address.
Socket	The socket number (0-3)

When you are in server mode, it might be desirable to detect the IP address of the connecting client.
You can use this for logging, security, etc.

The IP number MSB, is stored in the LS byte of the variable.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN , GETDSTPORT

Partial Example
```
Dim L as Long

L = GetdstIP(i)  ' store current IP number of socket i
```

GETDSTPORT

Action
Returns the port number of the peer.

Syntax
Result = **GETDSTPort**(socket)

Remarks

Result	A WORD variable that is assigned with the port number of the peer or destination port number.
Socket	The socket number.

When you are in server mode, it might be desirable to detect the port number of the connecting client.
You can use this for logging, security, etc.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN , GETDSTIP

Partial Example
```
Dim P as Word
P = GetdstPORT(i)' store current port number of socket i
```

GETKBD

Action

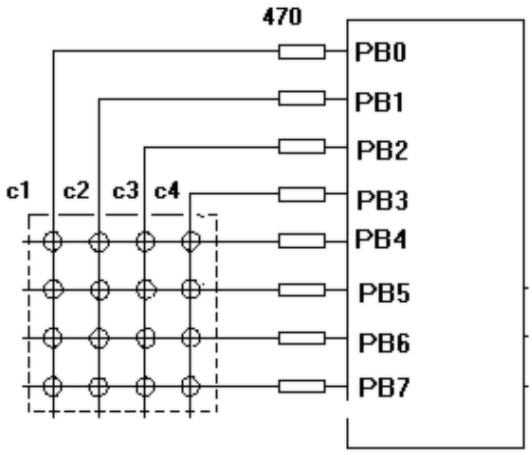
Scans a 4x4 matrix keyboard and return the value of the key pressed.

Syntax
var = **GETKBD**()

Remarks

Var	The numeric variable that is assigned with the value read from the keyboard

The GETKBD() function can be attached to a port of the uP.
You can define the port with the CONFIG KBD statement.
A schematic for PORTB is shown below



Note that the port pins can be used for other tasks as well. But you might need to set the port direction of those pins after you have used getkbd(). For example the LCD pins are set to output at the start of your program. A call to getkbd() would set the pins to input.

By setting DDR.x register you can set the pins to the proper state again.
As an alternative you can use CONFIG PIN or CONFIG PORT.

When no key is pressed 16 will be returned.

When using the 2 additional rows, 24 will be returned when no key is pressed.

On the STK200 this might not work since other hardware is connected too that interferes.

You can use the Lookup() function to convert the byte into another value. This because the GetKBD() function does not return the same value as the key pressed. It will depend on which keyboard you use.

Sometimes it can happen that it looks like a key is pressed while you do not press a key. This is caused by the scanning of the pins which happens at a very high frequency.

It will depend on the used keyboard. You can add series resistors with a value of 470-1K

The routine will wait for 100 mS by default after the code is retrieved. With CONFIG KBD you can set this delay.

See also
CONFIG KBD

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : getkbd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : GETKBD
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'specify which port must be used
'all 8 pins of the port are used
Config Kbd = Portb

'dimension a variable that receives the value of the pressed key
Dim B As Byte

'loop for ever
Do
  B = Getkbd()
  'look in the help file on how to connect the matrix keyboard
  'when you simulate the getkbd() it is important that you press/click the
keyboard button
  ' before running the getkbd() line !!!
  Print B
  'when no key is pressed 16 will be returned
  'use the Lookup() function to translate the value to another one
' this because the returned value does not match the number on the keyboad
Loop

End
```

GETRC

Action
Retrieves the value of a resistor or a capacitor.

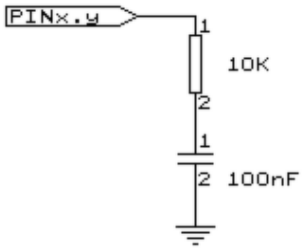
Syntax
var = **GETRC**(pin , number)

Remarks

Var	The word variable that is assigned with the value.
Pin	The PIN name for the R/C is connection.
Number	The port pin for the R/C is connection.

The name of the input port (PIND for example) must be passed even when all the other pins are configured for output. The pin number must also be passed. This may be a constant or a variable.

A circuit is shown below:



The capacitor is charged and the time it takes to discharge it is measured and stored in the variable. Now when you vary either the resistor or the capacitor, different values will be returned. This function is intended to return a relative position of a resistor wiper, not to return the value of the resistor. But with some calculations it can be retrieved.

See also

NONE

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : getrc.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates how to get the value of a resistor
'micro                    : AT90S8535
'suited for demo          : yes
'commercial addon needed  : no
' The library also shows how to pass a variable for use with individual port
' pins. This is only possible in the AVR architecture and not in the 8051
'-----------------------------------------------------------------------------
-----------

$regfile = "8535def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space
```

```
'The function works by charging a capacitor and uncharge it little by little
'A word counter counts until the capacitor is uncharged.
'So the result is an indication of the position of a pot meter not the actual
'resistor value

'This example used the 8535 and a 10K ohm variable resistor connected to PIND.4
'The other side of the resistor is connected to a capacitor of 100nF.
'The other side of the capacitor is connected to ground.
'This is different than BASCOM-8051 GETRC! This because the architecture is
different.

'The result of getrc() is a word so DIM one
Dim W As Word
Do
  'the first parameter is the PIN register.
  'the second parameter is the pin number the resistor/capacitor is connected
to
  'it could also be a variable!
  W = Getrc(pind , 4)
  Print W
  Wait 1
Loop
```

GETRC5

Action
Retrieves the RC5 remote code from a IR transmitter.

Syntax
GETRC5(address, command)

Uses
TIMER0

Remarks

address	The RC5 address
command	The RC5 command.

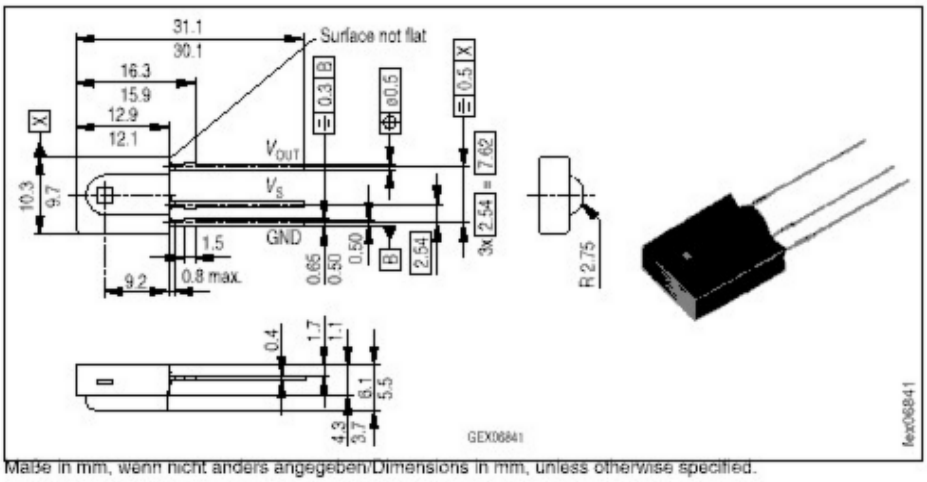
This statement is based on the AVR 410 application note. Since a timer is needed for accurate delays and background processing TIMER0 is used by this statement.

Also the interrupt of TIMER0 is used by this statement.
TIMER0 can be used by your application since the values are preserved by the statement but a delay can occur. The interrupt can not be reused.

GETRC5 supports extended RC5 code reception.

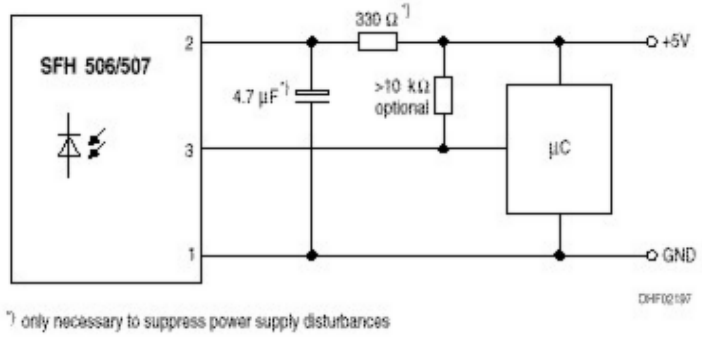
The SFH506-36 is used from Siemens. Other types can be used as well. The TSOP1736 has been tested with success.

IR-Empfänger/Demodulator-Baustein **SFH 506**
IR-Receiver/Demodulator Device



Maße in mm, wenn nicht anders angegeben/Dimensions in mm, unless otherwise specified.

For a good operation use the following values for the filter.



*) only necessary to suppress power supply disturbances

Most audio and video systems are equipped with an infra-red remote control.

The RC5 code is a 14-bit word bi-phase coded signal.
The two first bits are start bits, always having the value 1.
The next bit is a control bit or toggle bit, which is inverted every time a button is pressed on the remote control transmitter.
Five system bits hold the system address so that only the right system responds to the code.

Usually, TV sets have the system address 0, VCRs the address 5 and so on. The command sequence is six bits long, allowing up to 64 different commands per address.

The bits are transmitted in bi-phase code (also known as Manchester code).

For extended RC5 code, the extended bit is bit 6 of the command.
The toggle bit is stored in bit 7 of the command.

See also

CONFIG RC5 , RC5SEND, RC6SEND

Example

```
'-----------------------------------------------------------------------
-----------
'name                      : rc5.bas
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : based on Atmel AVR410 application note
'micro                     : 90S2313
'suited for demo           : yes
'commercial addon needed   : no
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'use byte library for smaller code
$lib "mcsbyte.lbx"

'This example shows how to decode RC5 remote control signals
'with a SFH506-35 IR receiver.

'Connect to input to PIND.2 for this example
'The GETRC5 function uses TIMER0 and the TIMER0 interrupt.
'The TIMER0 settings are restored however so only the interrupt can not
'be used anymore for other tasks


'tell the compiler which pin we want to use for the receiver input

Config Rc5 = Pind.2

'the interrupt routine is inserted automatic but we need to make it occur
'so enable the interrupts
Enable Interrupts

'reserve space for variables
Dim Address As Byte , Command As Byte
Print "Waiting for RC5..."

Do
  'now check if a key on the remote is pressed
  'Note that at startup all pins are set for INPUT
  'so we dont set the direction here
  'If the pins is used for other input just unremark the next line
  'Config Pind.2 = Input
  Getrc5(address , Command)

  'we check for the TV address and that is 0
  If Address = 0 Then
     'clear the toggle bit
     'the toggle bit toggles on each new received command
     'toggle bit is bit 7. Extended RC5 bit is in bit 6
     Command = Command And &B01111111
     Print Address ; "  " ; Command
  End If
Loop
End
```

GETTCPREGS

Action
Read a register value from the W3100A

Syntax
var = **GETTCPREGS**(address, bytes)

Remarks

Address	The address of the W3100A register.
bytes	The number of bytes to read.

Most W3100A options are implemented with BASCOM statements or functions. When there is a need to read from the W3100A register you can use the GETTCPREGS function. It can read multiple bytes. It is important that you specify the highest address. This because the registers must be read starting with the higest address.

See also
SETTCPREGS

ASM
NONE

Example
See SETTCPREGS

GETSOCKET

Action
Creates a socket for TCP/IP communication.

Syntax
Result = **GETSOCKET**(socket, mode, port, param)

Remarks

Result	A byte that is assigned with the socket number you requested. When the operation fails, it will return 255.

Mode	The socket mode. Use sock_stream(1), sock_dgrm(2), sock_ipl_raw(3), sock) or macl_raw(4). The modes are defined with constants. For TCP/IP communication you need to specify sock_stream or the equivalent value 1. For UDP communication you need to specify sock_dgrm or the equivalent value 2.
Port	This is the local port that will be used for the communication. You may specify any value you like but each socket must have it's own local port number. When you use 0, the value of LOCAL_PORT will be used. LOCAL_PORT is assigned with CONFIG TCPIP. After the assignment, LOCAL_PORT will be increased by 1. So the simplest way is to setup a local port with CONFIG TCPIP, and then use 0 for port.
Param	Optional parameter. Use 0 for default. 128 : send/receive broadcast message in UDP 64 : use register value with designated timeout value 32 : when not using no delayed ack 16: when not using silly window syndrome Consult the W3100A documentation for more information.

After the socket has been initialized you can use SocketConnect to connect to a client, or SocketListen to act as a server.

See also
CONFIG TCPIP, SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Partial Example

```
I = Getsocket(0 , Sock_stream , 5000 , 0)' get a new socket
```

GLCDCMD

Action
Sends a command byte to the SED graphical LCD display.

Syntax
GLCDCMD byte

Remarks

byte	A variable or numeric constant to send to the display.

With GLCDCMD you can write command bytes to the display. This is convenient to control the display when there is no specific statement available.

You need to include the glibSED library with :
$LIB "glibsed.lbx"

See also
CONFIG GRAPHLCD , LCDAT, GLCDDATA

Example
NONE

GLCDDATA

Action
Sends a data byte to the SED graphical LCD display.

Syntax
GLCDDATA byte

Remarks

byte	A variable or numeric constant to send to the display.

With GLCDDATA you can write data bytes to the display. This is convenient to control the display when there is no specific statement available.
You need to include the glibSED library with :

$LIB "glibsed.lbx"

See also
CONFIG GRAPHLCD , LCDAT, GLCDCMD

Example
NONE

GOSUB

Action
Branch to and execute subroutine.

Syntax

GOSUB label

Remarks

Label	The name of the label where to branch to.

With GOSUB, your program jumps to the specified label, and continues execution at that label.
When it encounters a RETURN statement, program execution will continue after the GOSUB statement.

See also

GOTO , CALL , RETURN

Example

```
'------------------------------------------------------------------------------
-----------
'name                      : gosub.bas
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : demo: GOTO, GOSUB and RETURN
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Goto Continue
Print "This code will not be executed"

Continue:                                                  'end a label with a
colon
Print "We will start execution here"
Gosub Routine
Print "Back from Routine"
End


Routine:                                                   'start a subroutine
  Print "This will be executed"
Return                                                     'return from
subroutine
```

GOTO

Action
Jump to the specified label.

Syntax
GOTO label

Remarks
Labels can be up to 32 characters long.
When you use duplicate labels, the compiler will give you a warning.

See also
GOSUB

Example
```
Dim A As Byte
Start:          'a label must end with a colon
A = A + 1       'increment a
If A < 10 Then  'is it less than 10?
   Goto  Start   'do it again
End If     'close IF
Print   "Ready"    'that is it
```

GRAY2BIN

Action
Returns the numeric value of a Gray code.

Syntax
var1 = **GRAY2BIN**(var2)

Remarks

var1	Variable that will be assigned with the binary value of the Grey code.
var2	A variable in Grey format that will be converted.

Gray code is used for rotary encoders. Gray2bin() works for byte, integer, word and long variables.

See also
BIN2GRAY

ASM
Depending on the data type of the target variable the following routine will be called from mcs.lbx:
_Bin2grey for bytes , _Bin2Grey2 for integer/word and _Bin2grey4 for longs.

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : graycode.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : show the Bin2Gray and Gray2Bin functions
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'Bin2Gray() converts a byte,integer,word or long into grey code.
'Gray2Bin() converts a gray code into a binary value

Dim B As Byte                                              ' could be
word,integer or long too

Print "BIN" ; Spc(8) ; "GREY"
For B = 0 To 15
  Print B ; Spc(10) ; Bin2gray(b)
Next

Print "GREY" ; Spc(8) ; "BIN"
For B = 0 To 15
  Print B ; Spc(10) ; Gray2bin(b)
Next

End
```

HEX

Action

Returns a string representation of a hexadecimal number.

Syntax

var = **HEX**(x)

Remarks

var	A string variable.
X	A numeric variable of data type Byte, Integer, Word, Long, Single or Double.

See also
HEXVAL , VAL , STR , BIN , BINVAL

Example
```
$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim B As Byte , J As Integer , W As Word , L As Long
B = 1 : J = &HF001
W = &HF001
L = W

Print B ; Spc(3) ; Hex(b)
Print J ; Spc(3) ; Hex(j)
Print W ; Spc(3) ; Hex(w)
Print L ; Spc(3) ; Hex(l)
End
```

HEXVAL

Action
Convert string representing a hexadecimal number into a numeric variable.

Syntax
var = **HEXVAL**(x)

Remarks
Var	The numeric variable that must be assigned.
X	The hexadecimal string that must be converted.

In VB you can use the VAL() function to convert hexadecimal strings.
But since that would require an extra test for the leading &H signs that are required in VB, a separate function was designed.

See also
HEX , VAL , STR , BIN , BINVAL

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim L As Long

Dim S As String * 8
Do
  Input "Hex value " , S
  L = Hexval(s)
  Print L ; Spc(3) ; Hex(l)
Loop
```

HIGH

Action

Retrieves the most significant byte of a variable.

Syntax

var = **HIGH**(s)

Remarks

Var	The variable that is assigned with the MSB of var S.
S	The source variable to get the MSB from.

See also

LOW , HIGHW

Example

```
Dim I As Integer , Z As Byte
I = &H1001
Z = High(i)                                                ' is 10 hex or 16
dec
End
```

HIGHW

Action
Retrieves the most significant word of a long variable.

Syntax
var = **HIGHW**(s)

Remarks

Var	The variable that is assigned with the MS word of var S.
S	The source variable to get the MSB from.

There is no LowW() function. This because when you assign a Long to a word or integer, only the lower part is assigned. For this reason you do not need a Loww() function. W=L will do the same.

See also
LOW , HIGH

Example
```
Dim X As Word , L As Long
L = &H12345678
X = Highw(l)
Print Hex(x)
```

HOME

Action
Place the cursor at the specified line at location 1.

Syntax
HOME UPPER | LOWER | THIRD | FOURTH

Remarks
If only HOME is used than the cursor will be set to the upper line.
You may also specify the first letter of the line like: HOME U

See also
CLS , LOCATE

For a complete example see LCD

Partial Example

```
Locate 2 , 1                                    'set cursor position
Lcd "*"                                         'display this
Home Upper                                      'select line 1 and
return home
```

I2CINIT

Action
Initializes the SCL and SDA pins.

Syntax
I2CINIT

Remarks
By default the SCL and SDA pins are in the right state when you reset the chip. Both the PORT and the DDR bits are set to 0 in that case.
When you need to change the DDR and/or PORT bits you can use I2CINIT to bring the pins in the proper state again.

ASM
The I2C routines are located in the i2c.lib/lbx files. _i2c_init is called.

See also
I2CSEND , I2CSTART , I2CSTOP , I2CRBYTE , I2CWBYTE

Example
```
Config Sda = Portb.5
Config Scl = Portb.7
I2cinit

Dim X As Byte , Slave As Byte
X = 0                                           'reset variable
Slave = &H40                                    'slave address of a
PCF 8574 I/O IC
I2creceive Slave , X                            'get the value
Print X                                         'print it
```

I2CRECEIVE

Action
Receives data from an I2C serial slave device.

Syntax
I2CRECEIVE slave, var
I2CRECEIVE slave, var , b2W, b2R

Remarks

Slave	A byte, Word/Integer variable or constant with the slave address from the I2C-device.
Var	A byte or integer/word variable that will receive the information from the I2C-device.
b2W	The number of bytes to write. Be cautious not to specify too many bytes!
b2R	The number of bytes to receive. Be cautious not to specify too many bytes!

You must specify the base address of the slave chip because the read/write bit is set/reset by the software.
When an error occurs, the internal ERR variable will return 1. Otherwise it will be set to 0.

ASM
The I2C routines are located in the i2c.lib/i2c.lbx files.

See also
I2CSEND, I2CSTART , I2CSTOP, I2CRBYTE , I2CWBYTE

Example
```
Config Sda = Portb.5
Config Scl = Portb.7
Dim X As Byte , Slave As Byte
X = 0                                                   'reset variable
Slave = &H40                                            'slave address of a
PCF 8574 I/O IC
I2creceive Slave , X                                    'get the value
Print X                                                 'print it


Dim Buf(10)as Byte
Buf(1) = 1 : Buf(2) = 2
I2creceive Slave , Buf(1) , 2 , 1                       'send two bytes and
receive one byte
Print Buf(1)                                            'print the received
byte

End
```

I2CSEND

Action
Send data to an I2C-device.

Syntax
I2CSEND slave, var

I2CSEND slave, var , bytes

Remarks

Slave	The slave address off the I2C-device.
Var	A byte, integer/word or numbers that holds the value, which will be, send to the I2C-device.
Bytes	The number of bytes to send.

When an error occurs, the internal ERR variable will return 1. Otherwise it will be set to 0.

ASM
The I2C routines are located in the i2c.lib/i2c.lbx files.

See also
I2CRECEIVE , I2CSTART, I2CSTOP , I2CRBYTE , I2CWBYTE

Example
```
Config Sda = Portb.5
Config Scl = Portb.7
Dim X As Byte , A As Byte , Bytes As Byte
X = 5                                                    'assign variable to
5
Dim Ax(10)as Byte
Const Slave = &H40                                       'slave address of a
PCF 8574 I/O IC
I2csend Slave , X                                        'send the value or


For A = 1 To 10
  Ax(a) = A                                              'Fill dataspace
Next
Bytes = 10
I2csend Slave , Ax(1) , Bytes
End
```

I2START,I2CSTOP, I2CRBYTE, I2CWBYTE

Action
I2CSTART generates an I2C start condition.
I2CSTOP generates an I2C stop condition.
I2CRBYTE receives one byte from an I2C-device.
I2CWBYTE sends one byte to an I2C-device.

Syntax
I2CSTART
I2CSTOP
I2CRBYTE var, ack/nack
I2CWBYTE val

Remarks

Var	A variable that receives the value from the I2C-device.
ack/nack	Specify ACK if there are more bytes to read. Specify NACK if it is the last byte to read.
Val	A variable or constant to write to the I2C-device.

These statements are provided as an addition to the I2CSEND and I2CRECEIVE statements. While I2CSEND and I2CRECEIVE are well suited for most tasks, a slave chip might need a special sequence that is not possible with the I2C routines.

When an error occurs, the internal ERR variable will return 1. Otherwise it will be set to 0.

ASM

The I2C routines are located in the i2c.lib/i2c.lbx files.

See also

I2CSEND , I2CRECEIVE , I2CSTART , I2CSTOP, I2CRBYTE , I2CWBYTE

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : i2c.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: I2CSEND and I2CRECEIVE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Config Scl = Portb.4
Config Sda = Portb.5

Declare Sub Write_eeprom(byval Adres As Byte , Byval Value As Byte)
Declare Sub Read_eeprom(byval Adres As Byte , Value As Byte)

Const Addressw = 174                                        'slave write
address
Const Addressr = 175                                        'slave read address

Dim B1 As Byte , Adres As Byte , Value As Byte              'dim byte

Call Write_eeprom(1 , 3)                                    'write value of
three to address 1 of EEPROM
```

```
Call Read_eeprom(1 , Value) : Print Value                   'read it back
Call Read_eeprom(5 , Value) : Print Value                   'again for address
5


'-------- now write to a PCF8474 I/O expander -------
I2csend &H40 , 255                                          'all outputs high
I2creceive &H40 , B1                                        'retrieve input
Print "Received data " ; B1                                 'print it
End

Rem Note That The Slaveaddress Is Adjusted Automaticly With I2csend &
I2creceive
Rem This Means You Can Specify The Baseaddress Of The Chip.



'sample of writing a byte to EEPROM AT2404
Sub Write_eeprom(byval Adres As Byte , Byval Value As Byte)
    I2cstart                                                'start condition
    I2cwbyte Addressw                                       'slave address
    I2cwbyte Adres                                          'asdress of EEPROM
    I2cwbyte Value                                          'value to write
    I2cstop                                                 'stop condition
    Waitms 10                                               'wait for 10
milliseconds
End Sub


'sample of reading a byte from EEPROM AT2404
Sub Read_eeprom(byval Adres As Byte , Value As Byte)
   I2cstart                                                 'generate start
   I2cwbyte Addressw                                        'slave adsress
   I2cwbyte Adres                                           'address of EEPROM
   I2cstart                                                 'repeated start
   I2cwbyte Addressr                                        'slave address
(read)
   I2crbyte Value , Nack                                    'read byte
   I2cstop                                                  'generate stop
End Sub


' when you want to control a chip with a larger memory like the 24c64 it
requires an additional byte
' to be sent (consult the datasheet):
' Wires from the I2C address that are not connected will default to 0 in most
cases!

'   I2cstart                                                'start condition
'   I2cwbyte &B1010_0000                                    'slave address
'   I2cwbyte H                                              'high address
'   I2cwbyte L                                              'low address
'   I2cwbyte Value                                          'value to write
'   I2cstop                                                 'stop condition
'   Waitms 10
```

IDLE

Action

Put the processor into the idle mode.

Syntax
IDLE

Remarks
In the idle mode, the system clock is removed from the CPU but not from the interrupt logic, the serial port or the timers/counters.

The idle mode is terminated either when an interrupt is received(from the watchdog, timers, external level triggered or ADC) or upon system reset through the RESET pin.

Most new chips have many options for Power down/Idle. It is advised to consult the data sheet to see if a better mode is available.

See also
POWERDOWN

Example
IDLE

IF-THEN-ELSE-END IF

Action
Allows conditional execution or branching, based on the evaluation of a Boolean expression.

Syntax
IF expression **THEN**

[**ELSEIF** expression **THEN**]

[**ELSE**]

END IF

Remarks

Expression	Any expression that evaluates to true or false.

The one line version of IF can be used :
IF expression THEN statement [ELSE statement]
The use of [ELSE] is optional.

Tests like IF THEN can also be used with bits and bit indexes.
IF var.bit = 1 THEN
^--- bit is a variable or numeric constant in the range from 0-255

Dim Var As Byte, Idx As Byte
Var = 255

```
Idx = 1
If Var.idx = 1 Then
  Print "Bit 1 is 1"
EndIf
```

See also
ELSE

Example
```
Dim A As Integer
A = 10
If A = 10 Then                                          'test expression
  Print "This part is executed."                       'this will be
printed
Else
  Print "This will never be executed."                 'this not
End If
If A = 10 Then Print "New in BASCOM"
If A = 10 Then Goto Label1 Elseprint "A<>10"
Label1:

Rem The following example shows enhanced use of IF THEN
If A.15 = 1 Then                                        'test for bit
  Print "BIT 15 IS SET"
EndIf
Rem the following example shows the 1 line use of IF THEN [ELSE]
If A.15 = 0 Then Print "BIT 15 is cleared" Else Print "BIT 15 is set"
```

INCR

Action
Increments a variable by one.

Syntax
INCR var

Remarks

Var	Any numeric variable.

See also
DECR

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : incr.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: INCR
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
```

```
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte

A = 5                                                      'assign value to a
Incr A                                                     'inc (by one)
Print A                                                    'print it
End
```

INITFILESYSTEM

Action
Initialize the file system

Syntax
bErrorCode = **INITFILESYSTEM** (bPartitionNumber)

Remarks

bErrorCode	(Byte) Error Result from Routine, Returns 0 if no Error
bPartitionNumber	(Byte) Partitionnumber on the Flashcard Drive (normally 1)

Reads the Master boot record and the partition boot record (Sector) from the flashcard and initializes the filesystem.
This function must be called before any other file-system function is used.

See also
OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_GetFileSystem	
Input	r24: partitionnumber (1-based)	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example

```
Dim bErrorCode as Byte
bErrorCode = InitFileSystem(1)
If bErrorCode > 0 then
   Print "Error: "; bErrorCode
Else
   Print "Filesystem successfully initialized"
End If
```

INITLCD

Action
Initializes the LCD display.

Syntax
INITLCD

Remarks
The LCD display is initialized automatic at start up when LCD statements are used by your code.
If fore some reason you would like to initialize it again you can use the INITLCD statement.

The LCD routines depend on the fact that the WR pin of the LCD is connected to ground. But when you connect it to as port pin, you can use INITLCD after you have set the WR pin to logic 0.

ASM
The generated ASM code :
Rcall _Init_LCD

See also
LCD

Example
NONE

INKEY

Action
Returns the ASCII value of the first character in the serial input buffer.

Syntax
var = **INKEY**()

var = **INKEY**(#channel)

Remarks

Var	Byte, Integer, Word, Long or String variable.
Channel	A constant number that identifies the opened channel if software UART mode

If there is no character waiting, a zero will be returned.
Use the IsCharWaiting() function to check if there is a byte waiting.

The INKEY routine can be used when you have a RS-232 interface on your uP.
The RS-232 interface can be connected to a comport of your computer.

As zero(0) will be returned when no character is waiting, the usage is limited when the value of 0 is used in the serial transmission. You can not make a difference between a byte with the value 0 and the case where no data is available.
In that case you can use IsCharwaiting to deterimine if there is a byte waiting.

See also

WAITKEY , ISCHARWAITING

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : inkey.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: INKEY , WAITKEY
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , S As String * 2
Do
   A = Inkey()                                             'get ascii value
from serial port
   's = Inkey()
   If A > 0 Then                                           'we got something
      Print "ASCII code " ; A ; " from serial"
   End If
Loop Until A = 27                                          'until ESC is
pressed

A = Waitkey()                                              'wait for a key
's = waitkey()
Print Chr(a)
```

```
'wait until ESC is pressed
Do
Loop Until Inkey() = 27

'When you need to receive binary data and the bibary value 0 ,
'you can use the IScharwaiting() function.
'This will return 1 when there is a char waiting and 0 if there is no char
waiting.
'You can get the char with inkey or waitkey then.
End
```

INP

Action
Returns a byte read from a hardware port or any internal or external memory location.

Syntax
var = **INP**(address)

Remarks

var	Numeric variable that receives the value.
address	The address where to read the value from. (0- &HFFFF)

The PEEK() function will read only the lowest 32 memory locations (registers).
The INP() function can read from any memory location since the AVR has a linear memory model.

When you want to read from XRAM memory you must enable external memory access in the Compiler Chip Options.

See also
OUT , PEEK , POKE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : peek.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates PEEk, POKE, CPEEK, INP and OUT
'micro                    : Mega162
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m162def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
```

```
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Dim I As Integer , B1 As Byte
'dump internal memory
For I = 0 To 31                                              'only 32 registers
in AVR
  B1 = Peek(i)                                               'get byte from
internal memory
  Print Hex(b1) ; "  ";
  'Poke I , 1                              'write a value into memory
Next
Print                                                        'new line
'be careful when writing into internal memory !!

'now dump a part ofthe code-memory(program)
For I = 0 To 255
  B1 = Cpeek(i)                                              'get byte from
internal memory
  Print Hex(b1) ; "  ";
Next
'note that you can not write into codememory!!

Out &H8000 , 1                                               'write 1 into XRAM
at address 8000
B1 = Inp(&H8000)                                             'return value from
XRAM
Print B1

End
```

INPUTBIN

Action

Read binary data from the serial port.

Syntax

INPUTBIN var1 [,var2]
INPUTBIN #channel , var1 [,var2]

Remarks

var1	The variable that is assigned with the characters from the serial port.
var2	An optional second (or more) variable that is assigned with the data from the serial input stream.

The channel is for use with the software UART routine and must be used with OPEN and CLOSE.

The number of bytes to read depends on the variable you use.
When you use a byte variable, 1 character is read from the serial port.
An integer will wait for 2 characters and an array will wait until the whole array is filled.

Note that the INPUTBIN statement doesn't wait for a <RETURN> but just for the number of

bytes.

You may also specify an additional numeric parameter that specifies how many bytes will be read. This is convenient when you are filling an array.

Inputbin ar(1) , 4 ' will fill 4 bytes starting at index 1.

See also
PRINTBIN

Example
```
Dim A As Byte , C As Integer
Inputbin A , C 'wait for 3 characters
End
```

INPUTHEX

Action
Allows hexadecimal input from the keyboard during program execution.

Syntax
INPUTHEX [" prompt"] , var[, varn]

Remarks

prompt	An optional string constant printed before the prompt character.
Var,varn	A numeric variable to accept the input value.

The INPUTHEX routine can be used when you have a RS-232 interface on your uP.
The RS-232 interface can be connected to a serial communication port of your computer.

This way you can use a terminal emulator and the keyboard as input device.
You can also use the build in terminal emulator.
The input entered may be in lower or upper case (0-9 and A-F)

If var is a byte then the input can be maximum 2 characters long.
If var is an integer/word then the input can be maximum 4 characters long.
If var is a long then the input can be maximum 8 characters long.

In VB you can specify **&H** with INPUT so VB will recognize that a hexadecimal string is being used.
BASCOM implements a new statement: INPUTHEX. This is only to save code as otherwise also code would be needed for decimal conversion.

See also
INPUT , ECHO , INPUTBIN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : input.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: INPUT, INPUTHEX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim V As Byte , B1 As Byte
Dim C As Integer , D As Byte
Dim S As String * 15

Input "Use this to ask a question " , V
Input B1                                                   'leave out for no
question

Input "Enter integer " , C
Print C


Inputhex "Enter hex number (4 bytes) " , C
Print C
Inputhex "Enter hex byte (2 bytes) " , D
Print D

Input "More variables " , C , D
Print C ; " " ; D

Input C Noecho                                             'supress echo

Input "Enter your name " , S
Print "Hello " ; S

Input S Noecho                                             'without echo
Print S
End
```

INPUT

Action

Allows input from the keyboard or file during program execution.

Syntax

INPUT [" prompt"] , var[, varn]
INPUT #ch, var[, varn]

Remarks

Prompt	An optional string constant printed before the prompt character.
Var,varn	A variable to accept the input value or a string.
Ch	A channel number, which identifies an opened file. This can be a hard coded constant or a variable.

The INPUT routine can be used when you have an RS-232 interface on your uP.
The RS-232 interface can be connected to a serial communication port of your computer.
This way you can use a terminal emulator and the keyboard as an input device.
You can also use the built-in terminal emulator.

For usage with the AVR-DOS file system, you can read variables from an opened file. Since these variables are stored in ASCII format, the data is converted to the proper format automatically.
When you use INPUT with a file, the prompt is not supported.

Difference with VB

In VB you can specify **&H** with INPUT so VB will recognize that a hexadecimal string is being used.
BASCOM implements a new statement : INPUTHEX.

See also

INPUTHEX , PRINT , ECHO , WRITE , INPUTBIN

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : input.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: INPUT, INPUTHEX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim V As Byte , B1 As Byte
Dim C As Integer , D As Byte
Dim S As String * 15

Input "Use this to ask a question " , V
Input B1                                                   'leave out for no
question
```

```
Input "Enter integer " , C
Print C


Inputhex "Enter hex number (4 bytes) " , C
Print C
Inputhex "Enter hex byte (2 bytes) " , D
Print D

Input "More variables " , C , D
Print C ; " " ; D

Input C Noecho                                                  'supress echo

Input "Enter your name " , S
Print "Hello " ; S

Input S Noecho                                                  'without echo
Print S
End
```

INSTR

Action
Returns the position of a sub string in a string.

Syntax
var = **INSTR**(start , string , substr)
var = **INSTR**(string , substr)

Remarks

Var	Numeric variable that will be assigned with the position of the sub string in the string. Returns 0 when the sub string is not found.
Start	An optional numeric parameter that can be assigned with the first position where must be searched in the string. By default (when not used) the whole string is searched starting from position 1.
String	The string to search.
Substr	The search string.

No constant can be used for *string* it must be a string variable.
Only *substr* can be either a string or a constant.

See also
SPLIT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                  : instr.bas
'copyright             : (c) 1995-2005, MCS Electronics
'purpose               : INSTR function demo
'micro                 : Mega48
```

```
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'dimension variables
Dim Pos As Byte
Dim S As String * 8 , Z As String * 8

'assign string to search
S = "abcdeab"                                              ' Z = "ab"

'assign search string
Z = "ab"

'return first position in pos
Pos = Instr(s , Z)
'must return 1

'now start searching in the string at location 2
Pos = Instr(2 , S , Z)
'must return 6


Pos = Instr(s , "xx")
'xx  is not in the string so return 0

End
```

INT

Action

Returns the integer part of a single or double.

Syntax

var = **INT**(source)

Remarks

Var	A numeric variable that is assigned with the integer of variable source.
Source	The source variable to get the integer of.

The fraction is the right side after the decimal point of a single.
The integer is the left side before the decimal point.

1234.567 1234 is the integer part, .567 is the fraction

See Also
FRAC , FIX , ROUND

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : round_fix_int.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : ROUND,FIX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim S As Single , Z As Single
For S = -10 To 10 Step 0.5
  Print S ; Spc(3) ; Round(s) ; Spc(3) ; Fix(s) ; Spc(3) ; Int(s)
Next
End
```

IP2STR

Action
Convert an IP number into it’s string representation.

Syntax
Var = **IP2STR**(num)

Remarks
An IP number is represented with dots like 192.168.0.1.
The IP2STR function converts an IP number into a string.
This function is intended to be used in combination with the BASCOM TCP/IP routines.

Var	The string variable that is assigned with the IP number
Num	A variable that contains the ip number is numeric format.

See also
CONFIG TCPIP

ISCHARWAITING

Action
Returns one(1) when a character is waiting in the hardware UART buffer.

Syntax
var = **ISCHARWAITING**()
var = **ISCHARWAITING**(#channel)

Remarks

Var	Byte, Integer, Word or Long variable.
Channel	A constant number that identifies the opened channel.

If there is no character waiting, a zero will be returned.
If there is a character waiting, a one (1) will be returned.
The character is not retrieved or altered by the function.

While the Inkey() will get the character from the HW UART when there is a character in the buffer, it will return a zero when the character is zero. This makes it unusable to work with binary data that might contain the value 0.

With IsCharWaiting() you can first check for the presence of a character and when the function returns 1, you can retrieve the character with Inkey or Waitkey.

See also
WAITKEY , INKEY

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , S As String * 2
Do
   A = Ischarwaiting()
   If A = 1 Then                                           'we got something
      A = Waitkey()                                        'get it
      Print "ASCII code " ; A ; " from serial"
   End If
Loop Until A = 27                                          'until ESC is
```

```
pressed
```

KILL

Action
Delete a file from the Disk

Syntax
KILL sFileName

Remarks

sFileName	A String variable or string expression, which denotes the file to delete

This function deletes a file from the disk. A file in use can't be deleted. WildCards in Filename are not supported. Check the DOS-Error in variable gDOSError.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_DeleteFile	
Input	X: Pointer to string with filename	
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example
```
'We can use the KILL statement to delete a file.
'A file mask is not supported
Print "Kill (delete) file demo"
Kill "test.txt"
```

LCASE

Action
Converts a string in to all lower case characters.

Syntax
Target = **LCASE**(source)

Remarks

Target	The string that is assigned with the lower case string of string target.
Source	The source string.

See also
UCASE

ASM
The following ASM routines are called from MCS.LIB : _LCASE
The generated ASM code : (can be different depending on the micro used)
```
;##### Z = Lcase(s)
Ldi R30,$60
Ldi R31,$00 ; load constant in register
Ldi R26,$6D
Rcall _Lcase
```

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim S As String * 12 , Z As String * 12
S = "Hello World"
Z = Lcase(s)
Print Z
Z = Ucase(s)
Print Z
End
```

LCD

Action
Send constant or variable to LCD display.

Syntax
LCD x

Remarks
X	Variable or constant to display.

More variables can be displayed separated by the **;** -sign

LCD a ; b1 ; "constant"

The LCD statement behaves just like the PRINT statement. So SPC() can be used too.

See also

$LCD , $LCDRS , CONFIG LCD , SPC , CLS

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : lcd.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: LCD, CLS, LOWERLINE, SHIFTLCD, SHIFTCURSOR,
HOME
'                           CURSOR, DISPLAY
'micro                    : Mega8515
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8515.dat"                                      ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


$sim
'REMOVE the above command for the real program !!
'$sim is used for faster simulation


'note : tested in PIN mode with 4-bit

'Config Lcdpin = Pin , Db4 = Portb.1 , Db5 = Portb.2 , Db6 = Portb.3 , Db7 =
Portb.4 , E = Portb.5 , Rs = Portb.6
Config Lcdpin = Pin , Db4 = Porta.4 , Db5 = Porta.5 , Db6 = Porta.6 , Db7 =
Porta.7 , E = Portc.7 , Rs = Portc.6
'These settings are for the STK200 in PIN mode
'Connect only DB4 to DB7 of the LCD to the LCD connector of the STK D4-D7
'Connect the E-line of the LCD to A15 (PORTC.7) and NOT to the E line of the
LCD connector
'Connect the RS, V0, GND and =5V of the LCD to the STK LCD connector

Rem with the config lcdpin statement you can override the compiler settings


Dim A As Byte
Config Lcd = 16 * 2                                         'configure lcd
screen


'other options are 16 * 4 and 20 * 4, 20 * 2 , 16 * 1a
'When you dont include this option 16 * 2 is assumed
'16 * 1a is intended for 16 character displays with split addresses over 2
lines
```

```
'$LCD = address will turn LCD into 8-bit databus mode
'       use this with uP with external RAM and/or ROM
'       because it aint need the port pins !

Cls                                                     'clear the LCD
display
Lcd "Hello world."                                      'display this at
the top line
Wait 1
Lowerline                                               'select the lower
line
Wait 1
Lcd "Shift this."                                       'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                                       'shift the text to
the right
   Wait 1                                               'wait a moment
Next

For A = 1 To 10
   Shiftlcd Left                                        'shift the text to
the left
   Wait 1                                               'wait a moment
Next

Locate 2 , 1                                            'set cursor
position
Lcd "*"                                                 'display this
Wait 1                                                  'wait a moment

Shiftcursor Right                                       'shift the cursor
Lcd "@"                                                 'display this
Wait 1                                                  'wait a moment

Home Upper                                              'select line 1 and
return home
Lcd "Replaced."                                         'replace the text
Wait 1                                                  'wait a moment

Cursor Off Noblink                                      'hide cursor
Wait 1                                                  'wait a moment
Cursor On Blink                                         'show cursor
Wait 1                                                  'wait a moment
Display Off                                             'turn display off
Wait 1                                                  'wait a moment
Display On                                              'turn display on
'-----------------NEW support for 4-line LCD------
Thirdline
Lcd "Line 3"
Fourthline
Lcd "Line 4"
Home Third                                              'goto home on line
three
Home Fourth
Home F                                                  'first letteer also
works
Locate 4 , 1 : Lcd "Line 4"
Wait 1

'Now lets build a special character
'the first number is the characternumber (0-7)
'The other numbers are the rowvalues
'Use the LCD tool to insert this line
```

```
Deflcdchar 1 , 225 , 227 , 226 , 226 , 226 , 242 , 234 , 228       ' replace ?
with number (0-7)
Deflcdchar 0 , 240 , 224 , 224 , 255 , 254 , 252 , 248 , 240       ' replace ?
with number (0-7)
Cls                                                          'select data RAM
Rem it is important that a CLS is following the deflcdchar statements because
it will set the controller back in datamode
Lcd Chr(0) ; Chr(1)                                          'print the special
character

'----------------- Now use an internal routine ------------
_temp1 = 1                                                   'value into ACC
!rCall _write_lcd                                            'put it on LCD
End
```

LCDAT

Action

Send constant or variable to a SED or other graphical display.

Syntax

LCDAT y , x , var [, inv]
LCDAT y , x , var [, FG, BG]

Remarks

X	X location. In the range from 0-63. The SED displays columns are 1 pixel width. Other displays might have a bigger range such as 132 or 255.
Y	Y location. The row in pixels. The maximum value depends on the display.
Var	The constant or variable to display
inv	Optional number. Value 0 will show the data normal. Any other value will invert the data.
	For COLOR DISPLAYS
FG	Forground color
BG	Background color

You need to include the glibSED library with :
$LIB "glibsed.lbx"

Other libraries must be included with a different directive.

See also

CONFIG GRAPHLCD , SETFONT, GLCDCMD, GLCDDATA

Example

```
'-----------------------------------------------------------------------------
-----------
'name                    : sed1520.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : demonstrates the SED1520 based graphical display
support
```

```
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 7372800                                          ' used crystal
frequency
$baud = 115200                                              ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'I used a Staver to test

'some routines to control the display are in the glcdSED.lib file
'IMPORTANT : since the SED1520 uses 2 chips, the columns are split into 2 of
60.
'This means that data after column 60 will not print correct. You need to
locate the data on the second halve
'For example when you want to display a line of text that is more then 8 chars
long, (8x8=64) , byte 8 will not draw correctly
'Frankly i find the KS0108 displays a much better choice.

$lib "glcdSED1520.lbx"

'First we define that we use a graphic LCD

Config Graphlcd = 120 * 64sed , Dataport = Porta , Controlport = Portd , Ce =
5 , Ce2 = 7 , Cd = 3 , Rd = 4


'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE =CS  Chip Enable/ Chip select
'CE2= Chip select / chip enable of chip 2
'CD=A0   Data direction
'RD=Read

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'clear the screen
Cls
Wait 2
'specify the font we want to use
Setfont Font8x8

'You can use locate but the columns have a range from 1-132

'When you want to show somthing on the LCD, use the LDAT command
'LCDAT Y , COL, value
Lcdat 1 , 1 , "1231231"
Lcdat 3 , 80 , "11"
'lcdat accepts an additional param for inversing the text
'lcdat 1,1,"123" , 1  ' will inverse the text

Wait 2
Line(0 , 0) -(30 , 30) , 1
Wait 2
```

```
Showpic 0 , 0 , Plaatje                                    'show a comnpressed
picture
End                                                        'end program


'we need to include the font files
$include "font8x8.font"
'$include "font16x16.font"


Plaatje:
'include the picture data
$bgf "smile.bgf"
```

LCDCONTRAST

Action
Set the contrast of a TEXT LCD.

Syntax
LCDCONTRAST x

Remarks

X	A variable or constant in the range from 0-3.

Some LCD text displays support changing the contrast. Noritake displays have this option for example.

See also
NONE

Example
NONE

LEFT

Action
Return the specified number of leftmost characters in a string.

Syntax
var = **LEFT**(var1 , n)

Remarks

Var	The string that is assigned.
Var1	The source string.

n	The number of characters to get from the source string.

See also
RIGHT , MID

Partial Example
```
Dim S As String * 15 , Z As String * 15
S ="ABCDEFG"
Z = Left(s , 5)
Print Z                                                    'ABCDE
Z = Right(s , 3) : Print Z
Z = Mid(s , 2 , 3) : Print Z
End
```

LEN

Action
Returns the length of a string.

Syntax
var = **LEN**(string)

Remarks

var	A numeric variable that is assigned with the length of string.
string	The string to calculate the length of.

Strings can be maximum 254 bytes long.

See Also
VAL

Partial Example
```
Dim S As String * 15 , Z As String * 15
S ="ABCDEFG"
Print Len(s)
```

LINE

Action
Draws a line on a graphic display.

Syntax

LINE(x0,y0) – (x1,y1), color

Remarks

X0	Starting horizontal location of the line.
Y0	Starting vertical location of the line.
X1	Horizontal end location of the line
Y1	Vertical end location of the line.

See Also

LINE , CONFIG GRAPHLCD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : t6963_240_128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : T6963C graphic display support demo 240 * 128
'micro                    : Mega8535
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m8535.dat"                                      ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'-----------------------------------------------------------------
'                    (c) 2001-2003 MCS Electronics
'                T6963C graphic display support demo 240 * 128
'-----------------------------------------------------------------

'The connections of the LCD used in this demo
'LCD pin                  connected to
' 1        GND            GND
 '2        GND            GND
 '3        +5V            +5V
 '4        -9V            -9V potmeter
 '5        /WR            PORTC.0
 '6        /RD            PORTC.1
 '7        /CE            PORTC.2
 '8        C/D            PORTC.3
 '9        NC             not conneted
 '10       RESET          PORTC.4
 '11-18    D0-D7           PA
 '19       FS             PORTC.5
 '20       NC             not connected

'First we define that we use a graphic LCD
' Only 240*64 supported yet
Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
```

```
'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'Clear the screen will both clear text and graph display
Cls
'Other options are :
' CLS TEXT   to clear only the text display
' CLS GRAPH  to clear only the graphical part

Cursor Off

Wait 1
'locate works like the normal LCD locate statement
' LOCATE LINE,COLUMN LINE can be 1-8 and column 0-30


Locate 1 , 1

'Show some text
Lcd "MCS Electronics"
'And some othe text on line 2
Locate 2 , 1 : Lcd "T6963c support"
Locate 3 , 1 : Lcd "12345678901234567890123456789012345678901234567890"
Locate 16 , 1 : Lcd "write this to the lower line"

Wait 2

Cls Text


'use the new LINE statement to create a box
'LINE(X0,Y0) - (X1,Y1), on/off
Line(0 , 0) -(239 , 127) , 255                                  ' diagonal line
Line(0 , 127) -(239 , 0) , 255                                  ' diagonal line
Line(0 , 0) -(240 , 0) , 255                                    ' horizontal upper
line
Line(0 , 127) -(239 , 127) , 255                                'horizontal lower
line
Line(0 , 0) -(0 , 127) , 255                                    ' vertical left
line
Line(239 , 0) -(239 , 127) , 255                                ' vertical right
line


Wait 2
' draw a line using PSET X,Y, ON/OFF
' PSET on.off param is 0 to clear a pixel and any other value to turn it on
For X = 0 To 140
   Pset X , 20 , 255                                            ' set the pixel
Next

For X = 0 To 140
   Pset X , 127 , 255                                           ' set the pixel
Next

Wait 2

'circle time
'circle(X,Y), radius, color
'X,y is the middle of the circle,color must be 255 to show a pixel and 0 to
```

```
clear a pixel
For X = 1 To 10
  Circle(20 , 20) , X , 255                                    ' show circle
  Wait 1
  Circle(20 , 20) , X , 0                                      'remove circle
  Wait 1
Next

Wait 2

For X = 1 To 10
  Circle(20 , 20) , X , 255                                    ' show circle
  Waitms 200
Next
Wait 2
'Now it is time to show a picture
'SHOWPIC X,Y,label
'The label points to a label that holds the image data
Test:
Showpic 0 , 0 , Plaatje
Showpic 0 , 64 , Plaatje                                       ' show 2 since we
have a big display
Wait 2
Cls Text                                                       ' clear the text
End



'This label holds the mage data
Plaatje:
'$BGF will put the bitmap into the program at this location
$bgf "mcs.bgf"

'You could insert other picture data here
```

LINE INPUT

Action

Read a Line from an opened File.

Syntax

LINEINPUT #bFileNumber, sLineText

Remarks

BfileNumber	(Byte) Filenumber, which identifies an opened file
SlineText	(String) A string, which is assigned with the next line from the file.

Only valid for files opened in mode INPUT. Line INPUT works only with strings. It is great for working on text files.

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_FileLineInput	
Input	r24: filenumber	X: Pointer to String to be written from file
	r25: Stringlength	
Output	r25: Errorcode	C-Flag: Set on Error

Example

```
'Ok we want to check if the file contains the written lines
Ff = Freefile()' get file handle
Open "test.txt" For Input As #ff ' we can use a constant for the file too
Print Lof(#ff); " length of file"
Print Fileattr(#ff); " file mode"' should be 1 for input
Do
  LineInput#ff , S ' read a line
  ' line input is used to read a line of text from a file
  Print S ' print on terminal emulator
Loop Until Eof(ff)<> 0
'The EOF() function returns a non-zero number when the end of the file is reached
'This way we know that there is no more data we can read
Close #ff
```

LTRIM

Action

Returns a copy of a string with leading blanks removed

Syntax

var = **LTRIM**(org)

Remarks

Var	String that receives the result.
Org	The string to remove the leading spaces from

See also

RTRIM , TRIM

ASM

NONE

Partial Example

```
Dim S As String * 6
S =" AB "
Print Ltrim(s)
Print Rtrim(s)
Print Trim(s)
End
```

LOAD

Action
Load specified TIMER with a reload value.

Syntax
LOAD TIMER , value

Remarks

TIMER	TIMER0 , TIMER1 or TIMER2(or valid timer name)
Value	The variable or value to load.

The TIMER0 does not have a reload mode. But when you want the timer to generate an interrupt after 10 ticks for example, you can use the LOAD statement.

It will do the calculation : (256-value)

So LOAD TIMER0, 10 will load the TIMER0 with a value of 246 so that it will overflow after 10 ticks.
TIMER1 is a 16 bit counter so it will be loaded with the value of 65536-value.

See Also
NONE

Example
NONE

LOADADR

Action
Loads the address of a variable into a register pair.

Syntax
LOADADR var , reg

Remarks

var	A variable which address must be loaded into the register pair X, Y or Z.
reg	The register X, Y or Z.

The LOADADR statement serves as an assembly helper routine.

Example
```
Dim S As String * 12
Dim A As Byte

$ASM
loadadr S , X ; load address into R26 and R27
ld _temp1, X ; load value of location R26/R27 into R24(_temp1)
$END ASM
```

LOADLABEL

Action
Assigns a word variable with the address of a label.

Syntax
Var = **LOADLABEL**(label)

Remarks

var	The variable that is assigned with the address of the label.
lbl	The name of the label

In some cases you might need to know the address of a point in your program. To perform a Cpeek() for example.
You can place a label at that point and use LoadLabel to assign the address of the label to a variable.

LOADWORDADR

Action
Loads the Z-register and sets RAMPZ if available.

Syntax
LOADWORDADR label

Remarks

label	The name of the label which address will be loaded into R30-R31 which form the Z-register.

The code that will be generated :
```
LDI R30,Low(label * 2)
LDI R31,High(label * 2)
LDI R24,1 or CLR R24
STS RAMPZ, R24
```

As the AVR uses a word address, to find a byte address we multiply the address with 2.
RAMPZ forms together with pointer **Z** an address register. As the LS bit of Z is used to

identify the lower or the upper BYTE of the address, it is extended with the RAMPZ to address more then 15 bits. For example the Mega128 has 128KB of space and needs the RAMPZ register set to the right value in order to address the upper or lower 64KB of space.

See also
LOADLABEL, LOADADR

Example
```
LOADWORDADR label
```

LOC

Action
Returns the position of last read or written Byte of the file

Syntax
lLastReadWritten = **LOC** (#bFileNumber)

Remarks

bFileNumber	(Byte) Filenumber, which identifies an opened file
lLastReadWritten	(Long) Variable, assigned with the Position of last read or written Byte (1-based)

This function returns the position of the last read or written Byte. If an error occurs, 0 is returned. Check DOS-Error in variable gbDOSError. If the file position pointer is changed with the command SEEK, this function can not be used till the next read/write operation.

This function differs from VB. In VB the byte position is divided by 128.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_FileLoc	
Input	r24: filenumber	X: Pointer to Long-variable, which gets th result
Output	r25: Errorcode	C-Flag: Set on Error

Example
```
'open the file in BINARY mode
Open "test.biN" For Binary As #2
Put #2 , B ' write a byte
Put #2 , W ' write a word
```

```
Put #2 , L ' write a long
Ltemp = Loc(#2)+ 1 ' get the position of the next byte
Print  Ltemp ;" LOC"' store the location of the file pointer
Print Lof(#2);" length of file"
Print Fileattr(#2);" file mode"' should be 32 for binary
Put #2 , Sn ' write a single
Put #2 , Stxt ' write a string

Flush #2 ' flush to disk
Close #2
```

LOF

Action
Returns the length of the File in Bytes

Syntax
lFileLength = **LOF** (#bFileNumber)

Remarks

bFileNumber	(Byte) Filenumber, which identifies an opened file
LFileLength	(Long) Variable, which assigned with the Length of the file (1-based)

This function returns the length of an opened file. If an error occurs, 0 is returned. Check DOS-Error in variable gbDOSError.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Calls	_FileLOF	
Input	r24: filenumber	X: Pointer to Long-variable, which gets th result
Output	r25: Errorcode	C-Flag: Set on Error

Example

```
'open the file in BINARY mode
Open "test.biN" For Binary As #2
Put #2 , B ' write a byte
Put #2 , W ' write a word
Put #2 , L ' write a long
Ltemp = Loc(#2)+ 1 ' get the position of the next byte
Print Ltemp ;" LOC"' store the location of the file pointer
Print Lof(#2);" length of file"
Print Fileattr(#2);" file mode"' should be 32 for binary
Put #2 , Sn ' write a single
Put #2 , Stxt ' write a string
```

Flush #2 ' flush to disk
Close #2

LOCAL

Action
Dimensions a variable LOCAL to the function or sub program.

Syntax
LOCAL var As Type

Remarks

Var	The name of the variable
Type	The data type of the variable.

There can be only LOCAL variables of the type BYTE, INTEGER, WORD, LONG, SINGLE or STRING.

A LOCAL variable is a temporary variable that is stored on the frame.
When the SUB or FUNCTION is terminated, the memory will be released back to the frame.
BIT variables are not possible because they are GLOBAL to the system.

The AT , ERAM, SRAM, XRAM directives can not be used with a local DIM statement. Also local arrays are not possible.

See also
DIM

ASM
NONE

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : declare.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrate using declare
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
' Note that the usage of SUBS works different in BASCOM-8051
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
```

```
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space


' First the SUB programs must be declared

'Try a SUB without parameters
Declare Sub Test2

'SUB with variable that can not be changed(A) and
'a variable that can be changed(B1), by the sub program
'When BYVAL is specified, the value is passed to the subprogram
'When BYREF is specified or nothing is specified, the address is passed to
'the subprogram

Declare Sub Test(byval A As Byte , B1 As Byte)
Declare Sub Testarray(byval A As Byte , B1 As Byte)
'All variable types that can be passed
'Notice that BIT variables can not be passed.
'BIT variables are GLOBAL to the application
Declare Sub Testvar(b As Byte , I As Integer , W As Word , L As Long , S As
String)

'passing string arrays needs a different syntax because the length of the
strings must be passed by the compiler
'the empty () indicated that an array will be passed
Declare Sub Teststr(b As Byte , Dl() As String)

Dim Bb As Byte , I As Integer , W As Word , L As Long , S As String * 10
'dim used variables
Dim Ar(10) As Byte
Dim Sar(10) As String * 8                                    'strng array

For Bb = 1 To 10
  Sar(bb) = Str(bb)                                          'fill the array
Next
Bb = 1
'now call the sub and notice that we always must pass the first address with
index 1
Call Teststr(bb , Sar(1))


Call Test2                                                   'call sub
Test2                                                        'or use without
CALL
'Note that when calling a sub without the statement CALL, the enclosing
parentheses must be left out
Bb = 1
Call Test(1 , Bb)                                            'call sub with
parameters
Print Bb                                                     'print value that
is changed

'now test all the variable types
Call Testvar(bb , I , W , L , S )
Print Bb ; I ; W ; L ; S

'now pass an array
'note that it must be passed by reference
Testarray 2 , Ar(1)
Print "ar(1) = " ; Ar(1)
Print "ar(3) = " ; Ar(3)
```

```
$notypecheck                                                    ' turn off type
checking
Testvar Bb , I , I , I , S
'you can turn off type checking when you want to pass a block of memory
$typecheck                                                      'turn it back on
End

'End your code with the subprograms
'Note that the same variables and names must be used as the declared ones

Sub Test(byval A As Byte , B1 As Byte)                          'start sub
    Print A ; " " ; B1                                          'print passed
variables
    B1 = 3                                                      'change value
    'You can change A, but since a copy is passed to the SUB,
    'the change will not reflect to the calling variable
End Sub

Sub Test2                                                       'sub without
parameters
    Print "No parameters"
End Sub



Sub Testvar(b As Byte , I As Integer , W As Word , L As Long , S As String)
    Local X As Byte

    X = 5                                                       'assign local

    B = X
    I = -1
    W = 40000
    L = 20000
    S = "test"
End Sub

Sub Testarray(byval A As Byte , B1 As Byte)                     'start sub
    Print A ; " " ; B1                                          'print passed
variables
    B1 = 3                                                      'change value of
element with index 1
    B1(1) = 3                                                   'specify the index
which does the same as the line above
    B1(3) = 3                                                   'modify other
element of array
    'You can change A, but since a copy is passed to the SUB,
    'the change will not reflect to the calling variable
End Sub

'notice the empty() to indicate that a string array is passed
Sub Teststr(b As Byte , Dl() As String)
  Dl(b) = Dl(b) + "add"
End Sub
```

LOCATE

Action

Moves the LCD cursor to the specified position.

Syntax
LOCATE y , x

Remarks

X	Constant or variable with the position. (1-64*)
Y	Constant or variable with the line (1 - 4*)

* Depending on the used display

See also
CONFIG LCD , LCD , HOME , CLS

Partial Example
```
LCD "Hello"
Locate 1,10
LCD "*"
```

LOG

Action
Returns the natural logarithm of a single variable.

Syntax
Target = **LOG**(source)

Remarks

Target	The single that is assigned with the LOG() of single target.
Source	The source single to get the LOG of.

See also
EXP , LOG10

Example
Show sample

LOG10

Action
Returns the base 10 logarithm of a single variable.

Syntax
Target = **LOG10**(source)

Remarks

Target	The single that is assigned with the base 10 logarithm of single target.
Source	The source single to get the base 10 LOG of.

See also
EXP , LOG

Example
Show sample

LOOKDOWN

Action
Returns the index of a series of data.

Syntax
var = **LOOKDOWN**(value, label, entries)

Remarks

Var	The returned index value
Value	The value to search for
Label	The label where the data starts
entries	The number of entries that must be searched

When you want to look in BYTE series the VALUE variable must be dimensioned as a BYTE.
When you want to look in INTEGER or WORD series the VALUE variable must be dimensioned as an INTEGER.

The LookDown function is the counterpart of the LookUp function.
Lookdown will search the data for a value and will return the index when the value is found.
It will return –1 when the data is not found.

See also
LOOKUPSTR , LOOKUP

Example
```
'-----------------------------------------------------------------------------
-----------
'name                   : lookdown.bas
'copyright              : (c) 1995-2005, MCS Electronics
'purpose                : demo : LOOKDOWN
```

```
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim Idx As Integer , Search As Byte , Entries As Byte

'we want to search for the value 3
Search = 3
'there are 5 entries in the table
Entries = 5

'lookup and return the index
Idx = Lookdown(search , Label , Entries)
Print Idx

Search = 1
Idx = Lookdown(search , Label , Entries)
Print Idx


Search = 100
Idx = Lookdown(search , Label , Entries)
Print Idx                                                  ' return -1 if not
found


'looking for integer or word data requires that the search variable is
'of the type integer !
Dim Isearch As Integer
Isearch = 400
Idx = Lookdown(isearch , Label2 , Entries)
Print Idx                                                  ' return 3

End


Label:
Data 1 , 2 , 3 , 4 , 5

Label2:
Data 1000% , 200% , 400% , 300%
```

LOOKUP

Action

Returns a value from a table.

Syntax
var = **LOOKUP**(value, label)

Remarks

Var	The returned value
Value	A value with the index of the table
Label	The label where the data starts

The value can be up to 65535. 0 will return the first entry.

See also
LOOKUPSTR

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim B1 As Byte , I As Integer
B1 = Lookup(2 , Dta)
Print B1                                                   ' Prints 3 (zero
based)

I = Lookup(0 , Dta2)                                       ' print 1000
Print I
End


Dta:
Data 1 , 2 , 3 , 4 , 5
Dta2:
Data 1000% , 2000%
```

LOOKUPSTR

Action
Returns a string from a table.

Syntax
var = **LOOKUPSTR**(value, label)

Remarks

Var	The string returned
Value	A value with the index of the table. The index is zero-based. That is, 0 will return the first element of the table.
Label	The label where the data starts

The index value can have a maximum value of 255.

See also
LOOKUP , LOOKDOWN

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim S As String * 4 , Idx As Byte
Idx = 0 : S = Lookupstr(idx , Sdata)
Print S                                                    'will print 'This'
End

Sdata:
Data "This" , "is" , "a test"
```

LOW

Action
Retrieves the least significant byte of a variable.

Syntax
var = **LOW**(s)

Remarks

Var	The variable that is assigned with the LSB of var S.
S	The source variable to get the LSB from.

You can also assign a byte to retrieve the LSB of a Word or Long.
For example :
B = L , where B is a byte and L is a Long.

See also

HIGH , HIGHW

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim I As Integer , Z As Byte
I = &H1001
Z = Low(i)                                                 ' is 1
End
```

LOWERLINE

Action

Reset the LCD cursor to the lower line.

Syntax

LOWERLINE

Remarks

NONE

See also

UPPERLINE , THIRDLINE , FOURTHLINE , HOME

Partial Example

```
Lcd "Test"
Lowerline
Lcd "Hello"
End
```

MAKEBCD

Action

Convert a variable into its BCD value.

Syntax
var1 = **MAKEBCD**(var2)

Remarks

var1	Variable that will be assigned with the converted value.
Var2	Variable that holds the decimal value.

When you want to use an I2C clock device, which stores its values as BCD values you can use this function to convert variables from decimal to BCD.
For printing the bcd value of a variable, you can use the BCD() function which converts a BCD number into a BCD string.

See also
MAKEDEC , BCD , MAKEINT

Example
```
Dim A As Byte
A = 65
Lcd A
Lowerline
Lcd Bcd(a)
A = Makebcd(a)
Lcd " " ; A
End
```

MAKEINT

Action
Compact two bytes into a word or integer.

Syntax
varn = **MAKEINT**(LSB , MSB)

Remarks

Varn	Variable that will be assigned with the converted value.
LSB	Variable or constant with the LS Byte.
MSB	Variable or constant with the MS Byte.

The equivalent code is:
varn = (256 * MSB) + LSB

See also
LOW , HIGH , MAKEBCD , MAKEDEC

Example

```
Dim A As Integer , I As Integer
A = 2
I = Makeint(a , 1)                                          'I = (1 * 256) + 2
= 258
End
```

MAKEDEC

Action

Convert a BCD byte or Integer/Word variable to its DECIMAL value.

Syntax

var1 = **MAKEDEC**(var2)

Remarks

var1	Variable that will be assigned with the converted value.
var2	Variable that holds the BCD value.

When you want to use an I2C clock device, which stores its values as BCD values you can use this function to convert variables from BCD to decimal.

See also

MAKEBCD , MAKEBCD, MAKEINT

Example

```
Dim A As Byte
A = 65
Print A
Print Bcd(a)
A = Makedec(a)
Print Spc(3) ; A
End
```

MAKETCP

Action

Creates a TCP/IP formatted long variable.

Syntax

var = **MAKETCP**(b1,b2,b3,b4 [opt])
var = **MAKETCP**(num)

Remarks

var	The target variable of the type LONG that is assigned with the IP number
b1-b4	Four variables of numeric constants that form the IP number. b1 is the MSB of the IP/long b4 is the LSB of the IP/long example var = MakeTCP(192,168,0, varx). We can also use reverse order with the optional param : example var = MakeTCP(var3,0,168, 192, **1**). A value of 1 will use reverse order while a value of 0 will result in normal order. When you use a constant, provide only one param : example var = MakeTCP(192.168.0.2). Notice the dots !

MakeTCP is a helper routine for the TCP/IP library.

See also
CONFIG TCPIP , IP2STR

Example
NONE

MAX

Action
Returns the maximum value of a byte or word array.

Syntax
var1 = **MAX**(var2)
MAX(ar(1), m ,idx)

Remarks

var1	Variable that will be assigned with the maximum value.
var2	The first address of the array.
	The MAX statement can return the index too
Ar(1)	Starting element to get the maximum value and index of.
M	Returns the maximum value of the array.
Idx	Return the index of the array that contains the maximum value. Returns 0 if there is no maximum value.

The MIN() and MAX() functions work on BYTE and WORD arrays only.

See also
MIN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                        : minmax.bas
'copyright                   : (c) 1995-2005, MCS Electronics
'purpose                     : show the MIN and MAX functions
'micro                       : Mega48
'suited for demo             : yes
'commercial addon needed     : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


' These functions only works on BYTE and WORD arrays at the moment !!!!!

'Dim some variables
Dim Wb As Byte , B As Byte
Dim W(10) As Word                                          ' or use a BYTE
array

'fill the word array with values from 1 to 10
For B = 1 To 10
  W(b) = B
Next

Print "Max number " ; Max(w(1))
Print "Min number " ; Min(w(1))

Dim Idx As Word , M1 As Word
Min(w(1) , M1 , Idx)
Print "Min number " ; M1 ; " index " ; Idx

Max(w(1) , M1 , Idx)
Print "Max number " ; M1 ; " index " ; Idx
End
```

MEMCOPY

Action

Copies a block of memory

Syntax

bts = **MEMCOPY**(source, target , bytes[, option])

Remarks

bts	The total number of bytes copied. This must be a word or integer
source	The first address of the source variable that will be copied.
target	The first address of the target variable that will be copied to.
bytes	The number of bytes to copy from "source" to "target"
option	An optional numeric constant with one of the following values : 1 - only the source address will be increased after each copied byte 2 - only the target address will be increased after each copied byte 3 - both the source and target address will be copied after each copied byte

By default, option 3 is used as this will copy a block of memory from one memory location to another location. But it it also possible to fill an entire array of memory block with the value of 1 memory location. For example to clear a whole block or preset it with a value.
And with option 2, you can for example get a number of samples from a register like PINB and store it into an array.

See also
NONE

ASM
NONE

Example
```
'-----------------------------------------------------------------------
'name                          : MEMCOPY.BAS
'copyright                     : (c) 1995-2006, MCS Electronics
'purpose                       : show memory copy function
'suited for demo               : yes
'commercial addon needed       : no
'use in simulator              : possible
'-----------------------------------------------------------------------
$regfile = "m88def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 16                                              ' default use 10
for the SW stack
$framesize = 40

Dim Ars(10) As Byte                                        'source bytes
Dim Art(10) As Byte                                        'target bytes
Dim J As Byte                                              'index
For J = 1 To 10                                            'fill array
  Ars(j) = J
Next

J = Memcopy(ars(1) , Art(1) , 4)                           'copy 4 bytes

Print J ; " bytes copied"
For J = 1 To 10
  Print Art(j)
Next

J = Memcopy(ars(1) , Art(1) , 10 , 2)                      'assign them all
with element 1
```

```
Print J ; " bytes copied"
For J = 1 To 10
  Print Art(j)
Next


Dim W As Word , L As Long
W = 65511
J = Memcopy(w , L , 2)                                    'copy 2 bytes from
word to long

End
```

MIN

Action
Returns the minimum value of a byte or word array.

Syntax
var1 = **MIN**(var2)
MIN(ar(1), m , idx)

Remarks

var1	Variable that will be assigned with the minimum value.
var2	The first address of the array.
	The MIN statement can return the index too
Ar(1)	Starting element to get the minimum value and index of
M	Returns the minimum value of the array
Idx	Return the index of the array that contains the minimum value. Returns 0 if there is no minimum value.

The MIN() ans MAX() functions work on BYTE and WORD arrays only.

See also
MAX

Example
```
'-----------------------------------------------------------------------------
-----------
'name                    : minmax.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : show the MIN and MAX functions
'micro                   : Mega48
'suited for demo         : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                   ' specify the used
micro
```

```
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


' These functions only works on BYTE and WORD arrays at the moment !!!!!

'Dim some variables
Dim Wb As Byte , B As Byte
Dim W(10) As Word                                           ' or use a BYTE
array

'fill the word array with values from 1 to 10
For B = 1 To 10
  W(b) = B
Next

Print "Max number " ; Max(w(1))
Print "Min number " ; Min(w(1))

Dim Idx As Word , M1 As Word
Min(w(1) , M1 , Idx)
Print "Min number " ; M1 ; " index " ; Idx

Max(w(1) , M1 , Idx)
Print "Max number " ; M1 ; " index " ; Idx
End
```

MID

Action

The MID function returns part of a string (a sub string).
The MID statement replaces part of a string variable with another string.

Syntax

var = **MID**(var1 ,st [, l])
MID(var ,st [, l]) = var1

Remarks

var	The string that is assigned.
Var1	The source string.
st	The starting position.
l	The number of characters to get/set.

See also

LEFT , RIGHT

Example

```
Dim S As String * 15 , Z As String * 15
S ="ABCDEFG"
Z = Left(s , 5)
Print Z                                                    'ABCDE
Z = Right(s , 3) : Print Z
Z = Mid(s , 2 , 3) : Print Z
End
```

NBITS

Action

Set all except the specified bits to 1.

Syntax

Var = **NBITS**(b1 [,bn])

Remarks

Var	The BYTE/PORT variable that is assigned with the constant.
B1 , bn	A list of bit numbers that NOT must be set to 1.

While it is simple to assign a value to a byte, and there is special boolean notation **&B** for assigning bits, the Bits() and NBits() function makes it simple to assign a few bits.

B = &B01111101 : how many zero's are there?
This would make it more readable: B = NBits(1, 7)
You can read from the code that bit 1 and bit 7 are NOT set to 1.
It does not save code space as the effect is the same.

The NBITS() function will set all bits to 1 except for the specified bits.
It can only be used on bytes and port registers.
Valid bits are in range from 0 to 7.

See Also

BITS

Example

```
'-------------------------------------------------------------------------
--
'name                     : bits-nbits.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo for Bits() AND Nbits()
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
'-------------------------------------------------------------------------
--

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

Dim B As Byte

'while you can use &B notation for setting bits, like B = &B1000_0111
'there is also an alternative by specifying the bits to set
B = Bits(0 , 1 , 2 , 7)                                      'set only bit 0,1,2
and 7
Print B

'and while bits() will set all bits specified to 1, there is also Nbits()
'the N is for NOT. Nbits(1,2) means, set all bits except 1 and 2
B = Nbits(7)                                                 'do not set bit 7
Print B
End
```

ON INTERRUPT

Action

Execute subroutine when the specified interrupt occurs.

Syntax

ON interrupt label [NOSAVE]

Remarks

Interrupt	INT0, INT1, INT2, INT3, INT4,INT5, TIMER0 ,TIMER1, TIMER2, ADC , EEPROM , CAPTURE1, COMPARE1A, COMPARE1B,COMPARE1. Or you can use the AVR name convention: OC2 , OVF2, ICP1, OC1A, OC1B, OVF1, OVF0, SPI, URXC, UDRE, UTXC, ADCC, ERDY and ACI.
Label	The label to jump to if the interrupt occurs.

NOSAVE	When you specify NOSAVE, no registers are saved and restored in the interrupt routine. So when you use this option make sure to save and restore all used registers. When you omit NOSAVE all used registers will be saved. These are SREG , R31 to R16 and R11 to R0 with exception of R6,R8 and R9 . R12 – R15 are not saved. When you use floating point math in the ISR(not recommended) you must save and restore R12-R15 yourself in the ISR. My_Isr: Push R12 ' save registers Push R13 Push R14 Push R15 Single = single + 1 ' we use FP Pop R15 ' restore registers Pop R14 Pop R13 Pop R12 RETURN

You must return from the interrupt routine with the RETURN statement.

The first RETURN statement that is encountered that is outside a condition will generate a RETI instruction. You may have only one such RETURN statement in your interrupt routine because the compiler restores the registers and generates a RETI instruction when it encounters a RETURN statement in the ISR. All other RETURN statements are converted to a RET instruction.

The possible interrupt names can be looked up in the selected microprocessor register file. 2313def.dat for example shows that for the compare interrupt the name is COMPARE1. (look at the bottom of the file)

What are interrupts good for?

An interrupt will halt your program and will jump to a specific part of your program. You can make a DO .. LOOP and poll the status of a pin for example to execute some code when the input on a pin changes.

But with an interrupt you can perform other tasks and when then pin input changes a special part of your program will be executed. When you use INPUT "Name ", v for example to get a user name via the RS-232 interface it will wait until a RETURN is received. When you have an interrupt routine and the interrupt occurs it will branch to the interrupt code and will execute the interrupt code. When it is finished it will return to the Input statement, waiting until a RETURN is entered.

Maybe a better example is writing a clock program. You could update a variable in your program that updates a second counter. But a better way is to use a TIMER interrupt and update a seconds variable in the TIMER interrupt handler.

There are multiple interrupt sources and it depends on the used chip which are available.

To allow the use of interrupts you must set the global interrupt switch with a ENABLE INTERRUPTS statement. This only allows that interrupts can be used. You must also set the individual interrupt switches on!

ENABLE TIMER0 for example allows the TIMER0 interrupt to occur.

With the DISABLE statement you turn off the switches.

When the processor must handle an interrupt it will branch to an address at the start of flash memory. These addresses can be found in the DAT files.

The compiler normally generates a RETI instruction on these addresses so that in the event that an interrupt occurs, it will return immediately.

When you use the ON ... LABEL statement, the compiler will generate code that jumps to the specified label. The SREG and other registers are saved at the LABEL location and when the RETURN is found the compiler restores the registers and generates the RETI so that the program will continue where it was at the time the interrupt occurred.

When an interrupt is services no other interrupts can occur because the processor(not the compiler) will disable all interrupts by clearing the master interrupt enable bit. When the interrupt is services the interrupt is also cleared so that it can occur again when the conditions are met that sets the interrupt.

It is not possible to give interrupts a priority. The interrupt with the lowest address has the highest interrupt!

Finally some tips :

* when you use a timer interrupt that occurs each 10 uS for example, be sure that the interrupt code can execute in 10 uS. Otherwise you would loose time.

* it is best to set just a simple flag in the interrupt routine and to determine it's status in the main program. This allows you to use the NOSAVE option that saves stack space and program space. You only have to Save and Restore R24 and SREG in that case.

* Since you can not PUSH a hardware register, you need to load it first:

PUSH R24 ; since we are going to use R24 we better save it

IN r24, SREG ; get content of SREG into R24
PUSH R24 ; we can save a register

;here goes your asm code
POP R24 ;get content of SREG

OUT SREG, R24 ; save into SREG
POP R24 ; get r24 back

See Also

On VALUE

Partial Example

```
Enable Interrupts
Enable Int0                                          'enable the
interrupt
On Int0 Label2 Nosave                                'jump to label2 on
INT0
Do'endless loop
  nop
Loop
End
```

```
Label2:
Dim A AsByte
If A > 1 Then
  Return                                                    'generates a RET
because it is inside a condition
EndIf
Return                                                      'generates a RETI
because it is the first RETURN
Return                                                      'generates a RET
because it is the second RETURN
```

ON VALUE

Action
Branch to one of several specified labels, depending on the value of a variable.

Syntax
ON var [GOTO] [GOSUB] label1 [, label2] [,CHECK]

Remarks

Var	The numeric variable to test. This can also be a SFR such as PORTB.
label1, label2	The labels to jump to depending on the value of var.
CHECK	An optional check for the number of provided labels.

Note that the value is zero based. So when var is 0, the first specified label is jumped/branched.
It is important that each possible value has an associated label.
When there are not enough labels, the stack will get corrupted. For example :
ON value label1, label2

And value = 2, there is no associated label.

You can use the optional CHECK so the compiler will check the value against the number of provided labels. When there are not enough labels for the value, there will be no GOTO or GOSUB and the next line will be executed.

See Also
ON INTERRUPT

ASM
The following code will be generated for a non-MEGA micro with ON value GOTO.

```
Ldi R26,$60       ; load address of variable
Ldi R27,$00 ; load constant in register
Ld R24,X
Clr R25

Ldi R30, Low(ON_1_ * 1)     ; load Z with address of the label
Ldi R31, High(ON_1_ * 1)
```

```
Add zl,r24      ; add value to Z
Adc zh,r25

Ijmp       ; jump to address stored in Z

ON_1_:

Rjmp lbl1      ; jump table
Rjmp lbl2
Rjmp lbl3
```

The following code will be generated for a non-MEGA micro with ON value GOSUB.

```
;##### On X Gosub L1 , L2
Ldi R30,Low(ON_1_EXIT * 1)
Ldi R31,High(ON_1_EXIT * 1)
Push R30 ;push return address
Push R31
Ldi R30,Low(ON_1_ * 1)     ;load table address
Ldi R31,High(ON_1_ * 1)
Ldi R26,$60
Ld R24,X
Clr R25

Add zl,r24 ; add to address of jump table
Adc zh,r25
Ijmp       ; jump !!!

ON_1_:
Rjmp L1
Rjmp L2
ON_1_EXIT:
```

As you can see a jump is used to call the routine. Therefore the return address is first saved on the stack.

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : ongosub.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : ON .. GOSUB/GOTO
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
```

```
$framesize = 40                                             ' default use 40
for the frame space

Dim A As Byte
Input "Enter value 0-2 " , A                                'ask for input
Rem Note That The Starting Value Begins With 0
On A Gosub L0 , L1 , L2
Print "Returned"

If Portb < 2 Then                                           'you can also use
the portvalue
  On Portb Goto G0 , G1
End If
End_prog:
End


L0:
  Print "0 entered"
Return

L1:
  Print "1 entered"
Return

L2:
  Print "2 entered"
Return

G0:
  Print "P1 = 0"
  Goto End_prog

G1:
  Print "P1 = 1"
  Goto End_prog
```

OPEN

Action

Opens a device.

Syntax

OPEN "device" for MODE As #channel
OPEN file FOR MODE as #channel

Remarks

Device	The default device is COM1 and you don't need to open a channel to use INPUT/OUTPUT on this device. With the implementation of the software UART, the compiler must know to which pin/device you will send/receive the data. So that is why the OPEN statement must be used. It tells the compiler about the pin you use for the serial input or output and the baud rate you want to use. COMB.0:9600,8,N,2 will use PORT B.0 at 9600 baud with 2 stopbits. The format for COM1 and COM2 is : COM1: or COM2: There is no speed/baud rate parameter since the default baud rate will be used that is specified with $BAUD or $BAUD1 The format for the software UART is: COMpin:speed,8,N,stopbits[,INVERTED] Where pin is the name of the PORT-pin. Speed must be specified and stop bits can be 1 or 2. 7 bit data or 8 bit data may be used. For parity N, O or E can be used. An optional parameter ,INVERTED can be specified to use inverted RS-232. Open "COMD.1:9600,8,N,1,INVERTED" For Output As #1 , will use pin PORTD.1 for output with 9600 baud, 1 stop bit and with inverted RS-232. For the AVR-DOS filesystem, Device can also be a string or filename constant like "readme.txt" or sFileName
MODE	You can use BINARY or RANDOM for COM1 and COM2, but for the software UART pins, you must specify INPUT or OUTPUT. For the AVR-DOS filesystem, MODE may be INPUT, OUTPUT, APPEND or BINARY.
Channel	The number of the channel to open. Must be a positive constant >0. For the AVR-DOS filesystem, the channel may be a positive constant or a numeric variable. Note that the AVD-DOS filesystem uses real filehandles. The software UART does not use real file handles.

UART

The statements that support the device are PRINT , INPUT , INPUTHEX , INKEY and WAITKEY

Every opened device must be closed using the CLOSE #channel statement. Of course, you must use the same channel number.

In DOS the #number is a DOS file number that is passed to low level routines. In BASCOM the channel number is only used to identify the channel but there are no file handles. So opening a channel, will not use a channel. And closing the channel is only needed to make the syntax compatible with VB.

What is the difference?

In VB you can close the channel in a subroutine like this:

```
OPEN "com1:" for binary as #1
Call test
Close #1
End

Sub test
  Print #1, "test"
End Sub
```

This will work since the filenumber is a real variable in the OS.
In BASCOM it will not work : the CLOSE must come after the last I/O statement:

```
OPEN "com1:" for binary as #1
Call test
End

Sub test
  Print #1, "test"
End Sub
Close #1
```

The INPUT statement in combination with the software UART, will not echo characters back because there is no default associated pin for this.

AVR-DOS

The AVR-DOS file system uses real file handles. This means that the CLOSE statement can be used at any place in your program just as with VB.

See also

CLOSE , CRYSTAL, PRINT, LINE INPUT , LOC , LOF , EOF

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : open.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates software UART
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 10000000                                        ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
```

```
for the frame space


Dim B As Byte

'Optional you can fine tune the calculated bit delay
'Why would you want to do that?
'Because chips that have an internal oscillator may not
'run at the speed specified. This depends on the voltage, temp etc.
'You can either change $CRYSTAL or you can use
'BAUD #1,9610

'In this example file we use the DT006 from www.simmstick.com
'This allows easy testing with the existing serial port
'The MAX232 is fitted for this example.
'Because we use the hardware UART pins we MAY NOT use the hardware UART
'The hardware UART is used when you use PRINT, INPUT or other related
statements
'We will use the software UART.
Waitms 100

'open channel for output
Open "comd.1:19200,8,n,1" For Output As #1
Print #1 , "serial output"


'Now open a pin for input
Open "comd.0:19200,8,n,1" For Input As #2
'since there is no relation between the input and output pin
'there is NO ECHO while keys are typed
Print #1 , "Number"
'get a number
Input #2 , B
'print the number
Print #1 , B

'now loop until ESC is pressed
'With INKEY() we can check if there is data available
'To use it with the software UART you must provide the channel
Do
   'store in byte
   B = Inkey(#2)
   'when the value > 0 we got something
   If B > 0 Then
      Print #1 , Chr(b)                                    'print the
character
   End If
Loop Until B = 27


Close #2
Close #1


'OPTIONAL you may use the HARDWARE UART
'The software UART will not work on the hardware UART pins
'so you must choose other pins
'use normal hardware UART for printing
'Print B


'When you dont want to use a level inverter such as the MAX-232
'You can specify ,INVERTED :
'Open "comd.0:300,8,n,1,inverted" For Input As #2
'Now the logic is inverted and there is no need for a level converter
'But the distance of the wires must be shorter with this
End
```

OUT

Action
Sends a byte to a hardware port or internal or external memory address.

Syntax
OUT address, value

Remarks

Address	The address where to send the byte to in the range of 0-FFFF hex.
Value	The variable or value to output.

The OUT statement can write a value to any AVR memory location.

It is advised to use Words for the address. An integer might have a negative value and will write of course to a word address. So it will be 32767 higher as supposed. This because an integer has it's most significant bit set when it is negative.

To write to XRAM locations you must enable the External RAM access in the Compiler Chip Options.

You do not need to use OUT when setting a port variable. Port variables and other registers of the micro can be set like this : PORTB = value , where PORTB is the name of the register.

See also
INP , PEEK , POKE

Example
```
Out &H8000 , 1 'send 1 to the databus(d0-d7) at hex address 8000
End
```

PEEK

Action
Returns the content of a register.

Syntax
var = **PEEK**(address)

Remarks

Var	Numeric variable that is assigned with the content of the memory location address
Address	Numeric variable or constant with the address location.(0-31)

Peek() will read the content of a register.
Inp() can read any memory location

See also
POKE , CPEEK , INP , OUT

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : peek.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates PEEk, POKE, CPEEK, INP and OUT
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m162def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim I As Integer , B1 As Byte
'dump internal memory
For I = 0 To 31                                             'only 32 registers
in AVR
  B1 = Peek(i)                                              'get byte from
internal memory
  Print Hex(b1) ; "  ";
  'Poke I , 1                            'write a value into memory
Next
Print                                                       'new line
'be careful when writing into internal memory !!

'now dump a part ofthe code-memory(program)
For I = 0 To 255
  B1 = Cpeek(i)                                             'get byte from
internal memory
  Print Hex(b1) ; "  ";
Next
'note that you can not write into codememory!!

Out &H8000 , 1                                              'write 1 into XRAM
at address 8000
B1 = Inp(&H8000)                                            'return value from
XRAM
Print B1

End
```

POKE

Action
Write a byte to an internal register.

Syntax
POKE address , value

Remarks

Address	Numeric variable with the address of the memory location to set. (0-31)
Value	Value to assign. (0-255)

See also
PEEK , CPEEK , INP , OUT

Example
```
Poke 1 , 1 'write 1 to R1
End
```

POPALL

Action
Restores all registers that might be used by BASCOM.

Syntax
POPALL

Remarks
When you are writing your own ASM routines and mix them with BASIC you are unable to tell which registers are used by BASCOM because it depends on the used statements and interrupt routines that can run on the background.

That is why Pushall saves all used registers and POPALL restores all registers.

See also
PUSHALL

POWER

Action
Returns the power of a single or double variable and its argument

Syntax
var = **POWER**(source, raise)

Remarks

Var	A numeric variable that is assigned with the power of variable source ^ raise.
Source	The single or double variable to get the power of.

The POWER function works for positive floating point variables only.
When you use a ^ b , the sign will be preserved.

While Excel does not allow raising a negative single, QB does allow it.
The Power functions uses less code compared with the code that is generated when you use ^ for floating point values.
It is important that you use single variables for both single and raise. Constants are not accepted.

See Also
EXP ,LOG, LOG10 , SQR

Example
Show sample

POWERDOWN

Action
Put processor into power down mode.

Syntax
POWERDOWN

Remarks
In the power down mode, the external oscillator is stopped. The user can use the WATCHDOG to power up the processor when the watchdog timeout expires. Other possibilities to wake up the processor is to give an external reset or to generate an external level triggered interrupt.

Most new chips have many options for Power down/Idle. It is advised to consult the data sheet to see if a better mode is available.

See also
IDLE , POWERSAVE

Example
Powerdown

POWERSAVE

Action
Put processor into power save mode.

Syntax
POWERSAVE

Remarks
The POWERSAVE mode is only available in the 8535, Mega8, Mega163.

Most new chips have many options for Power down/Idle. It is advised to consult the datasheet to see if a better mode is available.

See also
IDLE, POWERDOWN

Example
Powersave

PRINT

Action
Send output to the RS-232 port.
Writes a string to a file.

Syntax
PRINT [#channel ,] var ; " constant"

Remarks

Var	The variable or constant to print.

You can use a semicolon (**;**) to print more than one variable at one line.
When you end a line with a semicolon, no linefeed and carriage return will be added.

The PRINT routine can be used when you have a RS-232 interface on your uP.
The RS-232 interface can be connected to a serial communication port of your computer.
This way you can use a terminal emulator as an output device.
You can also use the build in terminal emulator.

AVR-DOS

The AVR-DOS file system also supports PRINT. But in that case, only strings can be written to disk.
When you need to print to the second hardware UART, or to a software UART, you need to specify a channel : PRINT #1, "test"
The channel must be opened first before you can print to it. Look at OPEN and CLOSE for more details about the optional channel. For the first hardware UART, there is no need to use channels.
PRINT " test" will always use the first hardware UART.

See also
INPUT,OPEN , CLOSE , SPC

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : print.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: PRINT, HEX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , B1 As Byte , C As Integer , S As String * 4
A = 1
Print "print variable a " ; A
Print                                                      'new line
Print "Text to print."                                     'constant to print


B1 = 10
Print Hex(b1)                                              'print in hexa
notation
C = &HA000                                                 'assign value to c%
Print Hex(c)                                               'print in hex
notation
Print C                                                    'print in decimal
notation

C = -32000
Print C
Print Hex(c)
Rem Note That Integers Range From -32767 To 32768

Print "You can also use multiple" _
; "lines using _"
Print "use it for long lines"
'From version 1.11.6.4 :
A = &B1010_0111
```

```
Print Bin(a)
S = "1001"
A = Binval(s)
Print A                                                    '9 dec
End
```

PRINTBIN

Action
Print binary content of a variable to the serial port.

Syntax
PRINTBIN var [; varn]
PRINTBIN #channel, var [; varn]

Remarks

Var	The variable which value is send to the serial port.
varn	Optional variables to send.

The channel is optional and for use with OPEN and CLOSE statements.

PRINTBIN is equivalent to PRINT CHR(var);
When you use a Long for example, 4 bytes are printed.

Multiple variables may be sent. They must be separated by the **;** sign.

The number of bytes to send can be specified by an additional numeric parameter. This is convenient when sending the content of an array.

Printbin ar(1) ; 3 ' will send 3 bytes from array ar().
Printbin ar(1) ; 2 ; ar(2) ; 4 ' will send 2 bytes from array ar() starting at index 1, then 4 bytes from array ar() starting at index 4.

When you use Printbin ar(1) , the whole array will be printed.
When you need to print the content of a big array(array with more then 255 elements) you need to use the CONFIG PRINTBIN option.

See also
INPUTBIN , CONFIG PRINTBIN

Example
```
Dim A(10) As Byte, C As Byte
For C = 1 To 10
   A(c)= c 'fill array
Next
Printbin A(1)  'print content of a(1). Not the whole array will be sent!

End
```

PSET

Action
Sets or resets a single pixel.

Syntax
PSET X , Y, value

Remarks

X	The X location of the pixel. In range from 0-239.
Y	The Y location of the pixel. In range from 0-63.
value	The value for the pixel. 0 will clear the pixel. 1 Will set the pixel.

The PSET is handy to create a simple data logger or oscilloscope.

See also
SHOWPIC , CONFIG GRAPHLCD , LINE

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : t6963_240_128.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : T6963C graphic display support demo 240 * 128
'micro                    : Mega8535
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m8535.dat"                                      ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'-------------------------------------------------------------
'                    (c) 2001-2003 MCS Electronics
'                T6963C graphic display support demo 240 * 128
'-------------------------------------------------------------

'The connections of the LCD used in this demo
'LCD pin                  connected to
' 1        GND            GND
 '2        GND            GND
 '3        +5V            +5V
 '4        -9V            -9V potmeter
 '5        /WR            PORTC.0
 '6        /RD            PORTC.1
```

```
 '7        /CE             PORTC.2
 '8        C/D             PORTC.3
 '9        NC              not conneted
 '10       RESET           PORTC.4
 '11-18    D0-D7            PA
 '19       FS              PORTC.5
 '20       NC              not connected

'First we define that we use a graphic LCD
' Only 240*64 supported yet
Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'Clear the screen will both clear text and graph display
Cls
'Other options are :
' CLS TEXT   to clear only the text display
' CLS GRAPH  to clear only the graphical part

Cursor Off

Wait 1
'locate works like the normal LCD locate statement
' LOCATE LINE,COLUMN LINE can be 1-8 and column 0-30


Locate 1 , 1

'Show some text
Lcd "MCS Electronics"
'And some othe text on line 2
Locate 2 , 1 : Lcd "T6963c support"
Locate 3 , 1 : Lcd "12345678901234567890123456789012345678901234567890"
Locate 16 , 1 : Lcd "write this to the lower line"

Wait 2

Cls Text


'use the new LINE statement to create a box
'LINE(X0,Y0) - (X1,Y1), on/off
Line(0 , 0) -(239 , 127) , 255                                  ' diagonal line
Line(0 , 127) -(239 , 0) , 255                                  ' diagonal line
Line(0 , 0) -(240 , 0) , 255                                    ' horizontal upper
line
Line(0 , 127) -(239 , 127) , 255                                'horizontal lower
line
Line(0 , 0) -(0 , 127) , 255                                    ' vertical left
line
Line(239 , 0) -(239 , 127) , 255                                ' vertical right
line


Wait 2
' draw a line using PSET X,Y, ON/OFF
' PSET on.off param is 0 to clear a pixel and any other value to turn it on
For X = 0 To 140
```

```
   Pset X , 20 , 255                                          ' set the pixel
Next

For X = 0 To 140
   Pset X , 127 , 255                                         ' set the pixel
Next

Wait 2

'circle time
'circle(X,Y), radius, color
'X,y is the middle of the circle,color must be 255 to show a pixel and 0 to
clear a pixel
For X = 1 To 10
  Circle(20 , 20) , X , 255                                   ' show circle
  Wait 1
  Circle(20 , 20) , X , 0                                     'remove circle
  Wait 1
Next

Wait 2

For X = 1 To 10
  Circle(20 , 20) , X , 255                                   ' show circle
  Waitms 200
Next
Wait 2
'Now it is time to show a picture
'SHOWPIC X,Y,label
'The label points to a label that holds the image data
Test:
Showpic 0 , 0 , Plaatje
Showpic 0 , 64 , Plaatje                                      ' show 2 since we
have a big display
Wait 2
Cls Text                                                      ' clear the text
End



'This label holds the mage data
Plaatje:
'$BGF will put the bitmap into the program at this location
$bgf "mcs.bgf"

'You could insert other picture data here
```

PS2MOUSEXY

Action

Sends mouse movement and button information to the PC.

Syntax

PS2MOUSEXY X , Y, button

Remarks

X	The X-movement relative to the current position. The range is –255 to 255.
Y	The Y-movement relative to the current position. The range is –255 to 255.
Button	A variable or constant that represents the button state. 0 – no buttons pressed 1- left button pressed 2- right button pressed 4- middle button pressed You can combine these values by adding them. For example, 6 would emulate that the right and middle buttons are pressed. To send a mouse click, you need to send two ps2mouseXY statements. The first must indicate that the button is pressed, and the second must release the button. Ps2mouseXY 0,0,1 ' left mouse pressed PsmouseXY 0,0,0 ' left mouse released

The SENDSCAN statement could also be used.

See also
SENDSCAN, CONFIG PS2EMU

PULSEIN

Action
Returns the number of units between two occurrences of an edge of a pulse.

Syntax
PULSEIN var , PINX , PIN , STATE

Remarks

var	A word variable that is assigned with the result.
PINX	A PIN register like PIND
PIN	The pin number(0-7) to get the pulse time of.
STATE	May be 0 or 1. 0 means sample 0 to 1 transition. 1 means sample 1 to 0 transition.

ERR variable will be set to 1 in case of a time out. A time out will occur after 65535 unit counts. With 10 uS units this will be after 655.35 mS.

You can add a bitwait statement to be sure that the PULSEIN statement will wait for the start condition. But when using the BITWAIT statement and the start condition will never occur, your program will stay in a loop.

The PULSIN statement will wait for the specified edge.

When state 0 is used, the routine will wait until the level on the specified input pin is 0. Then a counter is started and stopped until the input level gets 1.

No hardware timer is used. A 16 bit counter is used. It will increase in 10 uS units. But this depends on the XTAL. You can change the library routine to adjust the units.

See also
PULSEOUT

ASM
The following ASM routine is called from mcs.lib
_pulse_in (calls _adjust_pin)

On entry ZL points to the PINx register , R16 holds the state, R24 holds the pin number to sample.
On return XL + XH hold the 16 bit value.

Example
```
Dim w As Byte
pulsein w , PIND , 1 , 0 'detect time from 0 to 1
print w
end
```

PULSEOUT

Action
Generates a pulse on a pin of a PORT of specified period in 1uS units for 4 MHz.

Syntax
PULSEOUT PORT , PIN , PERIOD

Remarks

PORT	Name of the PORT. PORTB for example
PIN	Variable or constant with the pin number (0-7).
PERIOD	Number of periods the pulse will last. The periods are in uS when an XTAL of 4 MHz is used.

The pulse is generated by toggling the pin twice, thus the initial state of the pin determines the polarity.
The PIN must be configured as an output pin before this statement can be used.

See also
PULSEIN

Example
```
Dim A As Byte
Config Portb = Output                                    'PORTB all output
pins
Portb = 0                                                'all pins 0
Do
  For A = 0 To 7
   Pulseout Portb , A , 60000                            'generate pulse
   Waitms 250                                            'wait a bit
  Next
Loop                                                     'loop for ever
```

PUSHALL

Action
Saves all registers that might be used by BASCOM.

Syntax
PUSHALL

Remarks
When you are writing your own ASM routines and mix them with BASIC you are unable to tell which registers are used by BASCOM because it depends on the used statements and interrupt routines that can run on the background.

That is why Pushall saves all used registers. Use POPALL to restore the registers.

The saved registers are : R0-R5, R7,R10,R11 and R16-R31

See also
POPALL

PUT

Action
Writes a byte to the hardware or software UART.
Writes data to a file opened in BINARY mode.

Syntax
PUT #channel, var
PUT #channel, var ,[pos] [,length]

Remarks

PUT in combination with the software/hardware UART is provided for compatibility with BASCOM-8051. It writes one byte

PUT in combination with the AVR-DOS file system is very flexible and versatile. It works on files opened in BINARY mode and you can write all data types.

#channel	A channel number, which identifies an opened file. This can be a hard coded constant or a variable.
Var	The variable or variable array that will be written to the file
Pos	This is an optional parameter that may be used to specify the position where the data must be written. This must be a long variable.
Length	This is an optional parameter that may be used to specify how many bytes must be written to the file.

By default you only need to provide the variable name. When the variable is a byte, 1 byte will be written. When the variable is a word or integer, 2 bytes will be written. When the variable is a long or single, 4 bytes will be written. When the variable is a string, the number of bytes that will be written is equal to the dimensioned size of the string. DIM S as string * 10 , would write 10 bytes.

Note that when you specify the length for a string, the maximum length is 255. The maximum length for a non-string array is 65535.

Example

```
PUT #1, var
PUT #1, var , , 2  ' write 2 bytes at default position
PUT #1, var ,PS, 2  ' write 2 bytes at location storied in variable PS
```

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET, FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

current position	Goto new position first
Byte:	
_FilePutRange_1 Input: r24: File number X: Pointer to variable T-Flag cleared	_FilePutRange_1 Input: r24: File number X: Pointer to variable r16-19 (A): New position (1-based) T-Flag Set
Word/Integer:	
_FilePutRange_2 Input: r24: File number X: Pointer to variable T-Flag cleared	_FilePutRange_2 Input: r24: File number X: Pointer to variable r16-19 (A): New position (1-based) T-Flag Set

Long/Single:	
_FilePutRange_4 Input: r24: File number X: Pointer to variable T-Flag cleared	_FilePutRange_4 Input: r24: File number X: Pointer to variable r16-19 (A): New position (1-based) T-Flag Set
String (<= 255 Bytes) with fixed length	
_FilePutRange_Bytes Input: r24: File number r20: Count of Bytes X: Pointer to variable T-Flag cleared	_FilePutRange_Bytes Input: r24: File number r20: Count of bytes X: Pointer to variable r16-19 (A): New position (1-based) T-Flag Set
Array (> 255 Bytes) with fixed length	
_FilePutRange Input: r24: File number r20/21: Count of Bytes X: Pointer to variable T-Flag cleared	_FilePutRange Input: r24: File number r20/21: Count of bytes X: Pointer to variable r16-19 (A): New position (1-based) T-Flag Set

Output from all kind of usage:
r25: Error Code
C-Flag on Error

Example

```
'for the binary file demo we need some variables of different types
Dim B AsByte, W AsWord, L AsLong, Sn AsSingle, Ltemp AsLong
Dim Stxt AsString* 10
B = 1 : W = 50000 : L = 12345678 : Sn = 123.45 : Stxt ="test"

'open the file in BINARY mode
Open"test.biN"ForBinaryAs#2
Put#2 , B ' write a byte
Put#2 , W ' write a word
Put#2 , L ' write a long
Ltemp =Loc(#2)+ 1 ' get the position of the next byte
Print Ltemp ;" LOC"' store the location of the file pointer
Print Seek(#2);" = LOC+1"

PrintLof(#2);" length of file"
PrintFileattr(#2);" file mode"' should be 32 for binary
Put#2 , Sn ' write a single
Put#2 , Stxt ' write a string

Flush#2 ' flush to disk
Close#2

'now open the file again and write only the single
Open"test.bin"ForBinaryAs#2
L = 1 'specify the file position
B =Seek(#2 , L)' reset is the same as using SEEK #2,L
```

```
Get#2 , B ' get the byte
Get#2 , W ' get the word
Get#2 , L ' get the long
Get#2 , Sn ' get the single
Get#2 , Stxt ' get the string
Close#2
```

RAD2DEG

Action
Converts a value in radians to degrees.

Syntax
var = **RAD2DEG**(Source)

Remarks

Var	A numeric variable that is assigned with the angle of variable source.
Source	The single or double variable to get the angle of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
DEG2RAD

Example
```
'-----------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates DEG2RAD function

'-----------------------------------------------------------------------
-
Dim S As Single
S = 90

S = Deg2Rad(s)
Print S
S = Rad2deg(s)
Print S
End
```

RC5SEND

Action
Sends RC5 remote code.

Syntax
RC5SEND togglebit, address, command

Uses
TIMER1

Remarks

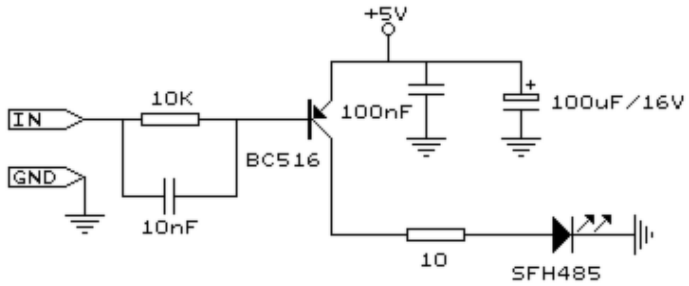
Togglebit	Make the toggle bit 0 or 32 to set the toggle bit
Address	The RC5 address
Command	The RC5 command.

The resistor must be connected to the OC1A pin. In the example a 2313 micro was used. This micro has pin portB.3 connected to OC1A.
Look in a datasheet for the proper pin when used with a different chip.

Most audio and video systems are equipped with an infra-red remote control.
The RC5 code is a 14-bit word bi-phase coded signal.
The two first bits are start bits, always having the value 1.
The next bit is a control bit or toggle bit, which is inverted every time a button is pressed on the remote control transmitter.
Five system bits hold the system address so that only the right system responds to the code.

Usually, TV sets have the system address 0, VCRs the address 5 and so on. The command sequence is six bits long, allowing up to 64 different commands per address.

The bits are transmitted in bi-phase code (also known as Manchester code).
An IR booster circuit is shown below:



See also
CONFIG RC5 , GETRC5 , RC6SEND

Example
```
'------------------------------------------------------------------------------
----------
'name                    : sendrc5.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : code based on application note from Ger Langezaal
'micro                   : AT90S2313
```

```
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'   +5V <---[A Led K]---[220 Ohm]---> Pb.3 for 2313.
' RC5SEND is using TIMER1, no interrupts are used
' The resistor must be connected to the OC1(A) pin , in this case PB.3

Dim Togbit As Byte , Command As Byte , Address As Byte

Command = 12                                                ' power on off
Togbit = 0                                                  ' make it 0 or 32
to set the toggle bit
Address = 0
Do
   Waitms 500
   Rc5send Togbit , Address , Command
   'or use the extended RC5 send code. You can not use both
   'make sure that the MS bit is set to 1, so you need to send
   '&B10000000 this is the minimal requirement
   '&B11000000 this is the normal RC5 mode
   '&B10100000 here the toggle bit is set
   ' Rc5sendext &B11000000 , Address , Command
Loop
End
```

RC5SENDEXT

Action

Sends extended RC5 remote code.

Syntax

RC5SENDEXT togglebit, address, command

Uses

TIMER1

Remarks

Togglebit	Make the toggle bit 0 or 32 to set the toggle bit
Address	The RC5 address
Command	The RC5 command.

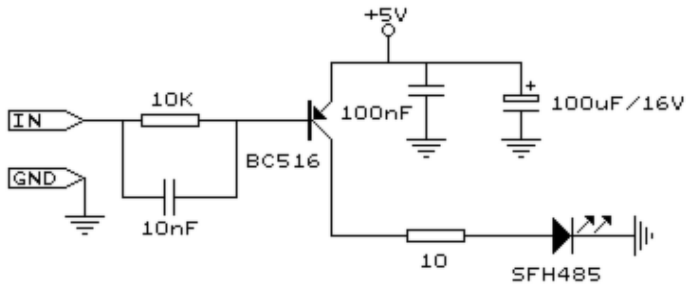
Normal RC5 code uses 2 leading bits with the value '1'. After that the toggle bit follows. With extended RC5, the second bit is used to select the bank. When you make it 1 (the default and normal RC5) the RC5 code is compatible. When you make it 0, you select bank 0 and thus use extended RC5 code.

The resistor must be connected to the OC1A pin. In the example a 2313 micro was used. This micro has pin portB.3 connected to OC1A.
Look in a datasheet for the proper pin when used with a different chip.

Most audio and video systems are equipped with an infra-red remote control.
The RC5 code is a 14-bit word bi-phase coded signal.
The two first bits are start bits, always having the value 1.
The next bit is a control bit or toggle bit, which is inverted every time a button is pressed on the remote control transmitter.
Five system bits hold the system address so that only the right system responds to the code.

Usually, TV sets have the system address 0, VCRs the address 5 and so on. The command sequence is six bits long, allowing up to 64 different commands per address.

The bits are transmitted in bi-phase code (also known as Manchester code).
An IR booster circuit is shown below:



See also

CONFIG RC5 , GETRC5 , RC6SEND

Example

```
'-----------------------------------------------------------------------
-----------
'name                    : sendrc5.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : code based on application note from Ger Langezaal
'micro                   : AT90S2313
'suited for demo         : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
```

```
$framesize = 40                                             ' default use 40
for the frame space

'   +5V <---[A Led K]---[220 Ohm]---> Pb.3 for 2313.
' RC5SEND is using TIMER1, no interrupts are used
' The resistor must be connected to the OC1(A) pin , in this case PB.3

Dim Togbit As Byte , Command As Byte , Address As Byte

Command = 12                                                ' power on off
Togbit = 0                                                  ' make it 0 or 32
to set the toggle bit
Address = 0
Do
   Waitms 500
    ' Rc5send Togbit , Address , Command
   'or use the extended RC5 send code. You can not use both
   'make sure that the MS bit is set to 1, so you need to send
   '&B10000000 this is the minimal requirement
   '&B11000000 this is the normal RC5 mode
   '&B10100000 here the toggle bit is set
   Rc5sendExt &B11000000 , Address , Command
Loop
End
```

RC6SEND

Action
Sends RC6 remote code.

Syntax
RC6SEND togglebit, address, command

Uses
TIMER1

Remarks

Togglebit	Make the toggle bit 0 or 1 to set the toggle bit
Address	The RC6 address
Command	The RC6 command.

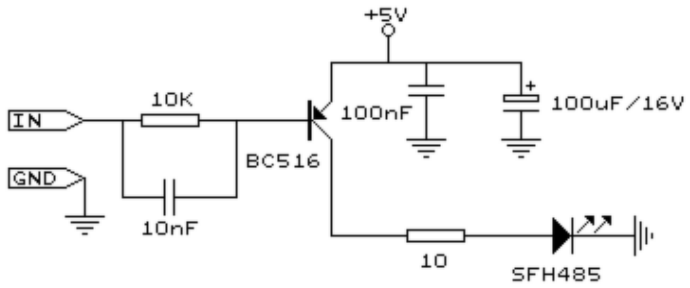
The resistor must be connected to the OC1A pin. In the example a 2313 micro was used. This micro has pin portB.3 connected to OC1A.
Look in a datasheet for the proper pin when used with a different chip.

Most audio and video systems are equipped with an infrared remote control.
The RC6 code is a 16-bit word bi-phase coded signal.
The header is 20 bits long including the toggle bits.
Eight system bits hold the system address so that only the right system responds to the code.

Usually, TV sets have the system address 0, VCRs the address 5 and so on. The command sequence is eight bits long, allowing up to 256 different commands per address.

The bits are transmitted in bi-phase code (also known as Manchester code).

An IR booster circuit is shown below:



Device	Address
TV	0
VCR	5
SAT	8
DVD	4

This is not a complete list.

Command	Value	Command	Value
Key 0	0	Balance right	26
Key 1	1	Balance left	27
Key 2-9	2-9	Channel search+	30
Previous program	10	Channel search -	31
Standby	12	Next	32
Mute/demute	13	Previous	33
Personal preference	14	External 1	56
Display	15	External 2	57
Volume up	16	TXT submode	60
Volume down	17	Standby	61
Brightness up	18	Menu on	84
Brightness down	19	Menu off	85
Saturation up	20	Help	129
Saturation down	21	Zoom -	246
Bass up	22	Zoom +	247
Bass down	23		
Treble up	24		
Treble down	25		

This list is by far not complete.
Since there is little info about RC6 on the net available, use code at your own risk!

See also

CONFIG RC5 , GETRC5 , RC5SEND

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : sendrc6.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : code based on application note from Ger Langezaal
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'   +5V <---[A Led K]---[220 Ohm]---> Pb.3 for 2313.
' RC6SEND is using TIMER1, no interrupts are used
' The resistor must be connected to the OC1(A) pin , in this case PB.3

Dim Togbit As Byte , Command As Byte , Address As Byte

'this controls the TV but you could use rc6send to make your DVD region free as
well :-)
'Just search the net for the codes you need to send. Do not ask me for info
please.
Command = 32                                                ' channel next
Togbit = 0                                                  ' make it 0 or 32
to set the toggle bit
Address = 0
Do
   Waitms 500
   Rc6send Togbit , Address , Command
Loop
End
```

READ

Action

Reads those values and assigns them to variables.

Syntax

READ var

Remarks

Var	Variable that is assigned data value.

It is best to place the DATA lines at the end of your program.

It is important that the variable is of the same type as the stored data.

See also
DATA , RESTORE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : readdata.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : READ,RESTORE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Integer , B1 As Byte , Count As Byte
Dim S As String * 15
Dim L As Long
Restore Dta1                                               'point to stored
data
For Count = 1 To 3                                         'for number of data
items
   Read B1 : Print Count ; "  " ; B1
Next

Restore Dta2                                               'point to stored
data
For Count = 1 To 2                                         'for number of data
items
   Read A : Print Count ; "  " ; A
Next

Restore Dta3
Read S : Print S
Read S : Print S


Restore Dta4
Read L : Print L                                           'long type


'demonstration of readlabel
Dim W As Iram Word At 8 Overlay                            ' location is used
by restore pointer
```

```
'note that W does not use any RAM it is an overlayed pointer to the data
pointer
W = Loadlabel(dta1)                                          ' loadlabel expects
the labelname
Read B1
Print B1


End


Dta1:
Data &B10 , &HFF , 10
Dta2:
Data 1000% , -1%

Dta3:
Data "Hello" , "World"
'Note that integer values (>255 or <0) must end with the %-sign
'also note that the data type must match the variable type that is
'used for the READ statement

Dta4:
Data 123456789&
'Note that LONG values must end with the &-sign
'Also note that the data type must match the variable type that is used
'for the READ statement
```

READEEPROM

Action

Reads the content from the DATA EEPROM and stores it into a variable.

Syntax

READEEPROM var , address

Remarks

Var	The name of the variable that must be stored
Address	The address in the EEPROM where the data must be read from.

This statement is provided for backwards compatibility with BASCOM-8051.
You can also use the ERAM variable instead of READEEPROM :

Dim V as Eram Byte 'store in EEPROM
Dim B As Byte 'normal variable
B = 10
V = B 'store variable in EEPROM
B = V 'read from EEPROM

When you use the assignment version, the data types must be equal!
According to a data sheet from ATMEL, the first location in the EEPROM with address 0, can be overwritten during a reset so don't use it.

You may also use ERAM variables as indexes. Like :
Dim ar(10) as Eram Byte

When you omit the address label in consecutive reads, you must use a new READEEPROM statement. It will not work in a loop:

```
Readeeprom B , Label1
Print B

Do
  Readeeprom B
  Print B Loop
Until B = 5
```

This will not work since there is no pointer maintained. The way it will work :

```
ReadEEprom B , Label1 ' specify label
ReadEEPROM B ' read next address in EEPROM
ReadEEPROM B ' read next address in EEPROM
```

See also

WRITEEEPROM , $EEPROM

ASM

NONE

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : eeprom2.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to use labels with READEEPROM
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'first dimension a variable
Dim B As Byte
Dim Yes As String * 1

'Usage for readeeprom and writeeprom :
'readeeprom var, address

'A new option is to use a label for the address of the data
'Since this data is in an external file and not in the code the eeprom data
'should be specified first. This in contrast with the normal DATA lines which
must
'be placed at the end of your program!!
```

```
'first tell the compiler that we are using EEPROM to store the DATA
$eeprom

'the generated EEP file is a binary file.
'Use $EEPROMHEX to create an Intel Hex file usable with AVR Studio.
'$eepromhex

'specify a label
Label1:
Data 1 , 2 , 3 , 4 , 5
Label2:
Data 10 , 20 , 30 , 40 , 50

'Switch back to normal data lines in case they are used
$data

'All the code above does not generate real object code
'It only creates a file with the EEP extension

'Use the new label option
Readeeprom B , Label1
Print B                                                         'prints 1
'Succesive reads will read the next value
'But the first time the label must be specified so the start is known
Readeeprom B
Print B                                                         'prints 2

Readeeprom B , Label2
Print B                                                         'prints 10
Readeeprom B
Print B                                                         'prints 20

'And it works for writing too :
'but since the programming can interfere we add a stop here
Input "Ready?" , Yes
B = 100
Writeeeprom B , Label1
B = 101
Writeeeprom B

'read it back
Readeeprom B , Label1
Print B                                                         'prints 1
'Succesive reads will read the next value
'But the first time the label must be specified so the start is known
Readeeprom B
Print B                                                         'prints 2


End
```

READMAGCARD

Action

Read data from a magnetic card.

Syntax

READMAGCARD var , count , 5|7

Remarks

Var	A byte array the receives the data.
Count	A byte variable that returns the number of bytes read.
5|7	A numeric constant that specifies if 5 or 7 bit coding is used.

There can be 3 tracks on a magnetic card.
Track 1 stores the data in 7 bit including the parity bit. This is handy to store alpha numeric data.
On track 2 and 3 the data is stored with 5 bit coding.

The ReadMagCard routine works with ISO7811-2 5 and 7 bit decoding.

The returned numbers for 5 bit coding are:

Returned number	ISO characterT
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	hardware control
11	start byte
12	hardware control
13	separator
14	hardware control
15	stop byte

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : magcard.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : show you how to read data from a magnetic card
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
```

```
$framesize = 40                                                 ' default use 40
for the frame space

'[reserve some space]
Dim Ar(100) As Byte , B As Byte , A As Byte

'the magnetic card reader has 5 wires
'red       - connect to +5V
'black     - connect to GND
'yellow    - Card inserted signal CS
'green     - clock
'blue      - data

'You can find out for your reader which wires you have to use by connecting +5V
'And moving the card through the reader. CS gets low, the clock gives a clock
pulse of equal pulses
'and the data varies
'I have little knowledge about these cards and please dont contact me about
magnectic readers
'It is important however that you pull the card from the right direction as I
was doing it wrong for
'some time :-)
'On the DT006 remove all the jumpers that are connected to the LEDs

'[We use ALIAS to specify the pins and PIN register]
_mport Alias Pinb                                               'all pins are
connected to PINB
_mdata Alias 0                                                  'data line (blue)
PORTB.0
_mcs Alias 1                                                    'CS line (yellow)
PORTB.1
_mclock Alias 2                                                 'clock line (green)
PORTB.2

Config Portb = Input                                            'we only need bit
0,1 and 2 for input
Portb = 255                                                     'make them high

Do
  Print "Insert magnetic card"                                  'print a message
  Readmagcard Ar(1) , B , 5                                     'read the data
  Print B ; " bytes received"
  For A = 1 To B
    Print Ar(a);                                                'print the bytes
  Next
  Print
Loop

'By sepcifying 7 instead of 5 you can read 7 bit data
```

REM

Action

Instruct the compiler that comment will follow.

Syntax

REM or '

Remarks
You can and should comment your program for clarity and your later sanity.
You can use REM or ' followed by your comment.
All statements after REM or ' are treated as comments so you cannot use statements on the same line after a REM statement.

Block comments can be used too:

'(start block comment
print "This will not be compiled
') end block comment

Example
```
Rem TEST.BAS version 1.00

Print A ' " this is comment : PRINT " Hello "

           ^ - - - This Will Not Be Executed!
```

RESET

Action
Reset a bit to zero.

Syntax
RESET bit
RESET var.x

Remarks

bit	Can be a SFR such as PORTB.x, or any bit variable where x=0-7.
var	Can be a byte, integer word or long variable.
x	Constant of variable to reset.(0-7) for bytes and (0-15) for Integer/Word. For longs(0-31)

You can also use the constants from the definition file to set or reset a bit.
RESET PORTB.PB7 'will reset bin 7 of portB. This because PB7 is a constant in the def file.

See also
SET , TOGGLE

Example
```
'-----------------------------------------------------------------------------
--
'name                          : boolean.bas
'copyright                     : (c) 1995-2005, MCS Electronics
```

```
'purpose                    : demo: AND, OR, XOR, NOT, BIT and MOD
'suited for demo            : yes
'commercial addon needed    : no
'use in simulator           : possible
'-------------------------------------------------------------------------------
--
$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


Dim A As Byte , B1 As Byte , C As Byte
Dim Aa As Bit , I As Integer

A = 5 : B1 = 3                                              ' assign values
C = A And B1                                                ' and a with b
Print "a AND c = " ; C                                      ' print result

C = A Or B1                                                 'also for or
Print "a OR b1 = " ; C

C = A Xor B1                                                ' and for xor
Print "a XOR b1 = " ; C

A = 1
C = Not A                                                   'not
Print "c = NOT a " ; C
C = C Mod 10
Print "c MOD 10 = " ; C


If Portb.1 = 1 Then
   Print "Bit set"
Else
   Print "Bit not set"
End If

Aa = 1                                                      'use this or ..
Set Aa                                                      'use the set
statement
If Aa = 1 Then
   Print "Bit set (aa=1)"
Else
   Print "Bit not set(aa=0)"
End If

Aa = 0                                                      'now try 0
Reset Aa                                                    'or use reset
If Aa = 1 Then
   Print "Bit set (aa=1)"
Else
   Print "Bit not set(aa=0)"
End If


B1 = 255                                                    'assign variable
Reset B1.0                                                  'reset bit 0 of a
byte variable
```

```
Print B1                                                    'print it

Set B1.0                                                    'set it
Print B1                                                    'print it

End
```

RESTORE

Action
Allows READ to reread values in specified DATA statements by setting data pointer to beginning of data statement.

Syntax
RESTORE label

Remarks

label	The label of a DATA statement.

See also
DATA , READ , LOOKUP

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : readdata.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : READ,RESTORE
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim A As Integer , B1 As Byte , Count As Byte
Dim S As String * 15
Dim L As Long
Restore Dta1                                                'point to stored
data
For Count = 1 To 3                                          'for number of data
items
   Read B1 : Print Count ; "  " ; B1
Next
```

```
Restore Dta2                                                    'point to stored
data
For Count = 1 To 2                                              'for number of data
items
   Read A : Print Count ; "  " ; A
Next

Restore Dta3
Read S : Print S
Read S : Print S


Restore Dta4
Read L : Print L                                                'long type


'demonstration of readlabel
Dim W As Iram Word At 8 Overlay                                 ' location is used
by restore pointer
'note that W does not use any RAM it is an overlayed pointer to the data
pointer
W = Loadlabel(dta1)                                             ' loadlabel expects
the labelname
Read B1
Print B1


End


Dta1:
Data &B10 , &HFF , 10
Dta2:
Data 1000% , -1%

Dta3:
Data "Hello" , "World"
'Note that integer values (>255 or <0) must end with the %-sign
'also note that the data type must match the variable type that is
'used for the READ statement

Dta4:
Data 123456789&
'Note that LONG values must end with the &-sign
'Also note that the data type must match the variable type that is used
'for the READ statement
```

RETURN

Action
Return from a subroutine.

Syntax
RETURN

Remarks
Subroutines must be ended with a related RETURN statement.
Interrupt subroutines must also be terminated with the Return statement.

See also
GOSUB

Example
```
'-----------------------------------------------------------------------
-----------
'name                      : gosub.bas
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : demo: GOTO, GOSUB and RETURN
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Goto Continue
Print "This code will not be executed"

Continue:                                                  'end a label with a
colon
Print "We will start execution here"
Gosub Routine
Print "Back from Routine"
End


Routine:                                                   'start a subroutine
  Print "This will be executed"
Return                                                     'return from
subroutine
```

RIGHT

Action
Return a specified number of rightmost characters in a string.

Syntax
var = **RIGHT**(var1 ,n)

Remarks

var	The string that is assigned.

Var1	The source string.
st	The number of bytes to copy from the right of the string.

See also
LEFT , MID

Example
```
Dim S As String * 15 , Z As String * 15
S ="ABCDEFG"
Z = Left(s , 5)
Print Z                                                    'ABCDE
Z = Right(s , 3) : Print Z
Z = Mid(s , 2 , 3) : Print Z
End
```

RND

Action
Returns a random number.

Syntax
var = **RND**(limit)

Remarks
Limit	Word that limits the returned random number.
Var	The variable that is assigned with the random number.

The RND() function returns an Integer/Word and needs an internal storage of 2 bytes. (___RSEED). Each new call to Rnd() will give a new positive random number.

Notice that it is a software based generated number. And each time you will restart your program the same sequence will be created.

You can use a different SEED value by dimensioning and assigning ___RSEED yourself:
Dim ___rseed as word : ___rseed = 10234
Dim I as word : I = rnd(10)

When your application uses a timer you can assign ___RSEED with the timer value. This will give a better random number.

See also
NONE

Example
```
'-----------------------------------------------------------------------
```

```
-----------
'name                          : rnd.bas
'copyright                     : (c) 1995-2005, MCS Electronics
'purpose                       : demo : RND() function
'micro                         : Mega48
'suited for demo               : yes
'commercial addon needed       : no
'--------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim I As Word                                              ' dim variable
Do
  I = Rnd(40)                                              'get random number
(0-39)
  Print I                                                  'print the value
  Wait 1                                                   'wait 1 second
Loop                                                       'for ever
End
```

ROTATE

Action

Rotate all bits one place to the left or right.

Syntax

ROTATE var , LEFT/RIGHT[, shifts]

Remarks

Var	Byte, Integer/Word or Long variable.
Shifts	The number of shifts to perform.

The ROTATE statement rotates all the bits in the variable to the left or right. All bits are preserved so no bits will be shifted out of the variable.
This means that after rotating a byte variable with a value of 1, eight times the variable will be unchanged.
When you want to shift out the MS bit or LS bit, use the SHIFT statement.

See also

SHIFT , SHIFTIN , SHIFTOUT

Example

```
'--------------------------------------------------------------------------------
```

```
-----------
'name                     : rotate.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example for ROTATE and SHIFT statement
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'--------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'dimension some variables
Dim B As Byte , I As Integer , L As Long

'the shift statement shift all the bits in a variable one
'place to the left or right
'An optional paramater can be provided for the number of shifts.
'When shifting out then number 128 in a byte, the result will be 0
'because the MS bit is shifted out

B = 1
Shift B , Left
Print B
'B should be 2 now

B = 128
Shift B , Left
Print B
'B should be 0 now

'The ROTATE statement preserves all the bits
'so for a byte when set to 128, after a ROTATE, LEFT , the value will
'be 1

'Now lets make a nice walking light
'First we use PORTB as an output
Config Portb = Output
'Assign value to portb
Portb = 1
Do
   For I = 1 To 8
     Rotate Portb , Left
     'wait for 1 second
     Wait 1
   Next
   'and rotate the bit back to the right
   For I = 1 To 8
     Rotate Portb , Right
     Wait 1
   Next
Loop

End
```

ROUND

Action
Returns a value rounded to the nearest value.

Syntax
var = **ROUND**(x)

Remarks

Var	A single or double variable that is assigned with the ROUND of variable x.
X	The single or double to get the ROUND of.

Round(2.3) = 2 , Round(2.8) = 3
Round(-2.3) = -2 , Round(-2.8) = -3

See Also
INT , FIX , SGN

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : round_fix_int.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : ROUND,FIX
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim S As Single , Z As Single
For S = -10 To 10 Step 0.5
  Print S ; Spc(3) ; Round(s) ; Spc(3) ; Fix(s) ; Spc(3) ; Int(s)
Next
End
```

RTRIM

Action
Returns a copy of a string with trailing blanks removed

Syntax
var = **RTRIM**(org)

Remarks

var	String that is assigned with the result.
org	The string to remove the trailing spaces from

See also
TRIM , LTRIM

ASM
NONE

Example
```
Dim S As String * 6
S =" AB "
Print Ltrim(s)
Print Rtrim(s)
Print Trim(s)
End
```

SECELAPSED

Action
Returns the elapsed Seconds to a former assigned time-stamp.

Syntax
Target = **SECELAPSED**(TimeStamp)

Remarks

Target	A variable (LONG), that is assigned with the elapsed Seconds
TimeStamp	A variable (LONG), which holds a timestamp like the output of an earlier called SecOfDay()

The Function works with the SOFTCLOCK variables _sec, _min and _hour and considers a jump over midnight and gives a correct result within 24 hour between two events.

The Return-Value is in the range of 0 to 86399.

See also
Date and Time Routines , SecOfDay , SysSecElapsed

Partial Example

```
Lsecofday = Secofday()
_hour = _hour + 1
Lvar1 = Secelapsed(lsecofday)
Print Lvar1
```

SECOFDAY

Action

Returns the Seconds of a Day.

Syntax

Target = **SECOFDAY**()
Target = **SECOFDAY**(bSecMinHour)
Target = **SECOFDAY**(strTime)
Target = **SECOFDAY**(lSysSec)

Remarks

Target	A variable (LONG), that is assigned with the Seconds of the Day
bSecMinHour	A Byte, which holds the Second-value followed by Minute(Byte) and Hour(Byte)
strTime	A String, which holds the time in the format „hh:mm:ss"
LSysSec	A Variable (Long) which holds the System Second

The Function can be used with 4 different kind of inputs:

1. Without any parameter. The internal Time of SOFTCLOCK (_sec, _min, _hour) is used.
2. With a user defined time array. It must be arranged in same way (Second, Minute, Hour) as the internal SOFTCLOCK time. The first Byte (Second) is the input by this kind of usage. So the Second of Day can be calculated of every time.
3. With a time-String. The time-string must be in the Format „hh:mm:ss".
4. With a System Second Number (LONG)

The Return-Value is in the range of 0 to 86399 from 00:00:00 to 23:59:59.
No validity-check of input is made.

See also

Date and Time Routines , SysSec

Partial Example

```
' ================= Second of Day ============================================
' Example 1 with internal RTC-Clock
_sec = 12 : _min = 30 : _hour = 18                          ' Load RTC-Clock
```

```
for example - testing

Lsecofday = Secofday()
Print "Second of Day of " ; Time$ ; " is " ; Lsecofday


' Example 2 with defined Clock - Bytes (Second / Minute / Hour)
Bsec = 20 : Bmin = 1 : Bhour = 7
Lsecofday = Secofday(bsec)
Print "Second of Day of Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; " ("
 ; Time(bsec) ; ") is " ; Lsecofday


' Example 3 with System Second
Lsyssec = 1234456789
Lsecofday = Secofday(lsyssec)
Print "Second of Day of System Second " ; Lsyssec ; "(" ; Time(lsyssec) ; ") is
" ; Lsecofday


' Example 4 with Time - String
Strtime = "04:58:37"
Lsecofday = Secofday(strtime)
Print "Second of Day of " ; Strtime ; " is " ; Lsecofday
```

SEEK

Action

Function: Returns the position of the next Byte to be read or written
Statement: Sets the position of the next Byte to be read or written

Syntax

Function: NextReadWrite = **SEEK** (#bFileNumber)
Statement: **SEEk** #bFileNumber, NewPos

Remarks

bFileNumber	(Byte) Filenumber, which identifies an opened file
NextReadWrite	A Long Variable, which is assigned with the Position of the next Byte to be read or written (1-based)
NewPos	A Long variable that holds the new position the file pointer must be set too.

This function returns the position of the next Byte to be read or written. If an error occurs, 0 is returned. Check DOS-Error in variable gbDOSError.

The statement also returns an error in the gbDOSerror variable in the event that an error occurs.
You can for example not set the file position behinds the file size.

In VB the file is filled with 0 bytes when you set the file pointer behind the size of the file. For embedded systems this does not seem a good idea.

Seek and Loc seems to do the same function, but take care : the seek function will return the position of the next read/write, while the Loc function returns the position of the last

read/write. You may say that Seek = Loc+1.

In QB/VB you can use seek to make the file bigger. When a file is 100 bytes long, setting the file pointer to 200 will increase the file with 0 bytes. By design this is not the case in AVR-DOS.

See also

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , FILELEN , WRITE , INPUT

ASM

Function Calls	_FileSeek	
Input	r24: filenumber	X: Pointer to Long-variable, which gets the result
Output	r25: Errorcode	C-Flag: Set on Error

Statement Calls	_FileSeekSet	
Input	r24: filenumber	X: Pointer to Long-variable with the position
Output	r25: Errorcode	C-Flag: Set on Error

Partial Example

```
Open "test.biN"for Binary As #2
Put#2 , B                                                    ' write a byte
Put#2 , W                                                    ' write a word
Put#2 , L                                                    ' write a long
Ltemp = Loc(#2) + 1                                          ' get the position
of the next byte
Print Ltemp ; " LOC"                                         ' store the
location of the file pointer
Print Seek(#2) ; " = LOC+1"
Close #2


'now open the file again and write only the single
Open "test.bin" For Binary As #2
Seek#2 , Ltemp                                               ' set the
filepointer
Sn = 1.23                                                    ' change the single
value so we can check it better
Put #2 , Sn = 1                                              'specify the file
position
Close #2
```

SELECT-CASE-END SELECT

Action
Executes one of several statement blocks depending on the value of an expression.

Syntax
```
SELECT CASE var
  CASE test1 : statements
 [CASE test2 : statements ]
  CASE ELSE : statements
END SELECT
```

Remarks
Var	Variable to test the value of
Test1	Value to test for.
Test2	Value to test for.

You can test for conditions to like:

CASE IS > 2 :

Another option is to test for a range :

CASE 2 TO 5 :

See also
IF THEN

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : case.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates SELECT CASE statement
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim I As Byte                                              'dim variable
Dim S As String * 5 , Z As String * 5
```

```
Do

  Input "Enter value (0-255) " , I
  Select Case I
    Case 1 : Print "1"
    Case 2 : Print "2"
    Case 3 To 5 : Print "3-5"
    Case Is >= 10 : Print ">= 10"
    Case Else : Print "Not in Case statement"
  End Select
Loop
End

'note that a Boolean expression like > 3 must be preceded
'by the IS keyword
```

SET

Action
Set a bit to the value one.

Syntax
SET bit
SET var.x

Remarks

Bit	Bitvariable.
Var	A byte, integer, word or long variable.
X	Bit of variable (0-7) to set. (0-15 for Integer/Word) and (0-31) for Long

See also
RESET , TOGGLE

Example
```
'-----------------------------------------------------------------------------
--
'name                     : boolean.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: AND, OR, XOR, NOT, BIT and MOD
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
'-----------------------------------------------------------------------------
--
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
```

```
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim A As Byte , B1 As Byte , C As Byte
Dim Aa As Bit , I As Integer

A = 5 : B1 = 3                                             ' assign values
C = A And B1                                               ' and a with b
Print "a AND c = " ; C                                     ' print result

C = A Or B1                                                'also for or
Print "a OR b1 = " ; C

C = A Xor B1                                               ' and for xor
Print "a XOR b1 = " ; C

A = 1
C = Not A                                                  'not
Print "c = NOT a " ; C
C = C Mod 10
Print "c MOD 10 = " ; C


If Portb.1 = 1 Then
   Print "Bit set"
Else
   Print "Bit not set"
End If

Aa = 1                                                     'use this or ..
Set Aa                                                     'use the set
statement
If Aa = 1 Then
   Print "Bit set (aa=1)"
Else
   Print "Bit not set(aa=0)"
End If

Aa = 0                                                     'now try 0
Reset Aa                                                   'or use reset
If Aa = 1 Then
   Print "Bit set (aa=1)"
Else
   Print "Bit not set(aa=0)"
End If


B1 = 255                                                   'assign variable
Reset B1.0                                                 'reset bit 0 of a
byte variable
Print B1                                                   'print it

Set B1.0                                                   'set it
Print B1                                                   'print it

End
```

SETFONT

Action
Sets the font used for LCDAT on SED based Graphical LCD displays.

Syntax
SETFONT font

Remarks

font	The name of the font that need to be used with LCDAT statements.

Since SED-based displays do not have their own font generator, you need to define your own fonts. You can create and modify your own fonts with the FontEditor Plugin.

SETFONT will set an internal used data pointer to the location in memory where you font is stored. The name you specify is the same name you use to define the font.

You need to include the used fonts with the $include directive:

$INCLUDE "font8x8.font"

The order is not important.

You need to include the glibSED library with :
$LIB "glibsed.lbx"

See also
CONFIG GRAPHLCD , LCDAT, GLCDCMD, GLCDDATA

Example
```
'-----------------------------------------------------------------------------
'name                     : sed1520.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates the SED1520 based graphical display
support
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 7372800                                          ' used crystal
frequency
$baud = 115200                                              ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'I used a Staver to test

'some routines to control the display are in the glcdSED.lib file
```

```
'IMPORTANT : since the SED1520 uses 2 chips, the columns are split into 2 of
60.
'This means that data after column 60 will not print correct. You need to
locate the data on the second halve
'For example when you want to display a line of text that is more then 8 chars
long, (8x8=64) , byte 8 will not draw correctly
'Frankly i find the KS0108 displays a much better choice.

$lib "glcdSED1520.lbx"

'First we define that we use a graphic LCD

Config Graphlcd = 120 * 64sed , Dataport = Porta , Controlport = Portd , Ce =
5 , Ce2 = 7 , Cd = 3 , Rd = 4


'The dataport is the portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE =CS  Chip Enable/ Chip select
'CE2= Chip select / chip enable of chip 2
'CD=A0   Data direction
'RD=Read

'Dim variables (y not used)
Dim X As Byte , Y As Byte


'clear the screen
Cls
Wait 2
'specify the font we want to use
Setfont Font8x8

'You can use locate but the columns have a range from 1-132

'When you want to show somthing on the LCD, use the LDAT command
'LCDAT Y , COL, value
Lcdat 1 , 1 , "1231231"
Lcdat 3 , 80 , "11"
'lcdat accepts an additional param for inversing the text
'lcdat 1,1,"123" , 1   ' will inverse the text

Wait 2
Line(0 , 0) -(30 , 30) , 1
Wait 2

Showpic 0 , 0 , Plaatje                                    'show a comnpressed
picture
End                                                        'end program


'we need to include the font files
$include "font8x8.font"
'$include "font16x16.font"


Plaatje:
'include the picture data
$bgf "smile.bgf"
```

SETTCP

Action

(Re) Configures the TCP/IP W3100A chip.

Syntax

SETTCP MAC , IP , SUBMASK , GATEWAY

Remarks

MAC	The MAC address you want to assign to the W3100A. The MAC address is a unique number that identifies your chip. You must use a different address for every W3100A chip in your network. Example : 123.00.12.34.56.78 You need to specify 6 bytes that must be separated by dots. The bytes must be specified in decimal notation.
IP	The IP address you want to assign to the W3100A. The IP address must be unique for every W3100A in your network. When you have a LAN, 192.168.0.10 can be used. 192.168.0.x is used for LAN's since the address is not an assigned internet address.
SUBMASK	The submask you want to assign to the W3100A. The submask is in most cases 255.255.255.0
GATEWAY	This is the gateway address of the W3100A. The gateway address you can determine with the IPCONFIG command at the command prompt : C:\>ipconfig Windows 2000 IP Configuration Ethernet adapter Local Area Connection 2: Connection-specific DNS Suffix . : IP Address. . . . . : 192.168.0.3 Subnet Mask . . . . . : 255.255.255.0 Default Gateway . . . . . : 192.168.0.1 **Use 192.168.0.1 in this case.**

The CONFIG TCPIP statement may be used only once.

When you want to set the TCP/IP settings dynamicly for instance when the settings are stored in EEPROM, you can not use constants. For this purpose, SETTCP must be used.

SETTCP can take a variable or a constant for each parameter.

When you set the TCP/IP settings dynamicly, you do not need to set them with CONFIG TCPIP. In the CONFIG TCPIP you can use the NOINIT parameter so that the MAC and IP are not initialized which saves code.

See also

GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN , CONFIG TCPIP

Example
See the DHCP.BAS example from the BASCOM Sample dir.

SETTCPREGS

Action
Writes to a W3100A register

Syntax
SETTCPREGS address, var , bytes

Remarks

address	The address of the register W3100A register. This must be the value of the MSB. For example in location &H92 and &H93, the timeout is stored. You need to specify &H93 then.
var	The variable to write.
bytes	The number of bytes to write.

Most W3100A options are implemented with BASCOM statements or functions. When there is a need to write to the W3100A register you can use the SETTCPREGS commands. It can write multiple bytes. It is important that you specify the highest address. This because the registers must be written starting with the higest address.

See also
GETTCPREGS

ASM
NONE

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : regs.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : test custom regs reading writing
'micro                    : Mega88
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------
$regfile = "m88def.dat"                                    ' specify the used
micro

$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 80                                              ' default use 32
for the hardware stack
$swstack = 128                                             ' default use 10
for the SW stack
```

```
$framesize = 80                                             ' default use 40
for the frame space


Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW


'we do the usual
Print "Init TCP"                                            ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55
, Twi = &H80 , Clock = 400000
Print "Init done"


'set the IP address to 192.168.0.135
Settcp 12.128.12.24.56.78 , 192.168.0.135 , 255.255.255.0 , 192.168.0.88


Dim L As Long
```

```
'now read the IP address direct from the registers
L = Gettcpregs(&H91 , 4)
Print Ip2str(l)

Dim B4 As Byte At L Overlay                                    ' this byte is the
same as the LSB of L

'now make the IP address 192.168.0.136 by writing to the LSB
B4 = 136
Settcpregs &H91 , L , 4                                        'write


'and check if it worked
L = Gettcpregs(&H91 , 4)
Print Ip2str(l)
'while the address has the right value now the chip needs a reset in order to
use the new settings
L = &B10000001                                                 ' set sysinit and
swrest bits
Settcpregs &H00 , L , 1                                        ' write 1 register

'and with PING you can check again that now it works
End
```

SENDSCAN

Action
Sends scan codes to the PC.

Syntax
SENDSCAN label

Remarks

Label	The name of the label that contains the scan codes.

The SENDSCAN statement can send multiple scan codes to the PC.
The label is used to specify the start of the scan codes. The first byte specifies the number of bytes that follow.

The following table lists all mouse scan codes.

Emulated Action	Data sent to host
Move up one	08,00,01
Move down one	28,00,FF
Move right one	08,01,00
Move left one	18,FF,00
Press left button	09,00,00
Release left button	08,00,00
Press middle button	0C,00,00
Release middle button	08,00,00
Press right button	0A,00,00

Release right button	08,00,00

To emulate a left mouse click, the data line would look like this:

```
DATA 6 , &H09, &H00, &H00, &H08 , &H00, &H00
      ^ send 6 bytes
           ^ left click
                          ^ release
```

See also

PS2MOUSEXY , CONFIG PS2EMU

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : ps2_emul.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PS2 Mouse emulator
'micro                    : 90S2313
'suited for demo          : NO, commercial addon needed
'commercial addon needed  : yes
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

$lib "mcsbyteint.lbx"                                       ' use optional lib
since we use only bytes

'configure PS2 pins
Config Ps2emu = Int1 , Data = Pind.3 , Clock = Pinb.0
'                 ^------------------------ used interrupt
'                                ^----------- pin connected to DATA
'                                         ^-- pin connected to clock
'Note that the DATA must be connected to the used interrupt pin


Waitms 500                                                  ' optional delay

Enable Interrupts                                           ' you need to turn
on interrupts yourself since an INT is used

Print "Press u,d,l,r,b, or t"
Dim Key As Byte
Do
    Key = Waitkey()                                         ' get key from
terminal
    Select Case Key
      Case "u" : Ps2mousexy 0 , 10 , 0                      ' up
      Case "d" : Ps2mousexy 0 , -10 , 0                     ' down
```

```
      Case "l" : Ps2mousexy -10 , 0 , 0                    ' left
      Case "r" : Ps2mousexy 10 , 0 , 0                     ' right
      Case "b" : Ps2mousexy 0 , 0 , 1                      ' left button
pressed
                 Ps2mousexy 0 , 0 , 0                      ' left button
released
      Case "t" : Sendscan Mouseup                          ' send a scan code
      Case Else
    End Select
Loop


Mouseup:
Data 3 , &H08 , &H00 , &H01                                ' mouse up by 1
unit
```

SENDSCANKBD

Action
Sends keyboard scan codes to the PC.

Syntax
SENDSCANKBD label | var

Remarks

Label	The name of the label that contains the scan codes.
var	The byte variable that will be sent to the PC.

The SENDSCANKBD statement can send multiple scan codes to the PC.
The label is used to specify the start of the scan codes. The first byte specifies the number of bytes that follow.

You can also send the content of a variable. This way you can send dynamic information.
You need to make sure you send the make and break codes.

The following tables lists all scan codes.

AT KEYBOARD SCANCODES

Table reprinted with permission of Adam Chapweske

http://panda.cs.ndsu.nodak.edu/~achapwes

KEY	MAKE	BREAK		KEY	MAKE	BREAK		KEY	MAKE	BREAK
A	1C	F0,1C		9	46	F0,46		[	54	FO,54
B	32	F0,32		`	0E	F0,0E		INSERT	E0,70	E0,F0,70
C	21	F0,21		-	4E	F0,4E		HOME	E0,6C	E0,F0,6C
D	23	F0,23		=	55	FO,55		PG UP	E0,7D	E0,F0,7D
E	24	F0,24		\	5D	F0,5D		DELETE	E0,71	E0,F0,71
F	2B	F0,2B		BKSP	66	F0,66		END	E0,69	E0,F0,69
G	34	F0,34		SPACE	29	F0,29		PG DN	E0,7A	E0,F0,7A
H	33	F0,33		TAB	0D	F0,0D		U ARROW	E0,75	E0,F0,75

I	43	F0,43		CAPS	58	F0,58		L ARROW	E0,6B	E0,F0,6B
J	3B	F0,3B		L SHFT	12	FO,12		D ARROW	E0,72	E0,F0,72
K	42	F0,42		L CTRL	14	FO,14		R ARROW	E0,74	E0,F0,74
L	4B	F0,4B		L GUI	E0,1F	E0,F0,1F		NUM	77	F0,77
M	3A	F0,3A		L ALT	11	F0,11		KP /	E0,4A	E0,F0,4A
N	31	F0,31		R SHFT	59	F0,59		KP *	7C	F0,7C
O	44	F0,44		R CTRL	E0,14	E0,F0,14		KP -	7B	F0,7B
P	4D	F0,4D		R GUI	E0,27	E0,F0,27		KP +	79	F0,79
Q	15	F0,15		R ALT	E0,11	E0,F0,11		KP EN	E0,5A	E0,F0,5A
R	2D	F0,2D		APPS	E0,2F	E0,F0,2F		KP .	71	F0,71
S	1B	F0,1B		ENTER	5A	F0,5A		KP 0	70	F0,70
T	2C	F0,2C		ESC	76	F0,76		KP 1	69	F0,69
U	3C	F0,3C		F1	05	F0,05		KP 2	72	F0,72
V	2A	F0,2A		F2	06	F0,06		KP 3	7A	F0,7A
W	1D	F0,1D		F3	04	F0,04		KP 4	6B	F0,6B
X	22	F0,22		F4	0C	F0,0C		KP 5	73	F0,73
Y	35	F0,35		F5	03	F0,03		KP 6	74	F0,74
Z	1A	F0,1A		F6	0B	F0,0B		KP 7	6C	F0,6C
0	45	F0,45		F7	83	F0,83		KP 8	75	F0,75
1	16	F0,16		F8	0A	F0,0A		KP 9	7D	F0,7D
2	1E	F0,1E		F9	01	F0,01		]	5B	F0,5B
3	26	F0,26		F10	09	F0,09		;	4C	F0,4C
4	25	F0,25		F11	78	F0,78		'	52	F0,52
5	2E	F0,2E		F12	07	F0,07		,	41	F0,41
6	36	F0,36		PRNT SCRN	E0,12, E0,7C	E0,F0, 7C,E0, F0,12		.	49	F0,49
7	3D	F0,3D		SCROL L	7E	F0,7E		/	4A	F0,4A
8	3E	F0,3E		PAUSE	E1,14,77, E1,F0,14, F0,77	-NONE-				

ACPI Scan Codes

Key	Make Code	Break Code
Power	E0, 37	E0, F0, 37
Sleep	E0, 3F	E0, F0, 3F
Wake	E0, 5E	E0, F0, 5E

Windows Multimedia Scan Codes

Key	Make Code	Break Code
Next Track	E0, 4D	E0, F0, 4D
Previous Track	E0, 15	E0, F0, 15
Stop	E0, 3B	E0, F0, 3B
Play/Pause	E0, 34	E0, F0, 34
Mute	E0, 23	E0, F0, 23
Volume Up	E0, 32	E0, F0, 32
Volume Down	E0, 21	E0, F0, 21
Media Select	E0, 50	E0, F0, 50
E-Mail	E0, 48	E0, F0, 48
Calculator	E0, 2B	E0, F0, 2B
My Computer	E0, 40	E0, F0, 40
WWW Search	E0, 10	E0, F0, 10
WWW Home	E0, 3A	E0, F0, 3A
WWW Back	E0, 38	E0, F0, 38
WWW Forward	E0, 30	E0, F0, 30
WWW Stop	E0, 28	E0, F0, 28
WWW Refresh	E0, 20	E0, F0, 20
WWW Favorites	E0, 18	E0, F0, 18

To emulate volume up, the data line would look like this:

```
DATA 5 , &HE0, &H32, &HE0, &HF0 , &H32
       ^ send 5 bytes
             ^ volume up
```

See also

CONFIG ATEMU

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : ps2_kbdemul.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : PS2 AT Keyboard emulator
'micro                    : 90S2313
'suited for demo          : no, ADD ON NEEDED
'commercial addon needed  : yes
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
```

```
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

$lib "mcsbyteint.lbx"                                       ' use optional lib
since we use only bytes

'configure PS2 AT pins
Enable Interrupts                                           ' you need to turn
on interrupts yourself since an INT is used
Config Atemu = Int1 , Data = Pind.3 , Clock = Pinb.0
'                 ^------------------------ used interrupt
'                              ^----------- pin connected to DATA
'                                        ^-- pin connected to clock
'Note that the DATA must be connected to the used interrupt pin


Waitms 500                                                  ' optional delay

'rcall _AT_KBD_INIT
Print "Press t for test, and set focus to the editor window"
Dim Key2 As Byte , Key As Byte
Do
    Key2 = Waitkey()                                        ' get key from
terminal
    Select Case Key2
      Case "t" :
      Waitms 1500
      Sendscankbd Mark                                      ' send a scan code
      Case Else
    End Select
Loop
Print Hex(key)

Mark:                                                       ' send mark
Data 12 , &H3A , &HF0 , &H3A , &H1C , &HF0 , &H1C , &H2D , &HF0 , &H2D , &H42 ,
 &HF0 , &H42
'    ^ send 12 bytes
'           m                   a                   r                   k
```

SERIN

Action

Reads serial data from a dynamic software UART.

Syntax

SERIN var , bts , port , pin, baud , parity , dbits , sbits

Remarks

While the OPEN and CLOSE statements can be used for software UARTS, they do not permit to use the same pin for input and output. The settings used when opened the communication channel can also not be changed at run time.

The SERIN and SEROUT statements are dynamic software UART routines to perform input and output. You can use them on the same pin for example send some data with SEROUT and get back an answer using SERIN.

Since the SERIN and SEROUT routines can use any pin and can use different parameter values, the code size of these routines is larger.

Parameter	Description
Var	A variable that will be assigned with the received data.
Bts	The number of bytes to receive. String variables will wait for a return (ASCII 13). There is no check if the variable you assign is big enough to hold the result.
Port	The name of the port to use. This must be a letter like A for portA.
Pin	The pin number you want to use of the port. This must be in the range from 0-7.
Baud	The baud rate you want to use. For example 19200.
Parity	A number that codes the parity. 0= NONE, 1 = EVEN, 2 = ODD
Dbits	The number of data bits. Use 7 or 8.
Sbits	The number of stop bits. 1 to 2.

The use of SERIN will create an internal variable named ___SER_BAUD. This is a LONG variable. It is important that you specify the correct crystal value with $CRYSTAL so the correct calculation can be made for the specified baud rate.

Note that ___SER_BAUD will not hold the passed baud rate but will hold the bit delay used internal.

Since the SW UART is dynamic you can change all the params at run time. For example you can store the baud rate in a variable and pass this variable to the SERIN routine.

Your code could change the baud rate under user control this way.

It is important to realize that software timing is used for the bit timing. Any interrupt that occurs during SERIN or SEROUT will delay the transmission. Disable interrupts while you use SERIN or SEROUT.

ASM

The routine called is named _serin and is stored in mcs.lib
For the baud rate calculation, _calc_baud is called.

See also

SEROUT

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : serin_out.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of DYNAMIC software UART
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

'tip : Also look at OPEN and CLOSE

'some variables we will use
Dim S As String * 10
Dim Mybaud As Long
'when you pass the baud rate with a variable, make sure you dimesion it as a
LONG

Mybaud = 19200
Do
  'first get some data
  Serin S , 0 , D , 0 , Mybaud , 0 , 8 , 1
  'now send it
  Serout S , 0 , D , 1 , Mybaud , 0 , 8 , 1
  '                                    ^ 1 stop bit
  '                                  ^---- 8 data bits
  '                                ^------ even parity (0=N, 1 = E, 2=O)
  '                          ^-------------- baud rate
  '                     ^-------------------- pin number
  '                ^----------------------- port so PORTA.0 and PORTA.1 are used
  '           ^---------------------------- for strings pass 0
  '      ^------------------------------- variable
  Wait 1
Loop
End

'because the baud rate is passed with a variable in theis example, you could
change it under user control
'for example check some DIP switches and change the variable mybaud
```

SEROUT

Action
Sends serial data through a dynamic software UART.

Syntax
SEROUT var , bts , port , pin, baud , parity , dbits , sbits

Remarks
While the OPEN and CLOSE statements can be used for software UARTS, they do not permit to use the same pin for input and output. The settings used when opened the communication channel can also not be changed at run time.

The SERIN and SEROUT statements are dynamic software UART routines to perform input and output. You can use them on the same pin for example send some data with SEROUT and get back an answer using SERIN.

Since the SERIN and SEROUT routines can use any pin and can use different parameter

values, the code size of these routines is larger.

Parameter	Description
Var	A variable which content is send through the UART. A constant can NOT be used.
Bts	The number of bytes to receive. String variables will wait for a return (ASCII 13). There is no check if the variable you assign is big enough to hold the result.
Port	The name of the port to use. This must be a letter like A for portA.
Pin	The pin number you want to use of the port. This must be in the range from 0-7.
Baud	The baud rate you want to use. For example 19200.
Parity	A number that codes the parity. 0= NONE, 1 = EVEN, 2 = ODD
Dbits	The number of data bits. Use 7 or 8.
Sbits	The number of stop bits. 1 to 2.

The use of SEROUT will create an internal variable named ___SER_BAUD. This is a LONG variable. It is important that you specify the correct crystal value with $CRYSTAL so the correct calculation can be made for the specified baud rate.

Note that ___SER_BAUD will not hold the passed baud rate but will hold the bit delay used internal.

Since the SW UART is dynamic you can change all the params at run time. For example you can store the baud rate in a variable and pass this variable to the SEROUT routine.

Your code could change the baud rate under user control this way.

It is important to realize that software timing is used for the bit timing. Any interrupt that occurs during SERIN or SEROUT will delay the transmission. Disable interrupts while you use SERIN or SEROUT.

The SEROUT will use the pin in Open Collector mode. This means that you can connect several AVR chips and poll the ' bus' with the SERIN statement.

ASM

The routine called is named _serout and is stored in mcs.lib
For the baud rate calculation, _calc_baud is called.

See also

SERIN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : serin_out.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of DYNAMIC software UART
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
```

```
frequency
$baud = 19200                                                ' use baud rate
$hwstack = 32                                                ' default use 32
for the hardware stack
$swstack = 10                                                ' default use 10
for the SW stack
$framesize = 40                                              ' default use 40
for the frame space

'tip : Also look at OPEN and CLOSE

'some variables we will use
Dim S As String * 10
Dim Mybaud As Long
'when you pass the baud rate with a variable, make sure you dimesion it as a
LONG

Mybaud = 19200
Do
  'first get some data
  Serin S , 0 , D , 0 , Mybaud , 0 , 8 , 1
  'now send it
  Serout S , 0 , D , 1 , Mybaud , 0 , 8 , 1
  '                                    ^ 1 stop bit
  '                                  ^---- 8 data bits
  '                                ^------ even parity (0=N, 1 = E, 2=O)
  '                          ^-------------- baud rate
  '                    ^-------------------- pin number
  '                ^---------------------- port so PORTA.0 and PORTA.1 are used
  '            ^---------------------------- for strings pass 0
  '      ^------------------------------- variable
  Wait 1
Loop
End

'because the baud rate is passed with a variable in theis example, you could
change it under user control
'for example check some DIP switches and change the variable mybaud
```

SETIPPROTOCOL

Action

Configures socket RAW-mode protocol

Syntax

SETIPPROTOCOL socket, value

Remarks

Socket	The socket number. (0-3)
Value	The IP-protocol value to set.

In order to use W3100A's IPL_RAW Mode, the protocol value of the IP Layer to be used (e.g., 01 in case
of ICMP) needs to be set before socket initialization.
As in UDP, data transmission and reception is possible when the corresponding channel is initialized.

The PING example demonstrates the usage.
As a first step, SETIPPROTOCOL is used :
Setipprotocol Idx , **1**
And second, the socket is initialized :
Idx = Getsocket(idx , **3** , 5000 , 0)

The W3100A datasheet does not provide much more details about the IPR register.

See also
SETTCPREGS, GETSOCKET

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                       : PING_TWI.bas
http://www.faqs.org/rfcs/rfc792.html
'copyright                  : (c) 1995-2005, MCS Electronics
'purpose                    : Simple PING program
'micro                      : Mega88
'suited for demo            : yes
'commercial addon needed    : no
'-----------------------------------------------------------------------------
-----------
$regfile = "m32def.dat"                                    ' specify the used
micro

$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 80                                              ' default use 32
for the hardware stack
$swstack = 128                                             ' default use 10
for the SW stack
$framesize = 80                                            ' default use 40
for the frame space

Const Debug = 1

Const Sock_stream = $01                                    ' Tcp
Const Sock_dgram = $02                                     ' Udp
Const Sock_ipl_raw = $03                                   ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                  ' Mac Layer Raw
Sock
Const Sel_control = 0                                      ' Confirm Socket
Status
Const Sel_send = 1                                         ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                         ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                    ' Status Of
Connection Closed
Const Sock_arp = $01                                       ' Status Of Arp
Const Sock_listen = $02                                    ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                   ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                               ' Status Of Setting
```

```
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW


'we do the usual
Print "Init TCP"                                            ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55
, Twi = &H80 , Clock = 400000
Print "Init done"

Dim Peersize As Integer , Peeraddress As Long , Peerport As Word
Dim Idx As Byte , Result As Word , J As Byte , Res As Byte
Dim Ip As Long
Dim Dta(12) As Byte , Rec(12) As Byte


Dta(1) = 8                                                  'type is echo
Dta(2) = 0                                                  'code

Dta(3) = 0                                                  ' for checksum
initialization
Dta(4) = 0                                                  ' checksum
Dta(5) = 0                                                  ' a signature can
be any number
Dta(6) = 1                                                  '   signature
Dta(7) = 0                                                  ' sequence number -
any number
Dta(8) = 1
Dta(9) = 65

Dim W As Word At Dta + 2 Overlay                            'same as dta(3) and
dta(4)
W = Tcpchecksum(dta(1) , 9)                                 ' calculate
checksum and store in dta(3) and dta(4)

#if Debug
  For J = 1 To 9
    Print Dta(j)
  Next
#endif



Ip = Maketcp(192.168.0.16)                                  'try to check this
server

Print "Socket " ; Idx ; " " ; Idx
Setipprotocol Idx , 1                                       'set protocol to 1
```

```
'the protocol value must be set BEFORE the socket is openend

Idx = Getsocket(idx , 3 , 5000 , 0)


Do
   Result = Udpwrite(ip , 7 , Idx , Dta(1) , 9)              'write ping data
            '
   Print Result
   Waitms 100
   Result = Socketstat(idx , Sel_recv)                       'check for data
   Print Result
   If Result >= 11 Then
      Print "Ok"
      Res = Tcpread(idx , Rec(1) , Result)                   'get data with
TCPREAD !!!
      #if Debug
        Print "DATA RETURNED :" ; Res                        '
        For J = 1 To Result
          Print Rec(j) ; " " ;
        Next
        Print
      #endif
   Else                                                      'there might be a
problem
      Print "Network not available"
   End If
   Waitms 1000
Loop
```

SGN

Action
Returns the sign of a float value.

Syntax
var = **SGN**(x)

Remarks

Var	A single or double variable that is assigned with the SGNS of variable x.
X	The single or double to get the sign of.

For values <0, -1 will be returned
For 0, 0 will be returned
For values >0, 1 will be returned

See Also
INT , FIX , ROUND

Example
```
Dim S As Single , X As Single , Y As Single
X = 2.3 : S = Sgn(x)
Print S
X = -2.3 : S = Sgn(x)
Print S
```

```
End
```

SHIFT

Action
Shift all bits one place to the left or right.

Syntax
SHIFT var , LEFT/RIGHT[, shifts]

Remarks

Var	Byte, Integer/Word, Long or Single variable.
Shifts	The number of shifts to perform.

The SHIFT statement rotates all the bits in the variable to the left or right.

When shifting LEFT the most significant bit, will be shifted out of the variable. The LS bit becomes zero. Shifting a variable to the left, multiplies the variable with a value of two.

When shifting to the RIGHT, the least significant bit will be shifted out of the variable. The MS bit becomes zero. Shifting a variable to the right, divides the variable by two.

A Shift performs faster than a multiplication or division.

See also
ROTATE , SHIFTIN , SHIFTOUT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : shift.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example for SHIFTIN and SHIFTOUT statement
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim L As Long
```

```
Clock Alias Portb.0
Output Alias Portb.1
Sin Alias Pinb.2                                        'watch the PIN
instead of PORT

'shiftout pinout,pinclock, var,parameter [,bits , delay]
' value for parameter :
'  0 - MSB first ,clock low
'  1 - MSB first,clock high
'  2 - LSB first,clock low
'  3 - LSB first,clock high
'The bits is a new option to indicate the number of bits to shift out
'For a byte you should specify 1-8 , for an integer 1-16 and for a long 1-32
'The delay is an optional delay is uS and when used, the bits parameter must
'be specified too!

'Now shift out 9 most significant bits of the LONG variable L
Shiftout Output , Clock , L , 0 , 9



'shiftin pinin,pinclock,var,parameter [,bits ,delay]
'  0 - MSB first ,clock low  (4)
'  1 - MSB first,clock high  (5)
'  2 - LSB first,clock low   (6)
'  3 - LSB first,clock high  (7)

'To use an external clock, add 4 to the parameter
'The shiftin also has a new optional parameter to specify the number of bits

'The bits is a new option to indicate the number of bits to shift out
'For a byte you should specify 1-8 , for an integer 1-16 and for a long 1-32
'The delay is an optional delay is uS and when used, the bits parameter must
'be specified too!


'Shift in 9 bits into a long
Shiftin Sin , Clock , L , 0 , 9
'use shift to shift the bits to the right place in the long
Shift L , Right , 23

End
```

SHIFTCURSOR

Action
Shift the cursor of the LCD display left or right by one position.

Syntax
SHIFTCURSOR LEFT | RIGHT

See also
SHIFTLCD

Partial Example
```
LCD "Hello"
SHIFTCURSOR LEFT
```

End

SHIFTIN

Action
Shifts a bit stream into a variable.

Syntax
SHIFTIN pin , pclock , var , option [, bits , delay]

Remarks

Pin	The port pin which serves as an input.PINB.2 for example
Pclock	The port pin which generates the clock.
Var	The variable that is assigned.
Option	Option can be : 0 – MSB shifted in first when clock goes low 1 – MSB shifted in first when clock goes high 2 – LSB shifted in first when clock goes low 3 – LSB shifted in first when clock goes high Adding 4 to the parameter indicates that an external clock signal is used for the clock. In this case the clock will not be generated. So using 4 will be the same a 0 (MSB shifted in first when clock goes low) but the clock must be generated by an external signal. 4 – MSB shifted in first when clock goes low with ext. clock 5 – MSB shifted in first when clock goes high with ext. clock 6 – LSB shifted in first when clock goes low with ext. clock 7 – LSB shifted in first when clock goes high with ext. clock
Bits	Optional number of bits to shift in. Maximum 255.
Delay	Optional delay in uS. When you specify the delay, the number of bits must also be specified. When the number of bits is default you can use NULL for the BITS parameter.

If you do not specify the number of bits to shift, the number of shifts will depend on the type of the variable.
When you use a byte, 8 shifts will occur and for an integer, 16 shifts will occur. For a Long and Single 32 shifts will occur.

The SHIFTIN routine can be used to interface with all kind of chips.
The PIN is normally connected with the output of chip that will send information.

The PCLOCK pin can be used to clock the bits as a master, that is the clock pulses will be generated. Or it can sample a pin that generates these pulses.

The VARIABLE is a normal BASIC variable. And may be of any type except for BIT. The data read from the chip is stored in this variable.

The OPTIONS is a constant that specifies the direction of the bits. The chip that outputs the data may send the LS bit first or the MS bit first. It also controls on which edge of the clock signal the data must be stored.

When you add 4 to the constant you tell the compiler that the clock signal is not generated but that there is an external clock signal.
The number of bits may be specified. You may omit this info. In that case the number of bits of the element data type will be used.
The DELAY normally consists of 2 NOP instructions. When the clock is too fast you can specify a delay time(in uS).

See also
SHIFTOUT , SHIFT

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : shift.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example for SHIFTIN and SHIFTOUT statement
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim L As Long

clock Alias Portb.0
Output Alias Portb.1
sinp Alias Pinb.2                                           'watch the PIN
instead of PORT

'shiftout pinout,pinclock, var,parameter [,bits , delay]
' value for parameter :
'  0 - MSB first ,clock low
'  1 - MSB first,clock high
'  2 - LSB first,clock low
'  3 - LSB first,clock high
'The bits is a new option to indicate the number of bits to shift out
'For a byte you should specify 1-8 , for an integer 1-16 and for a long 1-32
'The delay is an optional delay is uS and when used, the bits parameter must
'be specified too!

'Now shift out 9 most significant bits of the LONG variable L
Shiftout Output , Clock , L , 0 , 9



'shiftin pinin,pinclock,var,parameter [,bits ,delay]
'  0 - MSB first ,clock low  (4)
'  1 - MSB first,clock high  (5)
'  2 - LSB first,clock low   (6)
'  3 - LSB first,clock high  (7)
```

```
'To use an external clock, add 4 to the parameter
'The shiftin also has a new optional parameter to specify the number of bits

'The bits is a new option to indicate the number of bits to shift out
'For a byte you should specify 1-8 , for an integer 1-16 and for a long 1-32
'The delay is an optional delay is uS and when used, the bits parameter must
'be specified too!


'Shift in 9 bits into a long
Shiftin Sinp , Clock , L , 0 , 9
'use shift to shift the bits to the right place in the long
Shift L , Right , 23

End
```

SHIFTOUT

Action

Shifts a bit stream out of a variable into a port pin .

Syntax

SHIFTOUT pin , pclock , var , option [, bits , delay]

Remarks

Pin	The port pin which serves as a data output.
Pclock	The port pin which generates the clock.
Var	The variable that is shifted out.
Option	Option can be : 0 – MSB shifted out first when clock goes low 1 – MSB shifted out first when clock goes high 2 – LSB shifted out first when clock goes low 3 – LSB shifted out first when clock goes high
Bits	Optional number of bits to shift out.
Delay	Optional delay in uS. When you specify the delay, the number of bits must also be specified. When the default must be used you can also use NULL for the number of bits.

If you do not specify the number of bits to shift, the number of shifts will depend on the type of the variable.
When you use a byte, 8 shifts will occur and for an integer, 16 shifts will occur. For a Long and Single 32 shifts will occur.

The SHIFTIN routine can be used to interface with all kind of chips.

The PIN is normally connected with the input of a chip that will receive information.

The PCLOCK pin is used to clock the bits out of the chip.

The VARIABLE is a normal BASIC variable. And may be of any type except for BIT. The data that is stored in the variable is sent with PIN.

The OPTIONS is a constant that specifies the direction of the bits. The chip that reads the data may want the LS bit first or the MS bit first. It also controls on which edge of the clock signal the data is sent to PIN.

The number of bits may be specified. You may omit this info. In that case the number of bits of the element data type will be used.

The DELAY normally consists of 2 NOP instructions. When the clock is too fast you can specify a delay time(in uS).

See also
SHIFTIN , SHIFT

Example
See SHIFTIN sample

SHIFTLCD

Action
Shift the LCD display left or right by one position.

Syntax
SHIFTLCD LEFT / RIGHT

Remarks
NONE

See also
SHIFTCURSOR

Partial Example
```
Cls                                          'clear the LCD
display
Lcd "Hello world."                           'display this at
the top line
Wait 1
Lowerline                                    'select the lower
line
Wait 1
Lcd "Shift this."                            'display this at
the lower line
Wait 1
For A = 1 To 10
   Shiftlcd Right                            'shift the text to
the right
   Wait 1                                    'wait a moment
Next

For A = 1 To 10
```

```
   Shiftlcd Left                                    'shift the text to
the left
   Wait 1                                           'wait a moment
Next

Locate 2 , 1                                        'set cursor
position
Lcd "*"                                             'display this
Wait 1                                              'wait a moment

Shiftcursor Right                                   'shift the cursor
Lcd "@"                                             'display this
```

SHOWPIC

Action
Shows a BGF file on the graphic display

Syntax
SHOWPIC x, y , label

Remarks
Showpic can display a converted BMP file. The BMP must be converted into a BGF file with the Tools Graphic Converter.

The X and Y parameters specify where the picture must be displayed. X and Y must be 0 or a multiple of 8. The picture height and width must also be a multiple of 8.

The label tells the compiler where the graphic data is located. It points to a label where you put the graphic data with the $BGF directive.

You can store multiple pictures when you use multiple labels and $BGF directives,

Note that the BGF files are RLE encoded to save code space.

See also
PSET , $BGF , CONFIG GRAPHLCD , LINE , CIRCLE , SHOWPICE

Example
See $BGF example

SHOWPICE

Action
Shows a BGF file stored in EEPROM on the graphic display

Syntax
SHOWPICE x, y , label

Remarks
Showpice can display a converted BMP file that is stored in the EEPROM of the micro processor. The BMP must be converted into a BGF file with the Tools Graphic Converter.

The X and Y parameters specify where the picture must be displayed. X and Y must be 0 or a multiple of 8. The picture height and width must also be a multiple of 8.

The label tells the compiler where the graphic data is located. It points to a label where you put the graphic data with the $BGF directive.
You can store multiple pictures when you use multiple labels and $BGF directives,

Note that the BGF files are RLE encoded to save code space.

See also
PSET , $BGF , CONFIG GRAPHLCD , LINE , SHOWPIC , CIRCLE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : showpice.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstrates showing a picture from EEPROM
'micro                    : AT90S8535
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "8535def.dat"                                    ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'First we define that we use a graphic LCD
' Only 240*64 supported yet
Config Graphlcd = 240 * 128 , Dataport = Porta , Controlport = Portc , Ce = 2 ,
Cd = 3 , Wr = 0 , Rd = 1 , Reset = 4 , Fs = 5 , Mode = 8
'The dataport is th e portname that is connected to the data lines of the LCD
'The controlport is the portname which pins are used to control the lcd
'CE, CD etc. are the pin number of the CONTROLPORT.
' For example CE =2 because it is connected to PORTC.2
'mode 8 gives 240 / 8 = 30 columns , mode=6 gives 240 / 6 = 40 columns

'we will load the picture data into EEPROM so we specify $EEPROM
'the data must be specified before the showpicE statement.
$eeprom
Plaatje:
'the $BGF directive will load the data into the EEPROM or FLASH depending on
the $EEPROM or $DATA directive
```

```
$bgf "mcs.bgf"
'switch back to normal DATA (flash) mode
$data

'Clear the screen will both clear text and graph display
Cls
'showpicE is used to show a picture from EEPROM
'showpic must be used when the data is located in Flash
Showpice 0 , 0 , Plaatje
End
```

SIN

Action
Returns the sine of a float

Syntax
var = **SIN**(source)

Remarks

Var	A numeric variable that is assigned with sinus of variable source.
source	The single or double variable to get the sinus of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , ATN , COS

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As Single , X As Single
S = 0.5 : X = Tan(s) : Print X                             ' prints
0.546302195
S = 0.5 : X = Sin(s) : Print X                             ' prints
0.479419108
S = 0.5 : X = Cos(s) : Print X                             ' prints
```

```
0.877588389

End
```

SINH

Action
Returns the sinus hyperbole of a float

Syntax
var = **SINH**(source)

Remarks

Var	A numeric variable that is assigned with sinus hyperbole of variable source.
source	The single or double variable to get the sinus hyperbole of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , ATN , COS , SIN , TANH , COSH

Example
Show sample

SOCKETCONNECT

Action
Establishes a connection to a TCP/IP server.

Syntax
Result = **SOCKETCONNECT**(socket, IP, port)

Remarks

Result	A byte that is assigned with 0 when the connection succeeded. It will return 1 when an error occurred.
IP	The IP number of the server you want to connect to. This may be a number like 192.168.0.2 or a LONG variable that is assigned with an IP number. Note that the LSB of the LONG, must contain the MSB of the IP number.
Port	The port number of the server you are connecting to.

You can only connect to a server. Standardized servers have dedicated port numbers. For example, the HTTP protocol(web server) uses port 80.

After you have established a connection the server might send data. This depends entirely on the used protocol. Most servers will send some welcome text, this is called a banner.

You can send or receive data once the connection is established.

The server might close the connection after this or you can close the connection yourself. This also depends on the protocol.

See also

CONFIG TCPIP, GETSOCKET , SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : servertest.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : start the easytcp.exe program after the chip is
programmed
'                           and create 2 connections
'micro                    : Mega161
'suited for demo          : no
'commercial addon needed  : yes
'-----------------------------------------------------------------------------
-----------

$regfile = "m161def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
```

```
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW


$lib "tcpip.lbx"                                            ' specify the tcpip
library
Print "Init , set IP to 192.168.0.8"                       ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 0.0.0.0 , Localport = 1000 , Tx = $55 , Rx = $55

'Use the line below if you have a gate way
'Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

Dim Bclient As Byte                                         ' socket number
Dim Idx As Byte
Dim Result As Word                                          ' result
Dim S As String * 80
Dim Flags As Byte
Dim Peer As Long


Do
  For Idx = 0 To 3
     Result = Socketstat(idx , 0)                           ' get status
     Select Case Result
       Case Sock_established
            If Flags.idx = 0 Then                           ' if we did not
send a welcome message yet
               Flags.idx = 1
               Result = Tcpwrite(idx , "Hello from W3100A{013}{010}")       '
send welcome
            End If
            Result = Socketstat(idx , Sel_recv)             ' get number of
bytes waiting
            If Result > 0 Then
               Do
                 Result = Tcpread(idx , S)
                 Print "Data from client: " ; Idx ; " " ; S
                 Peer = Getdstip(idx)
```

```
                  Print "Peer IP " ; Ip2str(peer)
                  'you could analyse the string here and send an appropiate
command
                  'only exit is recognized
                  If Lcase(s) = "exit" Then
                     Closesocket Idx
                  Elseif Lcase(s) = "time" Then
                     Result = Tcpwrite(idx , "12:00:00{013}{010}")       ' you
should send date$ or time$
                  End If
               Loop Until Result = 0
            End If
       Case Sock_close_wait
            Print "close_wait"
            Closesocket Idx
       Case Sock_closed
            Print "closed"
            Bclient = Getsocket(idx , Sock_stream , 5000 , 0)       ' get
socket for server mode, specify port 5000
            Print "Socket " ; Idx ; " " ; Bclient
            Socketlisten Idx
            Print "Result " ; Result
            Flags.idx = 0                                    ' reset the hello
message flag
     End Select
  Next
Loop
End
```

SOCKETLISTEN

Action

Opens a socket in server(listen) mode.

Syntax

SOCKETLISTEN socket

Remarks

Socket	The socket number you want to close in the range of 0 -3.

The socket will listen to the port you specified with the GetSocket function.
You can listen to a maximum of 4 sockets at the same time.

After the connection is closed by either the client or the server, a new connection need to be created and the SocketListen statement must be used again.

See also

CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET

Example

See SOCKETCONNECT example

SOCKETSTAT

Action
Returns information of a socket.

Syntax
Result = **SOCKETSTAT**(socket , mode)

Remarks

Result	A word variable that is assigned with the result.
Socket	The socket number you want to get information of
Mode	A parameter that specified what kind of information you want to retrieve. SEL_CONTROL or 0 : returns the status register value SEL_SEND or 1 : returns the number of bytes that might be placed into the transmission buffer. SEL_RECV or 2 : returns the number of bytes that are stored in the reception buffer.

The SocketStat function contains actual 3 functions. One to get the status of the connection, one to determine how many bytes you might write to the socket, and one to determine how many bytes you can read from the buffer.

When you specify mode 0, one of the following byte values will be returned:

Value	State	Description
0	SOCK_CLOSED	Connection closed
1	SOCK_ARP	Standing by for reply after transmitting ARP request
2	SOCK_LISTEN	Standing by for connection setup to the client when acting in passive mode
3	SOCK_SYNSENT	Standing by for SYN,ACK after transmitting SYN for connecting setup when acting in active mode
4	SOCK_SYNSENT_ACK	Connection setup is complete after SYN,ACK is received and ACK is transmitted in active mode
5	SOCK_SYNRECV	SYN,ACK is being transmitted after receiving SYN from the client in listen state, passive mode
6	SOCK_ESTABLISHED	Connection setup is complete in active, passive mode
7	SOCK_CLOSE_WAIT	Connection being terminated
8	SOCK_LAST_ACK	Connection being terminated
9	SOCK_FIN_WAIT1	Connection being terminated
10	SOCK_FIN_WAIT2	Connection being terminated
11	SOCK_CLOSING	Connection being terminated
12	SOCK_TIME_WAIT	Connection being terminated

13	SOCK_RESET	Connection being terminated after receiving reset packet from peer.
14	SOCK_INIT	Socket initializing
15	SOCK_UDP	Applicable channel is initialized in UDP mode.
16	SOCK_RAW	Applicable channel is initialized in IP layer RAW mode
17	SOCK_UDP_ARP	Standing by for reply after transmitting ARP request packet to the destination for UDP transmission
18	SOCK_UDP_DATA	Data transmission in progress in UDP RAW mode
19	SOCK_RAW_INIT	W3100A initialized in MAC layer RAW mode

The SocketStat function is also used internally by the library.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, TCPWRITE, TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Partial Example

```
Tempw = Socketstat(i , 0)' get status
SelectCase Tempw
  Case Sock_established
  Case Else
EndSelect
```

SONYSEND

Action
Sends Sony remote IR code.

Syntax
SONYSEND address [, bits]

Uses
TIMER1

Remarks

Address	The address of the Sony device.
bits	This is an optional parameter. When used, it must be 12, 15 or 20. Also, when you use this option, the address variable must be of the type LONG.

SONY CD Infrared Remote Control codes (RM-DX55)

Function	Hex	Bin
Power	A91	1010 1001 0001

Play	4D1	0100 1101 0001
Stop	1D1	0001 1101 0001
Pause	9D1	1001 1101 0001
Continue	B91	1011 1001 0001
Shuffle	AD1	1010 1101 0001
Program	F91	1111 1001 0001
Disc	531	0101 0011 0001
1	011	0000 0001 0001
2	811	1000 0001 0001
3	411	0100 0001 0001
4	C11	1100 0001 0001
5	211	0010 0001 0001
6	A11	1010 0001 0001
7	611	0110 0001 0001
8	E11	1110 0001 0001
9	111	0001 0001 0001
0	051	0000 0101 0001
>10	E51	1110 0101 0001
enter	D11	1101 0001 0001
clear	F11	1111 0001 0001
repeat	351	0011 0101 0001
disc -	BD1	1011 1101 0001
disc +	H7D1	0111 1101 0001
| <<	0D1	0000 1101 0001
>>|	8D1	1000 1101 0001
<<	CD1	1100 1101 0001
>>	2D1	0010 1101 0001
SONY Cassette	RM-J901)	
Deck A		
stop	1C1	0001 1100 0001
play >	4C1	0100 1100 0001
play <	EC1	1110 1100 0001
>>	2C1	0010 1100 0001
<<	CC1	1100 1100 0001
record	6C1	0110 1100 0001
pause	9C1	1001 1100 0001
Dec B		
stop	18E	0001 1000 1110
play >	58E	0101 1000 1110
play <	04E	0000 0100 1110
>>	38E	0011 1000 1110
<<	D8E	1101 1000 1110
record	78E	0111 1000 1110
pause	98E	1001 1000 1110

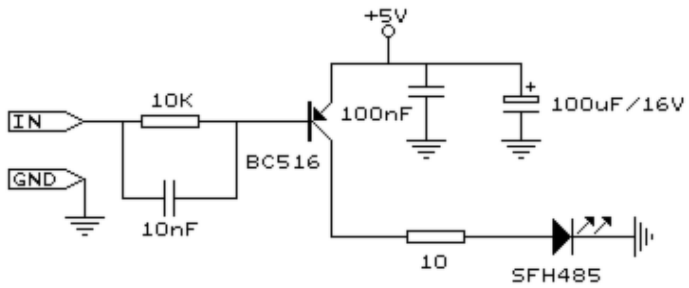
---[SONY TV Infrared Remote Control codes (RM-694)]-------------------------

program + = &H090 : 0000 1001 0000
program - = &H890 : 1000 1001 0000
volume + = &H490 : 0100 1001 0000
volume - = &HC90 : 1100 1001 0000
power = &HA90 : 1010 1001 0000
sound on/off = &H290 : 0010 1001 0000
1 = &H010 : 0000 0001 0000
2 = &H810 : 1000 0001 0000
3 = &H410 : 0100 0001 0000
4 = &HC10 : 1100 0001 0000
5 = &H210 : 0010 0001 0000
6 = &HA10 : 1010 0001 0000
7 = &H610 : 0110 0001 0000
8 = &HE10 : 1110 0001 0000
9 = &H110 : 0001 0001 0000
0 = &H910 : 1001 0001 0000
-/-- = &HB90 : 1011 1001 0000

For more SONY Remote Control info:
http://www.fet.uni-hannover.de/purnhage/

The resistor must be connected to the OC1A pin. In the example a 2313 micro was used. This micro has pin portB.3 connected to OC1A.
Look in a datasheet for the proper pin when used with a different chip.

An IR booster circuit is shown below:



See also

CONFIG RC5 , GETRC5 , RC5SEND , RC6SEND

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : sonysend.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : code based on application note from Ger Langezaal
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
```

```
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


'   +5V <---[A Led K]---[220 Ohm]---> Pb.3 for 2313.
' RC5SEND is using TIMER1, no interrupts are used
' The resistor must be connected to the OC1(A) pin , in this case PB.3

Do
   Waitms 500
   Sonysend &HA90
Loop
End
```

SOUND

Action
Sends pulses to a port pin.

Syntax
SOUND pin, duration, pulses

Remarks

Pin	Any I/O pin such as PORTB.0 etc.
Duration	The number of pulses to send. Byte, integer/word or constant.
Pulses	The time the pin is pulled low and high. This is the value for a loop counter.

When you connect a speaker or a buzzer to a port pin (see hardware) , you can use the SOUND statement to generate some tones.
The port pin is switched high and low for pulses times.
This loop is executed duration times.

The SOUND statement is not intended to generate accurate frequencies. Use a TIMER to do that.

See also
NONE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                          : sound.bas
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo : SOUND
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim Pulses As Word , Periods As Word
Pulses = 65535 : Periods = 10000                           'set variables
Speaker Alias Portb.1                                      'define port pin

Sound Speaker , Pulses , Periods                           'make some noice
'note that pulses and periods must have a high value for high XTALS
'sound is only intended to make some noise!

'pulses  range from 1-65535
'periods range from 1-65535

End
```

SPACE

Action

Returns a string that consists of spaces.

Syntax

var = **SPACE**(x)

Remarks

X	The number of spaces.
Var	The string that is assigned.

Using 0 for x will result in a string of 255 bytes because there is no check for a zero length assign.

See also

STRING , SPC

Example

```
'-------------------------------------------------------------------------
-
```

```
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates DEG2RAD function

'-----------------------------------------------------------------------------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim S As String * 15 , Z As String * 15
S = Space(5)
Print " {" ; S ; " }"                                      '{ }

Dim A As Byte
A = 3
S = Space(a)

End
```

SPC

Action

Prints the number of specified spaces.

Syntax

PRINT **SPC**(x)
LCD **SPC**(x)

Remarks

X	The number of spaces to print.

Using 0 for x will result in a string of 255 bytes because there is no check for a zero length assign.

SPC can be used with LCD too.

The difference with the SPACE function is that SPACE returns a number of spaces while SPC() can only be used with printing. Using SPACE() with printing is also possible but it will use a temporary buffer while SPC does not use a temporary buffer.

See also

SPACE

Example

```
'-----------------------------------------------------------------------
-
'copyright                : (c) 1995-2005, MCS Electronics
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'purpose                  : demonstrates DEG2RAD function

'-----------------------------------------------------------------------
-

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim S As String * 15 , Z As String * 15
Print "{" ; Spc(5) ; "}"                                   '{ }
Lcd "{" ; Spc(5) ; "}"                                     '{ }
```

SPIIN

Action

Reads a value from the SPI-bus.

Syntax

SPIIN var, bytes

Remarks

Var	The variable which receives the value read from the SPI-bus.
Bytes	The number of bytes to read. The maximum is 255.

See also

SPIOUT, SPIINIT, CONFIG SPI , SPIMOVE

Example

```
'-----------------------------------------------------------------------
-----------
'name                     : spi.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo :SPI
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
```

```
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Dim B As Byte
Dim A(10) As Byte

Spiinit
B = 5
Spiout A(1) , B

Spiin A(1) , B

A(1) = Spimove(a(2))
End
```

SPIINIT

Action
Initiate the SPI pins.

Syntax
SPIINIT

Remarks
After the configuration of the SPI pins, you must initialize the SPI pins to set them for the right data direction. When the pins are not used by other hardware/software, you only need to use SPIINIT once.

When other routines change the state of the SPI pins, use SPIINIT again before using SPIIN and SPIOUT.

See also
SPIIN , SPIOUT

ASM
Calls _init_spi

Example
See SPIIN

SPIMOVE

Action
Sends and receives a value or a variable to the SPI-bus.

Syntax
var = **SPIMOVE**(byte)

Remarks

Var	The variable that is assigned with the received byte(s) from the SPI-bus.
Byte	The variable or constant whose content must be send to the SPI-bus.

See also
SPIIN , SPIINIT , CONFIG SPI

Example
```
Config Spi = Soft , Din = Pinb.0 , Dout = Portb.1 , Ss = Portb.2 , Clock =
Portb.3

Spiinit

Dim a(10) as Byte , X As Byte

Spiout A(1) , 5                                          'send 5 bytes
Spiout X , 1                                             'send 1 byte
A(1) = Spimove(5)                                        ' move 5 to SPI and
store result in a(1)
End
```

SPIOUT

Action
Sends a value of a variable to the SPI-bus.

Syntax
SPIOUT var , bytes

Remarks

var	The variable whose content must be send to the SPI-bus.
bytes	The number of bytes to send. Maximum value is 255.

When SPI is used in HW(hardware) mode, there might be a small delay/pause after each byte that is sent. This is caused by the SPI hardware and the speed of the bus. After a byte is transmitted, SPSR bit 7 is checked. This bit 7 indicates that the SPI is ready for sending a new byte.

See also
SPIIN , SPIINIT , CONFIG SPI , SPIMOVE

Example
```
Dim A(10) As Byte
Config Spi = Soft , Din =Pinb.0 , Dout =Portb.1 , Ss =Portb.2 , Clock =Portb.3
Spiinit
Spiout A(1), 4 'write 4 bytes a(1), a(2) , a(3) and a(4)

End
```

SPLIT

Action
Split a string into a number of array elements.

Syntax
count = **SPLIT** (source, array, search)

Remarks

count	The number of elements that SPLIT() returned. When the array is not big enough to fill the array, this will be the maximum size of the array. So make sure the array is big enough to hold the results.
source	The source string or string constant to search for.
array	The index of the first element of the array that will be filled
search	The character to search for. This can be a string or string constant.

When you use the serial port to receive data, in some cases you need to process the data in parts.
For example when you need to split an IP number as "123.45.24.12" you could use INSTR() or you can use SPLIT().
You must DIM the array yourself. The content of the array will be overwritten.

It is also important to know that the individual elements of the array need to be big enough to store the string part.
For example when the array has 5 elements and each element may be 10 characters long, a string that is 11 bytes long will not fit. Another element will be used in that case to store the additional info.

The SPLIT function takes care not to overwrite other memory. So when you split "1.2.2.2.2.2.2.3.3.3" into an array of 3 elelements, you will loose the data.

See also
INSTR

Example
```
'-----------------------------------------------------------
```

```
'                        mega48.bas
'                     mega48 sample file
'                  (c) 1995-2005, MCS Electronics
'-----------------------------------------------------------------
$regfile = "m48def.dat"
$crystal = 8000000
$baud = 19200
Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0


Dim S As String * 80
Dim Ar(5) As String * 10
Dim Bcount As Byte

'The split function can split a string or string constant into elements
'It returns the number of elements
'You need to take care that there are enough elements and that each element is
big enough
'to hold the result
'When a result does not fit into 1 element it will be put into the next element
'The memory is protected against overwriting.

S = "this is a test"

Bcount = Split( "this is a test" , Ar(1) , " ")
'bcount will get the number of filled elements
'ar(1) is the starting address to use
'" " means that we check for a space

'When you use "  aa"   , the first element will contain a space
Bcount = Split( "thiscannotfit! into the element" , Ar(1) , " ")

Dim J As Byte
For J = 1 To Bcount
  Print Ar(j)
Next

'this demonstrates that your memory is safe and will not be overwritten when
there are too many string parts
Bcount = Split( "do not overflow the array please" , Ar(1) , " ")

For J = 1 To Bcount
  Print Ar(j)
Next


End
```

SQR

Action

Returns the Square root of a variable.

Syntax

var = **SQR**(source)

Remarks

var	A numeric single or double variable that is assigned with the SQR of variable source.
source	The single or double variable to get the SQR of.

When SQR is used with a single, the FP_TRIG library will be used.
When SQR is used with bytes, integers, words and longs, the SQR routine from MCS.LBX will be used.

See Also
POWER

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim A As Single
Dim B As Double
A = 9.0
B = 12345678.123

A =Sqr(A)
Print A                                                    ' prints 3.0
B = Sqr(b)
Print B

End
```

START

Action
Start the specified device.

Syntax
START device

Remarks

Device	TIMER0, TIMER1, COUNTER0 or COUNTER1, WATCHDOG, AC (Analog comparator power) or ADC(A/D converter power)

You must start a timer/counter in order for an interrupt to occur (when the external gate is disabled).
TIMER0 and COUNTER0 are the same device.

The AC and ADC parameters will switch power to the device and thus enabling it to work.

See also
STOP

Example
```
'-----------------------------------------------------------------------------
--
'name                     : adc.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstration of GETADC() function for 8535 or M163
micro
'micro                    : Mega163
'suited for demo          : yes
'commercial addon needed  : no
'use in simulator         : possible
' Getadc() will also work for other AVR chips that have an ADC converter
'-----------------------------------------------------------------------------
--
$regfile = "m163def.dat"                                    ' we use the M163
$crystal = 4000000

$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               'default use 10 for
the SW stack
$framesize = 40                                             'default use 40 for
the frame space


'configure single mode and auto prescaler setting
'The single mode must be used with the GETADC() function

'The prescaler divides the internal clock by 2,4,8,16,32,64 or 128
'Because the ADC needs a clock from 50-200 KHz
'The AUTO feature, will select the highest clockrate possible
Config Adc = Single , Prescaler = Auto
'Now give power to the chip
Start Adc

'With STOP ADC, you can remove the power from the chip
'Stop Adc

Dim W As Word , Channel As Byte

Channel = 0
'now read A/D value from channel 0
Do
  W = Getadc(channel)
  Print "Channel " ; Channel ; " value " ; W
  Incr Channel
  If Channel > 7 Then Channel = 0
Loop
End

'The new M163 has options for the reference voltage
'For this chip you can use the additional param :
```

```
'Config Adc = Single , Prescaler = Auto, Reference = Internal
'The reference param may be :
'OFF      : AREF, internal reference turned off
'AVCC     : AVCC, with external capacitor at AREF pin
'INTERNAL : Internal 2.56 voltage reference with external capacitor ar AREF pin

'Using the additional param on chip that do not have the internal reference
will have no effect.
```

STCHECK

Action
Calls a routine to check for various stack overflows. This routine is intended for debug purposes.

Syntax
STCHECK

Remarks
The different stack spaces used by BASCOM-AVR lead to lots of questions about them.
The STCHECK routine can help to determine if the stack size are trashed by your program.
The program STACK.BAS is used to explain the different settings.

Note that STCHECK should be removed form your final program. That is once you tested your program and found out is works fine, you can remove the call to STCHECK since it costs time and code space.

The settings used are :
HW stack 8
Soft stack 2
Frame size 14

Below is a part of the memory of the 90S2313 used for the example:
C0 C1 C2 C3 C4 C5 C6 C7 C8 C9 CA CB CC CD CE CF
D0 D1 D2 D3 D4 D5 D6 D7 D8 D9 DA DB DC DD DE DF
FR FR FR FR FR FR FR FR
FR FR FR FR FR FR YY YY SP SP SP SP SP SP SP SP

Since the last memory in SRAM is DF, the hardware stack is occupied by D8-DF(8 bytes)
When a call is made or a push is used the data is saved at the position the hardware stack pointer is pointing to. After this the stack pointer is decreased.
A call uses 2 bytes so SP will be SP-2. (DF-2) =DD
When 8 bytes are stored the SP will point to D7. Another call or push will thus destroy memory position D7 which is occupied by the soft stack.

The soft stack begins directly after the hardware stack and is also growing down.

The Y pointer(r28+r29) is used to point to this data.

Since the Y pointer is decreased first and then the data is saved, the pointer must point at start up to a position higher. That is D8, the end of the hardware space.

St -y,r24 will point to D8-1=D7 and will store R24 at location D7.
Since 2 bytes were allocated in this example we use D7 and D6 to store the data.
When the pointer is at D6 and another St -y,r24 is used, it will write to position D5 which is the end of the frame space that is used as temporarily memory.

The frame starts at C8 and ends at D5. Writing beyond will overwrite the soft stack.
And when there is no soft stack needed, it will overwrite the hardware stack space.
The map above shows FR(frame), YY(soft stack data) and SP(hardware stack space)

How to determine the right values?

The stack check routine can be used to determine if there is an overflow.

It will check :
-if SP is below it's size. In this case below D8.
-if YY is below it’s size in this case when it is D5
-if the frame is above its size in this case D6

When is YY(soft stack) used? When you use a LOCAL variable inside a SUB or function. Each local variable will use 2 bytes.
When you pass variables to user Subroutines or functions it uses 2 bytes for each parameter.
call mysub(x,y) will use 2 * 2 = 4 bytes.
local z as byte ' will use another 2 bytes

This space is freed when the routine ends.
But when you call another sub inside the sub, you need more space.

```
sub mysub(x as byte,y as byte)
    call testsub(r as byte) ' we must add another 2 bytes
```

When you use empty(no params) call like :

call mytest() , No space is used.

When do you need frame space?
When ever you use a num<>string conversion routine like:

Print b (where b is a byte variable)

Bytes will use 4 bytes max (123+0)
Integer will use 7 bytes max (-12345+0)c
Longs will use 16 bytes max
And the single will use 24 bytes max

When you add strings and use the original the value must be remembered by the compiler.

Consider this :

```
s$ = "abcd" + s$
```

Here you give s$ a new value. But you append the original value so the original value must be remembered until the operation has completed. This copy is stored in the frame too.

So when string s$ was dimmed with a length of 20, you need a frame space of 20+1(null

byte)

When you pass a variable by VALUE (BYVAL) then you actually pass a copy of the variable.
When you pass a byte, 1 byte of frame space is used, a long will take 4 bytes.
When you use a LOCAL LONG, you also need 4 bytes of frame space to store the local long.

The frame space is reused and so is the soft stack space and hardware stack space.

So the hard part is to determine the right sizes!

The stack check routine must be called inside the deepest nested sub or function.

Gosub test

```
test:
  gosub test1
return


test1:
' this is the deepest level so check the stack here
  stcheck
return
```

Stcheck will use 1 variable named ERROR. You must dimension it yourself.

Dim Error As Byte

Error will be set to :

1: if hardware stack grows down into the soft stack space
2: if the soft stack space grows down into the frame space
3: if the frame space grows up into the soft stack space.

The last 2 errors are not necessarily bad when you consider that when the soft stack is not used for passing data, it may be used by the frame space to store data. Confusing right.?

It is advised to use the simpler DBG/$DBG method. This requires that you can simulate your program.

ASM

Routines called by STCHECK :
_StackCheck : uses R24 and R25 but these are saved and restored.

Because the call uses 2 bytes of hardware stack space and the saving of R24 and R25 also costs 2 bytes, it uses 4 more bytes of hardware stack space than your final program would do that f course does not need to use STCHECK.

Example

```
'-----------------------------------------------------------------------------
-----------
'name                    : stack.bas
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : shows how to check for the stack sizes
```

```
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                     ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 8                                                ' default use 32
for the hardware stack
$swstack = 2                                                ' default use 10
for the SW stack
$framesize = 14                                             ' default use 40
for the frame space
'settings must be :

'HW Stack : 8
'Soft Stack : 2
'Frame size : 14

'note that the called routine (_STACKCHECK) will use 4 bytes
'ofhardware stack space
'So when your program works, you may subtract the 4 bytes of the needed
hardware stack size
'in your final program that does not include the STCHECK

'testmode =0  will work
'testmode =1 will use too much hardware stack
'testmode =2 will use too much soft stack space
'testmode =3 will use too much frame space
Const Testmode = 0
'compile and test the program with testmode from 0-3


'you need to dim the ERROR byte !!
Dim Error As Byte


#if Testmode = 2
   Declare Sub Pass(z As Long , Byval K As Long)
#else
   Declare Sub Pass()
#endif



Dim I As Long
I = 2
Print I
'call the sub in your code at the deepest level
'normally within a function or sub


#if Testmode = 2
   Call Pass(i , 1)
#else
   Call Pass()
#endif
End



#if Testmode = 2
   Sub Pass(z As Long , Byval K As Long)
```

```
#else
  Sub Pass()
#endif
    #if Testmode = 3
       Local S As String * 13
    #else
       Local S As String * 8
    #endif

    Print I
    Gosub Test
End Sub


Test:
#if Testmode = 1
  push r0 ; eat some hardware stack space
  push r1
  push r2
#endif

  ' *** here we call the routine ***
  Stcheck
  ' *** when error <>0 then there is a problem ***
#if Testmode = 1
  pop r2
  pop r1
  pop r0
#endif

Return
```

STOP

Action

Stop the specified device. Or stop the program

Syntax

STOP device
STOP

Remarks

Device	TIMER0, TIMER1, COUNTER0 or COUNTER1, WATCHDOG, AC (Analog comparator power) or ADC(A/D converter power)

The single STOP statement will end your program by generating a never ending loop. When END is used it will have the same effect but in addition it will disable all interrupts.

The STOP statement with one of the above parameters will stop the specified device.

TIMER0 and COUNTER0 are the same device.
The AC and ADC parameters will switch power off the device to disable it and thus save power.

See also
START , END

Example
See START example

STR

Action
Returns a string representation of a number.

Syntax
var = **STR**(x)

Remarks

var	A string variable.
X	A numeric variable.

The string must be big enough to store the result.
You do not need to convert a variable into a string before you print it.
When you use PRINT var, then you will get the same result as when you convert the numeric variable into a string, and print that string.
The PRINT routine will convert the numeric variable into a string before it gets printed to the serial port.

As the integer conversion routines can convert byte, integer, word and longs into a string it also means some code overhead when you do not use longs. You can include the alternative library named mcsbyte.lbx then. This library can only print bytes. There is also a library for printing integers and words only. This library is named mcsbyteint.
When you use these libs to print a long you will get an error message.

See also
VAL , HEX , HEXVAL , MCSBYTE , BIN

Difference with VB
In VB STR() returns a string with a leading space. BASCOM does not return a leading space.

Example
```
Dim A As Byte , S As String * 10
A = 123
S = Str(a)
Print S                                                    ' 123
'when you use print a, you will get the same result.
'but a string can also be manipulated with the string routines.
End
```

STRING

Action
Returns a string consisting of m repetitions of the character with ASCIICode n.

Syntax
var = **STRING**(m ,n)

Remarks

Var	The string that is assigned.
N	The ASCII-code that is assigned to the string.
M	The number of characters to assign.

Since a string is terminated by a 0 byte, you can't use 0 for n.
Using 0 for m will result in a string of 255 bytes, because there is no check on a length assign of 0.

See also
SPACE

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 40                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim S As String * 15
S = String(5 , 65)
Print S                                                    'AAAAA
End
```

SUB

Action
Defines a Sub procedure.

Syntax
SUB Name[(var1 , …)]

Remarks

Name	Name of the sub procedure, can be any non-reserved word.
var1	The name of the parameter.

You must end each subroutine with the END SUB statement.
You can copy the DECLARE SUB line and remove the DECLARE statement. This ensures that you have the right parameters.

See Also

FUNCTION , CALL

See the DECLARE SUB topic for more details.

SYSSEC

Action

Returns a Number, which represents the System Second

Syntax

Target = **SYSSEC**()
Target = **SYSSEC**(bSecMinHour)
Target = **SYSSEC**(strTime, strDate)
Target = **SYSSEC**(wSysDay)

Remarks

Target	A Variable (LONG), that is assigned with the System-Second
BSecMinHour	A Byte, which holds the Sec-value followed by Min(Byte), Hour (Byte), Day(Byte), Month(Byte) and Year(Byte)
StrTime	A time-string in the format „hh:mm:ss"
StrDate	A date-string in the format specified in the Config Date statement
wSysDay	A variable (Word) which holds the System Day (SysDay)

The Function can be used with 4 different kind of inputs:

1. Without any parameter. The internal Time and Date of SOFTCLOCK (_sec, _min, _hour, _day, _month, _year) is used.
2. With a user defined time and Date array. It must be arranged in same way (Second, Minute, Hour, Day, Month, Year) as the internal SOFTCLOCK time/date. The first Byte (Second) is the input by this kind of usage. So the System Second can be calculated of every time/date.
3. With a time-String and a date-string. The time-string must be in the Format „hh:mm:ss". The date-string must be in the format specified in the Config Date statement
4. With a System Day Number (Word). The result ist the System Second of this day at 00:00:00.

The Return-Value is in the Range of 0 to 2147483647. 2000-01-01 at 00:00:00 starts with 0. The Function is valid from 2000-01-01 to 2068-01-19 03:14:07. In the year 2068 a LONG – overflow will occur.

See also

Date and Time Routines , SYSSECELAPSED, SYSDAY

Example

```
Enable Interrupts
Config Clock = Soft
Config Date = YMD , Separator =.' ANSI-Format

Dim Strdate As String * 8
Dim Strtime As String * 8
Dim Bsec As Byte , Bmin As Byte , Bhour As Byte
Dim Bday As Byte , Bmonth As Byte , Byear As Byte
Dim Wsysday As Word
Dim Lsyssec As Long



' Example 1 with internal RTC-Clock
' Load RTC-Clock for example - testing
_sec = 17 : _min = 35 : _hour = 8 : _day = 16 : _month = 4 : _year = 3
Lsyssec = Syssec()
Print "System Second of " ; Time$ ; " at " ; Date$ ; " is " ; Lsyssec
' System Second of 08:35:17 at 03.04.16 is 103797317


' Example 2 with with defined Clock - Bytes (Second, Minute, Hour, Day / Month
/ Year)
Bsec = 20 : Bmin = 1 : Bhour = 7 : Bday = 22 : Bmonth = 12 : Byear = 1
Lsyssec = Syssec(bsec)
Strtime = Time_sb(bsec) : Strdate = Date_sb(bday)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec
' System Second of 07:01:20 at 01.12.22 is 62319680


' Example 3 with Time and Date - String
Strtime = "04:58:37"
strDate ="02.09.18"
Lsyssec = Syssec(strtime , Strdate)
Print "System Second of " ; Strtime ; " at " ; Strdate ; " is " ; Lsyssec
' System Second of 04:58:37 at 02.09.18 is 85640317



' Example 4 with System Day
Wsysday = 2000
Lsyssec = Syssec(wsysday)
Print "System Second of System Day " ; Wsysday ; " (00:00:00) is " ; Lsyssec
' System Second of System Day 2000 (00:00:00) is 172800000
```

SYSSECELAPSED

Action

Returns the elapsed Seconds to a earlier assigned system-time-stamp.

Syntax
Target = **SysSecElapsed**(SystemTimeStamp)

Remarks

Target	A variable (LONG), that is assigned with the elapsed Seconds
SystemTimeStamp	A variable (LONG), which holds a Systemtimestamp like the output of an earlier called SysSec()

The Return-Value is in the Range of 0 to 2147483647. The Function is valid from 2000-01-01 to 2068-01-19 at 03:14:07. In the year 2068 a LONG – overflow will occur.

The difference to the pair DayOfSec and SecElapsed is, that SysSec and SysSecElapsed can be used for event distances larger than 24 hours.

See also
Date and Time Routines , SECELAPSED, SYSSEC

Example
```
Enable Interrupts
Config Clock = Soft

Dim Lsystemtimestamp As Long
Dim Lsystemsecondselapsed As Long

Lsystemtimestamp = Syssec()
Print "Now it's " ; Lsystemtimestamp ; " seconds past 2000-01-01 00:00:00"

' do other stuff
' some time later

Lsystemsecondselapsed = Syssecelapsed(lsystemtimestamp)
Print "Now it's " ; Lsystemsecondselapsed ; " seconds later"
```

SYSDAY

Action
Returns a number, which represents the System Day

Syntax
Target = **SysDay**()
Target = **SysDay**(bDayMonthYear)
Target = **SysDay**(strDate)
Target = **SysDay**(lSysSec)

Remarks

Target	A Variable (LONG), that is assigned with the System-Day
bDayMonthDay	A Byte, which holds the Day-value followed by Month(Byte) and Year (Byte)

strDate	A String, which holds a Date-String in the format specified in the CONFIG DATA statement
lSysSec	A variable, which holds a System Second (SysSec)

The Function can be used with 4 different kind of inputs:

1. Without any parameter. The internal Date-values of SOFTCLOCK (_day, _month, _year) are used.
2. With a user defined date array. It must be arranged in same way (Day, Month, Year) as the internal SOFTCLOCK date. The first Byte (Day) is the input by this kind of usage. So the Day of the Year can be calculated of every date.
3. With a Date-String. The date-string must be in the Format specified in the Config Date Statement.
4. With a System Second Number (LONG)

The Return-Value is in the Range of 0 to 36524. 2000-01-01 starts with 0.
The Function is valid in the 21th century (from 2000-01-01 to 2099-12-31).

See also

Date and Time Routines , Config Date , Config Clock , SysSec

Example

```
Enable Interrupts
Config Clock = Soft
Config Date = YMD , Separator =.' ANSI-Format

Dim Strdate As String * 8
Dim Bday Asbyte , Bmonth As Byte , Byear As Byte
Dim Wsysday As Word
Dim Lsyssec As Long


' Example 1 with internal RTC-Clock
_day = 20 : _Month = 11 : _Year = 2 ' Load RTC-Clock for example - testing
Wsysday = Sysday()
Print "System Day of " ; Date$ ; " is " ; Wsysday

' System Day of 02.11.20 is 1054


' Example 2 with defined Clock - Bytes (Day / Month / Year)
Bday = 24 : Bmonth = 5 : Byear = 8
Wsysday = Sysday(bday)
Print "System Day of Day=" ; Bday ; " Month=" ; Bmonth ; " Year=" ; Byear ; "
is " ; Wsysday
' System Day of Day=24 Month=5 Year=8 is 3066


' Example 3 with Date - String
Strdate = "04.10.29"
Wsysday = Sysday(strdate)
Print "System Day of " ; Strdate ; " is " ; Wsysday
' System Day of 04.10.29 is 1763



' Example 4 with System Second
Lsyssec = 123456789
```

```
Wsysday = Sysday(lsyssec)
Print "System Day of System Second " ; Lsyssec ; " is " ; Wsysday
' System Day of System Second 123456789 is 1428"Now it's " ;
Lsystemsecondselapsed ; " seconds later"
```

SWAP

Action
Exchange two variables of the same type.

Syntax
SWAP var1, var2

Remarks

var1	A variable of type bit, byte, integer, word, long or string.
var2	A variable of the same type as var1.

After the swap, var1 will hold the value of var2 and var2 will hold the value of var1.

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : swap.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: SWAP
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , B1 As Byte
Dim Bbit1 As Bit , Bbit2 As Bit
Dim S1 As String * 10 , S2 As String * 10



S1 = "AAA" : S2 = "BBB"
Swap S1 , S2

A = 5 : B1 = 10                                            'assign some vars
Print A ; "   " ; B1                                       'print them

Swap A , B1                                                'swap them
```

```
Print A ; "    " ; B1                                    'print is again

Set Bbit1
Swap Bbit1 , Bbit2
Print Bbit1 ; Bbit2

End
```

TAN

Action
Returns the tangent of a float

Syntax
var = **TAN**(source)

Remarks

Var	A numeric variable that is assigned with tangent of variable source.
Source	The single or double variable to get the tangent of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , ATN , COS , SIN , ATN2

Example
```
$regfile = "m48def.dat"                                 ' specify the used
micro
$crystal = 8000000                                      ' used crystal
frequency
$baud = 19200                                           ' use baud rate
$hwstack = 32                                           ' default use 32
for the hardware stack
$swstack = 10                                           ' default use 10
for the SW stack
$framesize = 40                                         ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim S As Single , X As Single
S = 0.5 : X = Tan(s) : Print X                          ' prints
0.546302195
S = 0.5 : X = Sin(s) : Print X                          ' prints
0.479419108
S = 0.5 : X = Cos(s) : Print X                          ' prints
0.877588389

End
```

TCPCHECKSUM

Action
Return a TCP/IP checksum

Syntax
res= **TCPCHECKSUM**(buffer , bytes)

Remarks

Res	A word variable that is assigned with the TCP/IP checksum of the buffer
Buffer	A variable or array to get the checksum of.
Bytes	The number of bytes that must be examined.

Checksum's are used a lot in communication protocols. A checksum is a way to verify that received data is the same as it was sent. In the TCP/IP protocol a special checksum is used. You can use it for the PING sample.

See also
CRC8 , CRC16, CRC32 , CHECKSUM

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
'name                    : PING_TWI.bas
http://www.faqs.org/rfcs/rfc792.html
'copyright               : (c) 1995-2005, MCS Electronics
'purpose                 : Simple PING program
'micro                   : Mega88
'suited for demo         : yes
'commercial addon needed : no
'-----------------------------------------------------------------------------
$regfile = "m32def.dat"                                     ' specify the used
micro

$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 80                                               ' default use 32
for the hardware stack
$swstack = 128                                              ' default use 10
for the SW stack
$framesize = 80                                             ' default use 40
for the frame space

Const Debug = 1

Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
```

```
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW


'we do the usual
Print "Init TCP"                                            ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55
, Twi = &H80 , Clock = 400000
Print "Init done"

Dim Peersize As Integer , Peeraddress As Long , Peerport As Word
Dim Idx As Byte , Result As Word , J As Byte , Res As Byte
Dim Ip As Long
Dim Dta(12) As Byte , Rec(12) As Byte


Dta(1) = 8                                                  'type is echo
Dta(2) = 0                                                  'code

Dta(3) = 0                                                  ' for checksum
initialization
Dta(4) = 0                                                  ' checksum
Dta(5) = 0                                                  ' a signature can
be any number
Dta(6) = 1                                                  '   signature
Dta(7) = 0                                                  ' sequence number -
any number
Dta(8) = 1
Dta(9) = 65

Dim W As Word At Dta + 2 Overlay                            'same as dta(3) and
dta(4)
W = Tcpchecksum(dta(1) , 9)                                 ' calculate
```

```
checksum and store in dta(3) and dta(4)

#if Debug
  For J = 1 To 9
    Print Dta(j)
  Next
#endif


Ip = Maketcp(192.168.0.16)                                  'try to check this
server

Print "Socket " ; Idx ; " " ; Idx
Setipprotocol Idx , 1                                       'set protocol to 1
'the protocol value must be set BEFORE the socket is openend

Idx = Getsocket(idx , 3 , 5000 , 0)


Do
   Result = Udpwrite(ip , 7 , Idx , Dta(1) , 9)            'write ping data
            '
   Print Result
   Waitms 100
   Result = Socketstat(idx , Sel_recv)                      'check for data
   Print Result
   If Result >= 11 Then
      Print "Ok"
      Res = Tcpread(idx , Rec(1) , Result)                  'get data with
TCPREAD !!!
      #if Debug
        Print "DATA RETURNED :" ; Res                       '
        For J = 1 To Result
          Print Rec(j) ; " " ;
        Next
        Print
      #endif
   Else                                                     'there might be a
problem
      Print "Network not available"
   End If
   Waitms 1000
Loop
```

TCPREAD

Action

Reads data from an open socket connection.

Syntax

Result = **TCPREAD**(socket , var, bytes)

Remarks

Result	A byte variable that will be assigned with **0**, when no errors occured. When an error occurs, the value will be set to **1**. When there are not enough bytes in the reception buffer, the routine will wait until there is enough data or the socket is closed.
socket	The socket number you want to read data from (0-3).

Var	The name of the variable that will be assigned with the data from the socket.
Bytes	The number of bytes to read. Only valid for non-string variables.

When you use TCPread with a string variable, the routine will wait for CR + LF and it will return the data without the CR + LF.
For strings, the function will not overwrite the string.

For example, your string is 10 bytes long and the line you receive is 80 bytes long, you will receive only the first 10 bytes after CR + LF is encountered.
Also, for string variables, you do not need to specify the number of bytes to read since the routine will wait for CR + LF.

For other data types you need to specify the number of bytes.
There will be no check on the length so specifying to receive 2 bytes for a byte will overwrite the memory location after the memory location of the byte.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN

Partial Example
```
Result = Socketstat(idx , Sel_recv)              ' get number of bytes waiting
If Result > 0 Then
   Result = Tcpread(idx , S)
End If
```

TCPWRITE

Action
Write data to a socket.

Syntax
Result = **TCPWRITE**(socket , var , bytes)
Result = **TCPWRITE**(socket , EPROM, address , bytes)

Remarks

Result	A word variable that will be assigned with the number of bytes actually written to the socket. When the free transmission buffer is large enough to accept all the data, the result will be the same as BYTES. When there is not enough space, the number of written bytes will be returned. When there is no space, 0 will be returned.
Socket	The socket number you want to send data to(0-3).
Var	A constant string like "test" or a variable. When you send a constant string, the number of bytes to send does not need to be specified.

Bytes	A word variable or numeric constant that specifies how many bytes must be send.
Address	The address of the data stored in the chips internal EEPROM. You need to specify EPROM too in that case.
EPROM	An indication for the compiler so it knows that you will send data from EPROM.

The TCPwrite function can be used to write data to a socket that is stored in EEPROM or in memory.
When you want to send data from an array, you need to specify the element : var(idx) for example.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Example
```
Result = Tcpwrite(idx , "Hello from W3100A{013}{010}")
```

TCPWRITESTR

Action
Sends a string to an open socket connection.

Syntax
Result = **TCPWRITESTR**(socket , var , param)

Remarks

Result	A word variable that will be assigned with the number of bytes actually written to the socket. When the free transmission buffer is large enough to accept all the data, the result will be the same as BYTES. When there is not enough space, the number of written bytes will be returned. When there is no space, 0 will be returned.
Socket	The socket number you want to send data to (0-3).
Var	The name of a string variable.
Param	A parameter that might be 0 to send only the string or 255, to send the string with an additional CR + LF This option was added because many protocols expect CR + LF after the string.

The TCPwriteStr function is a special variant of the TCPwrite function.
It will use TCPWrite to send the data.

See also

CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPREAD, CLOSESOCKET , SOCKETLISTEN

Example

```
'-----------------------------------------------------------------------------
'                               SMTP.BAS
'                        (c) 2002 MCS Electronics
' sample that show how to send an email with SMTP protocol
'-----------------------------------------------------------------------------

$regfile = "m161def.dat"                                    ' used processor
$crystal = 4000000                                          ' used crystal
$baud = 19200                                               ' baud rate
$lib "tcpip.lbx"                                            ' specify the name
of the tcp ip lib

'W3100A constants
Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW
```

```
Const Debug = -1                                            ' for sending
feeback to the terminal


#if Debug
  Print "Start of SMTP demo"
#endif

Enable Interrupts                                           ' enable interrupts
'specify  MAC, IP, submask and gateway
'local port value will be used when you do not specify a port value while
creating a connection
'TX and RX are setup to use 4 connections each with a 2KB buffer
Config Tcpip = Int0 , Mac = 00.44.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

'dim the used variables
Dim S As String * 50 , I As Byte , J As Byte , Tempw As Word
#if Debug
  Print "setup of W3100A complete"
#endif

'First we need a socket
I = Getsocket(0 , Sock_stream , 5000 , 0)
'             ^ socket numer     ^ port
#if Debug
  Print "Socket : " ; I
  'the socket must return the asked socket number. It returns 255 if there was
an error
#endif

If I = 0 Then                                               ' all ok
   'connect to smtp server
   J = Socketconnect(i , 194.09.0. , 25)                    ' smtp server and
SMTP port 25
   '                  ^socket
   '                       ^ ip address of the smtp server
   '                                          ^ port 25 for smtp
    '  DO NOT FORGET to ENTER a valid IP number of your ISP smtp server
   #if Debug
      Print "Connection : " ; J
      Print S_status(1)
   #endif
   If J = 0 Then                                            ' all ok
      #if Debug
         Print "Connected"
      #endif
      Do
         Tempw = Socketstat(i , 0)                          ' get status
         Select Case Tempw
           Case Sock_established                            ' connection
established
              Tempw = Tcpread(i , S)                        ' read line
              #if Debug
                  Print S                                   ' show info from
smtp server
              #endif
              If Left(s , 3) = "220" Then                   ' ok
                 Tempw = Tcpwrite(i , "HELO username{013}{010}" )       ' send
username
                 '                             ^^^ fill in username there
                 #if Debug
                   Print Tempw ; "  bytes written"          ' number of bytes
actual send
                 #endif
```

```
                  Tempw = Tcpread(i , S)                    ' get response
                  #if Debug
                     Print S                                ' show response
                  #endif
                  If Left(s , 3) = "250" Then               ' ok
                     Tempw = Tcpwrite(i , "MAIL
FROM:<tcpip@test.com>{013}{010}")        ' send from address
                     Tempw = Tcpread(i , S)                 ' get response
                     #if Debug
                        Print S
                     #endif
                     If Left(s , 3) = "250" Then            ' ok
                        Tempw = Tcpwrite(i , "RCPT
TO:<tcpip@test.com>{013}{010}")        ' send TO address
                        Tempw = Tcpread(i , S)              ' get response
                        #if Debug
                           Print S
                        #endif
                        If Left(s , 3) = "250" Then         ' ok
                           Tempw = Tcpwrite(i , "DATA{013}{010}")       '
speicfy that we are going to send data
                           Tempw = Tcpread(i , S)           ' get response
                           #if Debug
                              Print S
                           #endif
                           If Left(s , 3) = "354" Then      ' ok
                              Tempw = Tcpwrite(i , "From:
tcpip@test.com{013}{010}")
                              Tempw = Tcpwrite(i , "To:
tcpip@test.com{013}{010}")
                              Tempw = Tcpwrite(i , "Subject: BASCOM SMTP
test{013}{010}")
                              Tempw = Tcpwrite(i , "X-Mailer: BASCOM
SMTP{013}{010}")
                              Tempw = Tcpwrite(i , "{013}{010}")
                              Tempw = Tcpwrite(i , "This is a test email from
BASCOM SMTP{013}{010}")
                              Tempw = Tcpwrite(i , "Add more lines as
needed{013}{010}")
                              Tempw = Tcpwrite(i , ".{013}{010}")       ' end
with a single dot

                              Tempw = Tcpread(i , S)        ' get response
                              #if Debug
                                Print S
                              #endif
                              If Left(s , 3) = "250" Then   ' ok
                                 Tempw = Tcpwrite(i , "QUIT{013}{010}")       '
quit connection
                                 Tempw = Tcpread(i , S)
                                 #if Debug
                                    Print S
                                 #endif
                              End If
                           End If
                        End If
                     End If
                  End If
               End If
            Case Sock_close_wait
               Print "CLOSE_WAIT"
               Closesocket I                                ' close the
connection
            Case Sock_closed
               Print "Socket CLOSED"                        ' socket is closed
```

```
            End
         End Select
      Loop
   End If
End If
End                                                    'end program
```

TANH

Action
Returns the hyperbole of a single

Syntax
var = **TANH**(source)

Remarks

Var	A numeric variable that is assigned with hyperbole of variable source.
Source	The single or double variable to get the hyperbole of.

All trig functions work with radians. Use deg2rad and rad2deg to convert between radians and angles.

See Also
RAD2DEG , DEG2RAD , ATN , COS , SIN , SINH , COSH

Example
Show sample

THIRDLINE

Action
Reset LCD cursor to the third line.

Syntax
THIRDLINE

Remarks
NONE

See also
UPPERLINE , LOWERLINE , FOURTHLINE

Example

```
Dim A As Byte
A = 255
Cls
Lcd A
Thirdline
Lcd A
Upperline
End
```

TIME$

Action

Internal variable that holds the time.

Syntax

TIME$ = "hh:mm:ss"
var = **TIME$**

Remarks

The TIME$ variable is used in combination with the CONFIG CLOCK and CONFIG DATE directive.

The CONFIG CLOCK statement will use the TIMER0 or TIMER2 in async mode to create a 1 second interrupt. In this interrupt routine the _Sec, _Min and _Hour variables are updated. The time format is 24 hours format.

When you assign TIME$ to a string variable these variables are assigned to the TIME$ variable.
When you assign the TIME$ variable with a constant or other variable, the _sec, _Hour and _Min variables will be changed to the new time.

The only difference with VB is that all digits must be provided when assigning the time. This is done for minimal code. You can change this behavior of course.

The async timer is only available in the M103, 90S8535, M163 and M32(3), Mega128, Mega64, Mega8. For other chips it will not work.

As new chips are launched by Atmel, and support is added by MCS, the list above might not be complete. It is intended to serve as an example for chips with a timer that can be used in asynchrone mode. So when your micro has a timer that can be used in asynchrone mode, it should work.

Do not confuse DATE$ with the DATE function.

ASM

The following asm routines are called from mcs.lib.
When assiging TIME$: _set_time (calls _str2byte)
When reading TIME$: _make_dt (calls _byte2str)

See also
DATE$, CONFIG CLOCK , CONFIG DATE

Example
See the sample of DATE$

TIME

Action
Returns a time-value (String or 3 Byte for Second, Minute and Hour) depending of the Type of the Target

Syntax
bSecMinHour = **Time**(lSecOfDay)
bSecMinHour = **Time**(lSysSec)
bSecMinHour = **Time**(strTime)

strTime = **Time**(lSecOfDay)
strTime = **Time**(lSysSec)
strTime = **Time**(bSecMinHour)

Remarks

bSecMinHour	A BYTE – variable, which holds the Second-value followed by Minute (Byte) and Hour (Byte)
strTime	A Time – String in Format „hh:mm:ss"
lSecOfDay	A LONG – variable which holds Second Of Day (SecOfDay)
lSysSec	A LONG – variable which holds System Second (SysSec)

Converting to a time-string:
The target string strTime must have a length of at least 8 Bytes, otherwise SRAM after the target-string will be overwritten.

Converting to Softclock format (3 Bytes for Second, Minute and Hour):
Three Bytes for Seconds, Minutes and Hour must follow each other in SRAM. The variable-name of the first Byte, that one for Second must be passed to the function.

See also
Date and Time Routines , SECOFDAY, SYSSEC

Partial Example
```
Enable Interrupts
Config Clock = Soft

Dim Strtime As String * 8
Dim Bsec As Byte , Bmin As Byte , Bhour As Byte
Dim Lsecofday As Long
```

```
Dim Lsyssec As Long


' Example 1: Converting defined Clock - Bytes (Second / Minute / Hour) to Time
- String
Bsec = 20 : Bmin = 1 : Bhour = 7
Strtime = Time(bsec)
Print "Time values: Sec=" ; Bsec ; " Min=" ; Bmin ; " Hour=" ; Bhour ; "
converted to string " ; Strtime
' Time values: Sec=20 Min=1 Hour=7 converted to string 07:01:20


' Example 2: Converting System Second to Time - String
Lsyssec = 123456789
Strtime = Time(lsyssec)
Print "Time of Systemsecond " ; Lsyssec ; " is " ; Strtime

' Time of Systemsecond 123456789 is 21:33:09


' Example 3: Converting Second of Day to Time - String
Lsecofday = 12345
Strtime = Time(lsecofday)
Print "Time of Second of Day " ; Lsecofday ; " is " ; Strtime
' Time of Second of Day 12345 is 03:25:45


' Example 4: Converting System Second to defined Clock - Bytes (Second / Minute
/ Hour)
Lsyssec = 123456789
Bsec = Time(lsyssec)
Print "System Second " ; Lsyssec ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour

' System Second 123456789 converted to Sec=9 Min=33 Hour=21


' Example 4: Converting Second of Day to defined Clock - Bytes (Second / Minute
/ Hour)
Lsecofday = 12345
Bsec = Time(lsecofday)
Print "Second of Day " ; Lsecofday ; " converted to Sec=" ; Bsec ; " Min=" ;
Bmin ; " Hour=" ; Bhour
' Second of Day 12345 converted to Sec=45 Min=25 Hour=3
```

TOGGLE

Action

Toggles the state of an output pin or bit variable.

Syntax

TOGGLE pin

Remarks

pin	Any port pin like PORTB.0 or bit variable. A port pin must be configured as an output pin before TOGGLE can be used.

With TOGGLE you can simply invert the output state of a port pin.

When the pin is driving a relays for example and the relays is OFF, one TOGGLE statement will turn the relays ON. Another TOGGLE will turn the relays OFF again.

See also
CONFIG PORT

ASM
NONE

Partial Example
```
Dim Var As Byte
Config Pinb.0 = Output                                  ' portB.0 is an
output now

Do
  Toggle Portb.0                                        'toggle state
  Waitms 1000                                           'wait for 1 sec
Loop
```

TRIM

Action
Returns a copy of a string with leading and trailing blanks removed

Syntax
var = **TRIM**(org)

Remarks

Var	String that receives the result.
Org	The string to remove the spaces from

TRIM is the same as a LTRIM() and RTRIM() call. It will remove the spaces on the left and right side of the string.

See also
RTRIM , LTRIM

Partial Example
```
Dim S As String * 6
S =" AB "
Print Ltrim(s)
Print Rtrim(s)
Print Trim(s)
End
```

UCASE

Action
Converts a string in to all upper case characters.

Syntax
Target = **UCASE**(source)

Remarks

Target	The string that is assigned with the upper case string of string target.
Source	The source string.

See also
LCASE

ASM
The following ASM routines are called from MCS.LIB : _UCASE
X must point to the target string, Z must point to the source string.
The generated ASM code : (can be different depending on the micro used)

```
;##### Z = Ucase(s)
Ldi R30,$60
Ldi R31,$00 ; load constant in register
Ldi R26,$6D
Rcall _Ucase
```

Example

```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


Dim S As String * 12 , Z As String * 12
S = "Hello World"
Z = Lcase(s)
Print Z
Z = Ucase(s)
Print Z
End
```

UDPREAD

Action
Reads data via UDP protocol.

Syntax
Result = **UDPREAD**(socket , var, bytes)

Remarks

Result	A byte variable that will be assigned with **0**, when no errors occured. When an error occurs, the value will be set to **1**. When there are not enough bytes in the reception buffer, the routine will wait until there is enough data or the socket is closed.
socket	The socket number you want to read data from (0-3).
Var	The name of the variable that will be assigned with the data from the socket.
Bytes	The number of bytes to read.

Reading strings is not supported for UDP.
When you need to read a string you can use the OVERLAY option of DIM.

There will be no check on the length so specifying to receive 2 bytes for a byte will overwrite the memory location after the memory location of the byte.

The socketstat function will return a length of the number of bytes + 8 for UDP. This because UDP sends also a 8 byte header. It contains the length of the data, the IP number of the peer and the port number.

The UDPread function will fill the following variables with this header data:

Peersize, PeerAddress, PeerPort

You need to DIM these variables in your program when you use UDP.
Use the following line :

Dim Peersize As Integer , Peeraddress As Long , Peerport As Word

Make sure you maintain the shown order.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPWRITESTR, CLOSESOCKET , SOCKETLISTEN , UDPWRITE, UDPWRITESTR

Example
```
'-------------------------------------------------------------------------------
-----------
'name                     : udptest.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : start the easytcp.exe program after the chip is
programmed and
'                          press UDP button
'micro                    : Mega161
'suited for demo          : no
'commercial addon needed  : yes
```

```
'-------------------------------------------------------------------------
-----------

$regfile = "m161def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW



$lib "tcpip.lbx"                                            ' specify the tcpip
library
Print "Init , set IP to 192.168.0.8"                       ' display a message
Enable Interrupts                                           ' before we use
```

```
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 0.0.0.0 , Localport = 1000 , Tx = $55 , Rx = $55

'Use the line below if you have a gate way
'Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

Dim Idx As Byte                                             ' socket number
Dim Result As Word                                          ' result
Dim S(80) As Byte
Dim Sstr As String * 20
Dim Temp As Byte , Temp2 As Byte                            ' temp bytes
'-------------------------------------------------------------------------------
-------------
'When you use UDP, you need to dimension the following variables in exactly the
same order !
Dim Peersize As Integer , Peeraddress As Long , Peerport As Word
'-------------------------------------------------------------------------------
-------------
Declare Function Ipnum(ip As Long) As String                ' a handy function

'like with TCP, we need to get a socket first
'note that for UDP we specify sock_dgram
Idx = Getsocket(idx , Sock_dgram , 5000 , 0)                ' get socket for
UDP mode, specify port 5000
Print "Socket " ; Idx ; " " ; Idx

'UDP is a connection less protocol which means that you can not listen, connect
or can get the status
'You can just use send and receive the same way as for TCP/IP.
'But since there is no connection protocol, you need to specify the destination
IP address and port
'So compare to TCP/IP you send exactly the same, but with the addition of the
IP and PORT
Do
   Temp = Inkey()                                           ' wait for terminal
input
   If Temp = 27 Then                                        ' ESC pressed
      Sstr = "Hello"
      Result = Udpwritestr(192.168.0.3 , 5000 , Idx , Sstr , 255)
   End If
   Result = Socketstat(idx , Sel_recv)                      ' get number of
bytes waiting
   If Result > 0 Then
      Print "Bytes waiting : " ; Result
      Temp2 = Result - 8                                    'the first 8 bytes
are always the UDP header which consist of the length, IP number and port
address
      Temp = Udpread(idx , S(1) , Result)                   ' read the result
      For Temp = 1 To Temp2
          Print S(temp) ; " " ;                             ' print result
      Next
      Print
      Print Peersize ; " " ; Peeraddress ; " " ; Peerport   ' these are
assigned when you use UDPREAD
      Print Ipnum(peeraddress)                              ' print IP in usual
format
      Result = Udpwrite(192.168.0.3 , Peerport , Idx , S(1) , Temp2)       '
write the received data back
   End If
Loop
'the sample above waits for data and send the data back for that reason temp2
is subtracted with 8, the header size

'this function can be used to display an IP number in normal format
```

```
Function Ipnum(ip As Long) As String
    Local T As Byte , J As Byte
    Ipnum = ""
    For J = 1 To 4
      T = Ip And 255
      Ipnum = Ipnum + Str(t)
      If J < 4 Then Ipnum = Ipnum + "."
      Shift Ip , Right , 8
    Next
End Function

End
```

UDPWRITE

Action
Write UDP data to a socket.

Syntax
Result = **UDPwrite**(IP, port, socket , var , bytes)
Result = **UDPwrite**(IP, port, socket , EPROM, address , bytes)

Remarks

Result	A word variable that will be assigned with the number of bytes actually written to the socket. When the free transmission buffer is large enough to accept all the data, the result will be the same as BYTES. When there is not enough space, the number of written bytes will be returned. When there is no space, 0 will be returned.
IP	The IP number you want to send data to. Use the format 192.168.0.5 or use a LONG variable that contains the IP number.
Port	The port number you want to send data too.
Socket	The socket number you want to send data to(0-3).
Var	A constant string like "test" or a variable. When you send a constant string, the number of bytes to send does not need to be specified.
Bytes	A word variable or numeric constant that specifies how many bytes must be send.
Address	The address of the data stored in the chips internal EEPROM. You need to specify EPROM too in that case.
EPROM	An indication for the compiler so it knows that you will send data from EPROM.

The UDPwrite function can be used to write data to a socket that is stored in EEPROM or in memory.
When you want to send data from an array, you need to specify the element : var(idx) for example.

Note that UDPwrite is almost the same as TCPwrite. Since UDP is a connection-less protocol, you need to specify the IP address and the port number.

UDP only requires an opened socket. The is no connect or close needed.

See also
CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITESTR, TCPREAD, CLOSESOCKET , SOCKETLISTEN , UDPWRITESTR , UDPREAD

Example
See UDPwriteStr

UDPWRITESTR

Action
Sends a string via UDP.

Syntax
Result = **UDPwriteStr**(IP, port, socket , var , param)

Remarks

Result	A word variable that will be assigned with the number of bytes actually written to the socket. When the free transmission buffer is large enough to accept all the data, the result will be the same as BYTES. When there is not enough space, the number of written bytes will be returned. When there is no space, 0 will be returned.
IP	The IP number you want to send data to. Use the format 192.168.0.5 or use a LONG variable that contains the IP number.
Port	The port number you want to send data too.
Socket	The socket number you want to send data to (0-3).
Var	The name of a string variable.
Param	A parameter that might be 0 to send only the string or 255, to send the string with an additional CR + LF This option was added because many protocols expect CR + LF after the string.

The UDPwriteStr function is a special variant of the UDPwrite function.
It will use UDPWrite to send the data.

See also

CONFIG TCPIP, GETSOCKET , SOCKETCONNECT, SOCKETSTAT , TCPWRITE, TCPREAD, CLOSESOCKET , SOCKETLISTEN , UDPWRITE, UDPREAD

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : udptest.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : start the easytcp.exe program after the chip is
programmed and
'                          press UDP button
'micro                    : Mega161
'suited for demo          : no
'commercial addon needed  : yes
'-----------------------------------------------------------------------------
-----------

$regfile = "m161def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

Const Sock_stream = $01                                     ' Tcp
Const Sock_dgram = $02                                      ' Udp
Const Sock_ipl_raw = $03                                    ' Ip Layer Raw Sock
Const Sock_macl_raw = $04                                   ' Mac Layer Raw
Sock
Const Sel_control = 0                                       ' Confirm Socket
Status
Const Sel_send = 1                                          ' Confirm Tx Free
Buffer Size
Const Sel_recv = 2                                          ' Confirm Rx Data
Size

'socket status
Const Sock_closed = $00                                     ' Status Of
Connection Closed
Const Sock_arp = $01                                        ' Status Of Arp
Const Sock_listen = $02                                     ' Status Of Waiting
For Tcp Connection Setup
Const Sock_synsent = $03                                    ' Status Of Setting
Up Tcp Connection
Const Sock_synsent_ack = $04                                ' Status Of Setting
Up Tcp Connection
Const Sock_synrecv = $05                                    ' Status Of Setting
Up Tcp Connection
Const Sock_established = $06                                ' Status Of Tcp
Connection Established
Const Sock_close_wait = $07                                 ' Status Of Closing
Tcp Connection
Const Sock_last_ack = $08                                   ' Status Of Closing
Tcp Connection
Const Sock_fin_wait1 = $09                                  ' Status Of Closing
Tcp Connection
Const Sock_fin_wait2 = $0a                                  ' Status Of Closing
Tcp Connection
Const Sock_closing = $0b                                    ' Status Of Closing
Tcp Connection
```

```
Const Sock_time_wait = $0c                                  ' Status Of Closing
Tcp Connection
Const Sock_reset = $0d                                      ' Status Of Closing
Tcp Connection
Const Sock_init = $0e                                       ' Status Of Socket
Initialization
Const Sock_udp = $0f                                        ' Status Of Udp
Const Sock_raw = $10                                        ' Status of IP RAW



$lib "tcpip.lbx"                                            ' specify the tcpip
library
Print "Init , set IP to 192.168.0.8"                        ' display a message
Enable Interrupts                                           ' before we use
config tcpip , we need to enable the interrupts
Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 0.0.0.0 , Localport = 1000 , Tx = $55 , Rx = $55

'Use the line below if you have a gate way
'Config Tcpip = Int0 , Mac = 12.128.12.34.56.78 , Ip = 192.168.0.8 , Submask =
255.255.255.0 , Gateway = 192.168.0.1 , Localport = 1000 , Tx = $55 , Rx = $55

Dim Idx As Byte                                             ' socket number
Dim Result As Word                                          ' result
Dim S(80) As Byte
Dim Sstr As String * 20
Dim Temp As Byte , Temp2 As Byte                            ' temp bytes
'-------------------------------------------------------------------------------
-------------
'When you use UDP, you need to dimension the following variables in exactly the
same order !
Dim Peersize As Integer , Peeraddress As Long , Peerport As Word
'-------------------------------------------------------------------------------
-------------
Declare Function Ipnum(ip As Long) As String                ' a handy function

'like with TCP, we need to get a socket first
'note that for UDP we specify sock_dgram
Idx = Getsocket(idx , Sock_dgram , 5000 , 0)                ' get socket for
UDP mode, specify port 5000
Print "Socket " ; Idx ; " " ; Idx

'UDP is a connection less protocol which means that you can not listen, connect
or can get the status
'You can just use send and receive the same way as for TCP/IP.
'But since there is no connection protocol, you need to specify the destination
IP address and port
'So compare to TCP/IP you send exactly the same, but with the addition of the
IP and PORT
Do
   Temp = Inkey()                                           ' wait for terminal
input
   If Temp = 27 Then                                        ' ESC pressed
      Sstr = "Hello"
      Result = Udpwritestr(192.168.0.3 , 5000 , Idx , Sstr , 255)
   End If
   Result = Socketstat(idx , Sel_recv)                      ' get number of
bytes waiting
   If Result > 0 Then
      Print "Bytes waiting : " ; Result
      Temp2 = Result - 8                                    'the first 8 bytes
are always the UDP header which consist of the length, IP number and port
address
      Temp = Udpread(idx , S(1) , Result)                   ' read the result
      For Temp = 1 To Temp2
```

```
          Print S(temp) ; " " ;                                ' print result
      Next
      Print
      Print Peersize ; " " ; Peeraddress ; " " ; Peerport    ' these are
assigned when you use UDPREAD
      Print Ipnum(peeraddress)                                 ' print IP in usual
format
      Result = Udpwrite(192.168.0.3 , Peerport , Idx , S(1) , Temp2)       '
write the received data back
   End If
Loop
'the sample above waits for data and send the data back for that reason temp2
is subtracted with 8, the header size

'this function can be used to display an IP number in normal format
Function Ipnum(ip As Long) As String
    Local T As Byte , J As Byte
    Ipnum = ""
    For J = 1 To 4
      T = Ip And 255
      Ipnum = Ipnum + Str(t)
      If J < 4 Then Ipnum = Ipnum + "."
      Shift Ip , Right , 8
    Next
End Function

End
```

UPPERLINE

Action
Reset LCD cursor to the upperline.

Syntax
UPPERLINE

Remarks
Optional you can also use the LOCATE statement.

See also
LOWERLINE , THIRDLINE , FOURTHLINE , LCD, CLS , LOCATE

Example
```
Dim A As Byte
A = 255
Cls
Lcd A
Thirdline
Lcd A
Upperline
End
```

VAL

Action
Converts a string representation of a number into a number.

Syntax
var = **VAL**(s)

Remarks

Var	A numeric variable that is assigned with the value of s.
S	Variable of the string type.

It depends on the variable type which conversion routine will be used. Single and Double conversion will take more code space.
When you use INPUT, internal the compiler also uses the VAL routines.
In order to safe code, there are different conversion routines. For example BINVAL and HEXVAL are separate routines.
While they could be added to the compiler, it would mean a certain overhead as they might never be needed.
With strings as input or the INPUT statement, the string is dynamic and so all conversion routines would be needed.

See also
STR , HEXVAL , HEX , BIN , BINVAL

Example
```
$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Config Com1 = Dummy , Synchrone = 0 , Parity = None , Stopbits = 1 , Databits =
8 , Clockpol = 0

Dim A As Byte , S As String * 10
S = "123"
A = Val(s)                                                 'convert string
Print A                                                    ' 123

S = "12345678"
Dim L As Long
L = Val(s)
Print L
End
```

VARPTR

Action
Retrieves the memory-address of a variable.

Syntax
var = **VARPTR**(var2)
var = **VARPTR**("var3")

Remarks

Var	The variable that receives the address of var2.
Var2	A variable to retrieve the address from.
var3	A constant

Sometimes you need to know the address of a variable, for example when you like to peek at it's memory content.
The VARPTR() function assigns this address.

See also
NONE

Example
```
Dim W As Byte
Print Hex(varptr(w)) ' 0060
```

VER

Action
Returns the AVR-DOS version

Syntax
result = **VER**()

Remarks

Result	A numeric variable that is assigned with the AVR-DOS version. The version number is a byte and the first release is version 1.

When you have a problem, MCS can ask you for the AVR-DOS version number. The VER() function can be used to return the version number then.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILEDATE , FILETIME ,

FILEDATETIME , DIR , WRITE , INPUT

The VERSION() function is something different. It is intended to include compile time info into the program.

ASM

Calls	_AVRDOSVer
Input	-
Output	R16 loaded with value

Example

Print Ver()

VERSION

Action

Returns a string with the date and time of compilation.

Syntax

Var = **VERSION**(frm)

Remarks

Var is a string variable that is assigned with a constant. This version constant is set at compilation time to MM-DD-YY hh:nn:ss Where MM is the month, DD the day of the month, YY the year. hh is the hour is 24-hour format, nn the minutes, and ss the seconds.
When frm is set to 1, the format date will be shown in eurpean DD-MM-YY hh:nn:ss format.

While it is simple to store the version of your program in the source code, it is harder to determine which version was used for a programmed chip.

The Version() function can print this information to the serial port, or to an LCD display.

See Also

VER

Example

Print Version()

WAIT

Action
Suspends program execution for a given time.

Syntax
WAIT seconds

Remarks

seconds	The number of seconds to wait.

No accurate timing is possible with this command.
When you use interrupts, the delay may be extended.

See also
DELAY , WAITMS

Example
```
WAIT 3  'wait for three seconds
Print "*"
```

WAITKEY

Action
Wait until a character is received.

Syntax
var = **WAITKEY**()
var = **WAITKEY**(#channel)

Remarks

var	Variable that receives the ASCII value of the serial buffer. Can be a numeric variable or a string variable.
#channel	The channel used for the software UART.

While Inkey() returns a character from the serial buffer too, INKEY() continues when there is no character. Waitkey() waits until there is a character received. This blocks your program.

See also
INKEY , ISCHARWAITING

Example
```
'-------------------------------------------------------------------------
-----------
'name                         : inkey.bas
```

```
'copyright                 : (c) 1995-2005, MCS Electronics
'purpose                   : demo: INKEY , WAITKEY
'micro                     : Mega48
'suited for demo           : yes
'commercial addon needed   : no
'-------------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte , S As String * 2
Do
   A = Inkey()                                             'get ascii value
from serial port
    's = Inkey()
   If A > 0 Then                                           'we got something
      Print "ASCII code " ; A ; " from serial"
   End If
Loop Until A = 27                                          'until ESC is
pressed

A = Waitkey()                                              'wait for a key
's = waitkey()
Print Chr(a)

'wait until ESC is pressed
Do
Loop Until Inkey() = 27

'When you need to receive binary data and the bibary value 0 ,
'you can use the IScharwaiting() function.
'This will return 1 when there is a char waiting and 0 if there is no char
waiting.
'You can get the char with inkey or waitkey then.
End
```

WAITMS

Action

Suspends program execution for a given time in mS.

Syntax

WAITMS mS

Remarks

Ms	The number of milliseconds to wait. (1-65535)

No accurate timing is possible with this command.

In addition, the use of interrupts can slow this routine.

See also
DELAY , WAIT , WAITUS

ASM
WaitMS will call the routine _WAITMS. R24 and R25 are loaded with the number of milliseconds to wait.
Uses and saves R30 and R31.
Depending on the used XTAL the asm code can look like :

```
_WaitMS:
_WaitMS1F:
Push R30 ; save Z
Push R31
_WaitMS_1:
Ldi R30,$E8 ;delay for 1 mS
Ldi R31,$03
_WaitMS_2:
Sbiw R30,1 ; -1
Brne _WaitMS_2 ; until 1 mS is ticked away
Sbiw R24,1
Brne _WaitMS_1 ; for number of mS
Pop R31
Pop R30
Ret
```

Example
```
WAITMS 10  'wait for 10 mS
Print "*"
```

WAITUS

Action
Suspends program execution for a given time in uS.

Syntax
WAITUS uS

Remarks

US	The number of microseconds to wait. (1-65535) This must be a constant. Not a variable!

No accurate timing is possible with this command.
In addition, the use of interrupts can slow this routine.

The minimum delay possible is determined by the used frequency.
The number of cycles that are needed to set and save registers is 17.

When the loop is set to 1, the minimum delay is 21 uS. In this case you can better use a NOP that generates 1 clock cycle delay.

At 4 MHz the minimum delay is 5 uS. So a waitus 3 will also generate 5 uS delay.
Above these values the delay will become accurate.

When you really need an accurate delay you can use a timer for this purpose.
Set the timer to a value and poll until the overflow flag is set. The disadvantage is that you can not use the timer for other tasks during this hardware delay.

The philosophy behind BASCOM is that it should not use hardware resources unless there is no other way to accomplish a task.

See also
DELAY , WAIT , WAITMS

Example
```
WAITUS 10  'wait for 10 uS
Print "*"
```

WHILE-WEND

Action
Executes a series of statements in a loop, as long as a given condition is true.

Syntax
```
WHILE condition
  statements
WEND
```

Remarks
If the condition is true then any intervening statements are executed until the WEND statement is encountered.
BASCOM then returns to the WHILE statement and checks the condition.
If it is still true, the process is repeated.
If it is not true, execution resumes with the statement following the WEND statement.

So in contrast with the DO-LOOP structure, a WHILE-WEND condition is tested first so that if the condition fails, the statements in the WHILE-WEND structure are never executed.

See also
DO-LOOP

Example
```
'-----------------------------------------------------------------------
-----------
'name                     : while_w.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demo: WHILE, WEND
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
```

```
'-------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

Dim A As Byte

A = 1                                                      'assign var
While A < 10                                               'test expression
   Print A                                                 'print var
   Incr A                                                  'increase by one
Wend                                                       'continue loop
End
```

WRITE

Action

Writes data to a sequential file

Syntax

WRITE #ch , data [,data1]

Remarks

Ch	A channel number, which identifies an opened file. This can be a hard coded constant or a variable.
Data , data1	A variable who's content are written to the file.

When you write a variables value, you do not write the binary representation but the ASCII representation. When you look in a file it contains readable text.

When you use PUT, to write binary info, the files are not readable or contain unreadable characters.
Strings written are surrounded by string delimiters "". Multiple variables written are separated by a comma. Consider this example :

Dim S as String * 10 , W as Word
S="hello" : W = 100
OPEN "test.txt" For OUTPUT as #1
WRITE #1, S , W
CLOSE #1

The file content will look like this : "hello",100
Use INPUT to read the values from value.

See also
INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , GET , PUT , FILEDATE , FILETIME , FILEDATETIME , DIR , WRITE , INPUT

ASM

Calls	_FileWriteQuotationMark	_FileWriteDecInt
	_FileWriteDecByte	_FileWriteDecWord
	_FileWriteDecLong	_FileWriteDecSingle
Input	Z points to variable	
Output		

Partial Example
```
Dim S As String * 10 , W As Word , L As Long

S = "write"
Open "write.dmo"for Output As #2
Write #2 , S , W , L                                    ' write is also
supported
Close #2

Open "write.dmo"for Input As #2
Input #2 , S , W , L                                    ' write is also
supported
Close #2
Print S ; " " ; W ; " " ; L
```

WRITEEEPROM

Action
Write a variables content to the DATA EEPROM.

Syntax
WRITEEEPROM var , address

Remarks

var	The name of the variable that must be stored
address	The address in the EEPROM where the variable must be stored. A new option is that you can provide a label name for the address. See example 2.

This statement is provided for compatibility with BASCOM-8051.

You can also use :
Dim V as Eram Byte 'store in EEPROM
Dim B As Byte 'normal variable

B = 10
V = B 'store variable in EEPROM

When you use the assignment version, the data types must be the same!

According to a data sheet from ATMEL, the first location in the EEPROM with address 0, can be overwritten during a reset. It is advised not to use this location.

For security, register R23 is set to a magic value before the data is written to the EEPROM. All interrupts are disabled while the EEPROM data is written. Interrupts are enabled automatic when the data is written.

It is advised to use the Brownout circuit that is available on most AVR processors. This will prevent that data is written to the EEPROM when the voltage drops under the specified level.

When data is written to the EEPROM, all interrupts are disabled, and after the EEPROM has been written, the interrupts are re-enabled.

See also
READEEPROM

ASM
NONE

Example
```
'-----------------------------------------------------------------------------
-----------
'name                     : eeprom2.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to use labels with READEEPROM
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 4000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space

'first dimension a variable
Dim B As Byte
Dim Yes As String * 1

'Usage for readeeprom and writeeprom :
'readeeprom var, address

'A new option is to use a label for the address of the data
'Since this data is in an external file and not in the code the eeprom data
'should be specified first. This in contrast with the normal DATA lines which
must
```

```
'be placed at the end of your program!!

'first tell the compiler that we are using EEPROM to store the DATA
$eeprom

'the generated EEP file is a binary file.
'Use $EEPROMHEX to create an Intel Hex file usable with AVR Studio.
'$eepromhex

'specify a label
Label1:
Data 1 , 2 , 3 , 4 , 5
Label2:
Data 10 , 20 , 30 , 40 , 50

'Switch back to normal data lines in case they are used
$data

'All the code above does not generate real object code
'It only creates a file with the EEP extension

'Use the new label option
Readeeprom B , Label1
Print B                                                 'prints 1
'Succesive reads will read the next value
'But the first time the label must be specified so the start is known
Readeeprom B
Print B                                                 'prints 2

Readeeprom B , Label2
Print B                                                 'prints 10
Readeeprom B
Print B                                                 'prints 20

'And it works for writing too :
'but since the programming can interfere we add a stop here
Input "Ready?" , Yes
B = 100
Writeeeprom B , Label1
B = 101
Writeeeprom B

'read it back
Readeeprom B , Label1
Print B                                                 'prints 1
'Succesive reads will read the next value
'But the first time the label must be specified so the start is known
Readeeprom B
Print B                                                 'prints 2


End
```

X10DETECT

Action

Returns a byte that indicates if a X10 Power line interface is found.

Syntax

Result = **X10DETECT**( )

Remarks

Result	A variable that will be assigned with 0 if there is no Power Line Interface found. 1 will be returned if the interface is found, and the detected mains frequency is 50 Hz. 2 will be returned if the interface is found and tre detected mains frequency is 60 Hz.

When no TW-523 or other suitable interface is found, the other X10 routines will not work.

See also

CONFIG X10 , X10SEND

Example

```
'-----------------------------------------------------------------------------
-----------
'name                     : x10.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : example needs a TW-523 X10 interface
'micro                    : Mega48
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "m48def.dat"                                    ' specify the used
micro
$crystal = 8000000                                         ' used crystal
frequency
$baud = 19200                                              ' use baud rate
$hwstack = 32                                              ' default use 32
for the hardware stack
$swstack = 10                                              ' default use 10
for the SW stack
$framesize = 40                                            ' default use 40
for the frame space


'define the house code
Const House = "M"                                          ' use code A-P

Waitms 500                                                 ' optional delay
not really needed

'dim the used variables
Dim X As Byte

'configure the zero cross pin and TX pin
Config X10 = Pind.4 , Tx = Portb.0
'             ^--zero cross
'                          ^--- transmission pin

'detect the TW-523
X = X10detect()
Print X                                                    ' 0 means error, 1
means 50 Hz, 2 means 60 Hz
```

```
Do
   Input "Send (1-32) " , X
   'enter a key code from 1-31
   '1-16 to address a unit
   '17 all units off
   '18 all lights on
   '19 ON
   '20 OFF
   '21 DIM
   '22 BRIGHT
   '23 All lights off
   '24 extended code
   '25 hail request
   '26 hail acknowledge
   '27 preset dim
   '28 preset dim
   '29 extended data analog
   '30 status on
   '31 status off
   '32 status request

   X10send House , X                                    ' send the code
Loop

Dim Ar(4) As Byte
X10send House , X , Ar(1) , 4                           ' send 4 additional
bytes

End
```

X10SEND

Action

Sends a house and key code with the X10 protocol.

Syntax

X10SEND house , code

Remarks

House	The house code in the form of a letter A-P. You can use a constant, or you can use a variable
Code	The code or function to send. This is a number between 1-32.

The X10SEND command needs a TW-523 interface.
Only ground, TX and Zero Cross, needs to be connected for transmission.
Use CONFIG X10 to specify the pins.

X10 is a popular protocol used to control equipment via the mains. A 110 Khz signal is added to the normal 50/60 Hz , 220/110 V power.

Notice that experimenting with 110V-240V can be very dangerous when you do not know exactly what you are doing !!!

In the US, X10 is very popular and wide spread. In Europe it is hard to get a TW-523 for

220/230/240 V.

I modified an 110V version so it worked for 220V. On the Internet you can find modification information. But as noticed before, MODIFY ONLY WHEN YOU UNDERSTAND WHAT YOU ARE DOING.

A bad modified device could result in a fire, and your insurance will most likely not pay. A modified device will not pass any CE, or other test.

When the TW-523 is connected to the mains and you use the X10SEND command, you will notice that the LED on the TW-523 will blink.

The following table lists all X10 codes.

Code value	Description
1-16	Used to address a unit. X10 can use a maximum of 16 units per house code.
17	All units off
18	All lights on
19	ON
20	OFF
21	DIM
22	BRIGHT
23	All lights off
24	Extended ode
25	Hail request
26	Hail acknowledge
27	Preset dim
28	Preset dim
29	Extended data analog
30	Status on
31	Status off
32	Status request

At www.x10.com you can find all X10 information. The intension of BASCOM is not to learn you everything about X10, but to show you how you can use it with BASCOM.

See also
CONFIG X10 , X10DETECT , X10SEND

Example
See X10DETECT

#IF ELSE ENDIF

Action
Conditional compilation directives intended for conditional compilation.

Syntax
#IF condition

#ELSE

#ENDIF

Remarks
Conditional compilation is supported by the compiler.
What is conditional compilation?
Conditional compilation will only compile parts of your code that meet the criteria of the condition.

By default all your code is compiled.

Conditional compilation needs a constant to test.
So before a condition can be tested you need to define a constant.

```
CONST test = 1
#IF TEST
    Print "This will be compiled"
#ELSE
    Print "And this not"
#ENDIF
```

Note that there is no THEN and that #ENDIF is not #END IF (no space)

You can nest the conditions and the use of #ELSE is optional.

There are a few internal constants that you can use. These are generated by the compiler:
_CHIP = 0
_RAMSIZE = 128
_ERAMSIZE = 128
_SIM = 0
_XTAL = 4000000
_BUILD = 11162

_CHIP is an integer that specifies the chip, in this case the 2313
_RAMSIZE is the size of the SRAM
_ERAMSIZE is the size of the EEPROM
_SIM is set to 1 when the $SIM directive is used
_XTAL contains the value of the specified crystal
_BUILD is the build number of the compiler.

The build number can be used to write support for statements that are not available in a certain version :

```
#IF _BUILD >= 11162
  s = Log(1.1)
#ELSE
  Print "Sorry, implemented in 1.11.6.2"
#ENDIF
```

Conditional compilation allows you to create different versions of your program but that you keep one source file.
For example you could make a multi langual program like this :

```
CONST LANGUAGE=1

'program goes here

#IF LANGUAGE=1
  DATA "Hello"
#ENDIF
#IF LANGUAGE=2
  DATA "Guten tag"
#ENDIF
```

By changing the just one constant you then have for example English or German data lines.

Conditonal compilation does not work with the $REGFILE directive. If you put the $REGFILE inside a condition or not, the compiler will use the first $REGFILE it encounters. This will be changed in a future verison.

A special check was added to 1.11.8.1 to test for existance of constants or variables.

```
#IF varexist("S")
       'the variable S was dimensioned so we can use it here
#ELSE
    'when it was not dimmed and we do need it, we can do it here
   DIM S as BYTE
#ENDIF
```

See Also

CONST

International Resellers

International Resellers

As the resellers list changes so now and then, it is not printed in this help. You can best look at the list at the MCS website.
See MCS Electronics web.

There is always a reseller near you. A reseller can help you in your own language and you are in the same time zone.
Sometimes there are multiple resellers in your country. All resellers have their own unique expertise. For example : industrial, robotics, educational, etc.

ASM Libraries

EXTENDED I2C

Action
Instruct the compiler to use parts of the extended i2c library

Syntax
$LIB = "i2c_extended.lib"

Remarks
The I2C library was written when the AVR architecture did not have extended registers. The designers of the AVR chips did not preserve enough space for registers. So when they made bigger chips with more ports they ran out of registers.
They solved it to use space from the RAM memory and move the RAM memory from &H60 to &H100.
In the free space from &60 to &H100 the new extended register were located.

While this is a practical solution, some ASM instructions could not be used anymore. This made it a problem to use the I2C statements on PORTF and PORTG of the Mega128.
The extended i2c library is inteded to use I2C on portF and portG on the M64 and M128.
It uses a bit more space then the normal I2C lib.

Best would be that you use the TWI interface and the i2c_twi library as this uses less code.
The disadvantage is that you need fixed pins as TWI used a fix pin for SCL and SDA.

See also
I2C

ASM
NONE

Example
```
'-----------------------------------------------------------------------
-
'                            (c) 2005 MCS Electronics
'                  This demo shows an example of I2C on the M128 portF
' PORTF is an extened port and requires a special I2C driver
'-----------------------------------------------------------------------
-


$regfile = "m128def.dat"                                    ' the used chip
$crystal = 8000000
$baud = 19200                                               ' baud rate

$lib "i2c_extended.lib"

Config Scl = Portf.0                                        ' we need to
provide the SCL pin name
```

```
Config Sda = Portf.1                                        ' we need to
provide the SDA pin name


Dim B1 As Byte , B2 As Byte
Dim W As Word At B1 Overlay



I2cinit                                                     ' we need to set
the pins in the proper state


Dim B As Byte , X As Byte
Print "Mega128 master demo"


Print "Scan start"
For B = 1 To 254 Step 2
  I2cstart
  I2cwbyte B
  If Err = 0 Then
     Print "Slave at : " ; B
  End If
  I2cstop
Next
Print "End Scan"


Do
  I2cstart
  I2cwbyte &H70                                             ' slave address
write
  I2cwbyte &B10101010                                       ' write command
  I2cwbyte 2
  I2cstop
  Print Err


  I2cstart
  I2cwbyte &H71
  I2crbyte B1 , Ack
  I2crbyte B2 , Nack
  I2cstop
  Print "Error : " ; Err                                   ' show error
  Waitms 500                                                'wait a bit
Loop
End
```

MCSBYTE

The numeric<>string conversion routines are optimized when used for byte, integer,word and longs.

When do you use a conversion routine ?
- When you use STR() , VAL() or HEX().
- When you print a numeric variable
- When you use INPUT on numeric variables.

To support all data types the built in routines are efficient in terms of code size.
But when you use only conversion routines on bytes there is a overhead.

The mcsbyte.lib library is an optimized version that only support bytes.
Use it by including : $LIB "mcsbyte.lbx" in your code.

Note that LBX is a compiled LIB file. In order to change the routines you need the commercial edition with the source code(lib files). After a change you should compile the library with the library manager.

See also
mcsbyteint.lib

MCSBYTEINT

The numeric<>string conversion routines are optimized when used for byte, integer,word and longs.

When do you use a conversion routine ?

-When you use STR() , VAL() or HEX().
-When you print a numeric variable
-When you use INPUT on numeric variables.

To support all data types the built in routines are efficient in terms of code size.
But when you use only conversion routines on bytes there is a overhead.

The mcsbyteint.lib library is an optimized version that only support bytes, integers and words.
Use it by including : $LIB "mcsbyteint.lbx" in your code.

Note that LBX is a compiled LIB file. In order to change the routines you need the commercial edition with the source code(lib files). After a change you should compile the library with the library manager.

See also
mcsbyte.lib

TCPIP

The TCPIP library allows you to use the W3100A internet chip from www.ininchip.com

MCS has developed a special development board that can get you started quickly with TCP/IP communication. Look at http://www.mcselec.com for more info.

The tcpip.lib with the ASM source is bundled with the MCS Easy TCP/IP PCB and/or the IIM7000 module.
The tcpip.lbx is shipped with BASCOM-AVR

The following functions are provided:

CONFIG TCPIP	Configures the W3100 chip.
GETSOCKET	Creates a socket for TCP/IP communication.
SOCKETCONNECT	Establishes a connection to a TCP/IP server.
SOCKETSTAT	Returns information of a socket.
TCPWRITE	Write data to a socket.
TCPWRITESTR	Sends a string to an open socket connection.
TCPREAD	Reads data from an open socket connection.
CLOSESOCKET	Closes a socket connection.
SOCKETLISTEN	Opens a socket in server(listen) mode.
GETDSTIP	Returns the IP address of the peer.
GETDSTPORT	Returns the port number of the peer.
BASE64DEC	Converts Base-64 data into the original data.
BASE64ENC	Convert a string into a BASE64 encoded string.
MAKETCP	Encodes a constant or 4 byte constant/variables into an IP number
UDPWRITE	Write UDP data to a socket.
UDPWRITESTR	Sends a string via UDP.
UDPREAD	Reads data via UDP protocol.

LCD

LCD4BUSY

BASCOM supports LCD displays in a way that you can choose all pins random. This is great for making a simple PCB but has the disadvantage of more code usage. BASCOM also does not use the WR-pin so that you can use this pin for other purposes.

The LCD4BUSY.LIB can be used when timing is critical.

The default LCD library uses delays to wait until the LCD is ready. The lcd4busy.lib is using an additional pin (WR) to read the status flag of the LCD.

The db4-db7 pins of the LCD must be connected to the higher nibble of the port.

The other pins can be defined.

```
'-----------------------------------------------------------------------
' (c) 2004 MCS Electronics
' lcd4busy.bas shows how to use LCD with busy check
'-----------------------------------------------------------------------
'code tested on a 8515
$regfile="8515def.dat"

'stk200 has 4 MHz
$crystal= 4000000

'define the custom library
'uses 184 hex bytes total

$lib"lcd4busy.lib"

'define the used constants
'I used portA for testing
Const _lcdport =Porta
Const _lcdddr =Ddra
Const _lcdin =Pina
Const _lcd_e = 1
Const _lcd_rw = 2
Const _lcd_rs = 3


'this is like always, define the kind of LCD
ConfigLcd= 16 * 2

'and here some simple lcd code
Cls
Lcd"test"
Lowerline
Lcd"this"
End
```

LCD4.LIB

The built in LCD driver for the PIN mode is written to support a worst case scenario where you use random pins of the microprocessor to drive the LCD pins.

This makes it easy to design your PCB but it needs more code.
When you want to have less code you need fixed pins for the LCD display.

With the statement $LIB "LCD4.LBX" you specify that the LCD4.LIB will be used.

The following connections are used in the asm code:

Rs = PortB.0
RW = PortB.1 we dont use the R/W option of the LCD in this version so connect to ground
E = PortB.2
E2 = PortB.3 optional for lcd with 2 chips
Db4 = PortB.4 the data bits must be in a nibble to save code
Db5 = PortB.5
Db6 = PortB.6
Db7 = PortB.7

You can change the lines from the lcd4.lib file to use another port.
Just change the address used :
.EQU LCDDDR=$17 ; change to another address for DDRD ($11)
.EQU LCDPORT=$18 ; change to another address for PORTD ($12)

See the demo lcdcustom4bit.bas in the SAMPLES dir.

Note that you still must select the display that you use with the CONFIG LCD statement.

See also the lcd42.lib for driving displays with 2 E lines.

Note that LBX is a compiled LIB file. In order to change the routines you need the commercial edition with the source code(lib files). After a change you should compile the library with the library manager.

LCD4E2

The built in LCD driver for the PIN mode is written to support a worst case scenario where you use random pins of the microprocessor to drive the LCD pins.

This makes it easy to design your PCB but it needs more code.

When you want to have less code you need fixed pins for the LCD display.
With the statement $LIB "LCD4E2.LBX" you specify that the LCD4.LIB will be used.

The following connections are used in the asm code:
Rs = PortB.0
RW = PortB.1 we don't use the R/W option of the LCD in this version so connect to ground
E = PortB.2
E2 = PortB.3 the second E pin of the LCD
Db4 = PortB.4 the data bits must be in a nibble to save code
Db5 = PortB.5
Db6 = PortB.6
Db7 = PortB.7

You can change the lines from the lcd4e2.lib file to use another port.
Just change the address used :
.EQU LCDDDR=$17 ; change to another address for DDRD ($11)
.EQU LCDPORT=$18 ; change to another address for PORTD ($12)

See the demo lcdcustom4bit2e.bas in the SAMPLES dir.

Note that you still must select the display that you use with the CONFIG LCD statement.

See also the lcd4.lib for driving a display with 1 E line.

A display with 2 E lines actually is a display with 2 control chips. They must both be controlled. This library allows you to select the active E line from your code.

In your basic code you must first select the E line before you use a LCD statement.

The initialization of the display will handle both chips.

Note that LBX is a compiled LIB file. In order to change the routines you need the commercial edition with the source code(lib files). After a change you should compile the library with the library manager.

GLCD

GLCD.LIB (LBX) is a library for Graphic LCD's based on the T6963C chip.

The library contains code for LOCATE, CLS, PSET, LINE, CIRCLE, SHOWPIC and SHOWPICE.

GLCDSED

GLCDSED.LIB (LBX) is a library for Graphic LCD's based on the SEDXXXX chip.

The library contains modified code for this type of display.

New special statements for this display are :

LCDAT

SETFONT

GLCDCMD

GLCDDATA

See the SED.BAS sample from the sample directory

PCF8533

COLOR LCD

Color displays were always relatively expensive. The mobile phone market changed that. And Display3000.com , sorted out how to connect these small nice colorfull displays.
You can buy brand new Color displays from Display3000. MCS Electronics offers the same displays.
There are two different chip sets used. One chipset is from EPSON and the other from Philips. For this reason there are two different libraries. When you select the wrong one it will not work, but you will not damage anything.
LCD-EPSON.LBX need to be used with the EPSON chipset.
LCD-PCF8833.LBX need to be used with the Philips chipset.

Config Graphlcd = Color , Controlport = Portc , Cs = 1 , Rs = 0 , Scl = 3 , Sda = 2

Controlport	The port that is used to control the pins. PORTA, PORTB, etc.
CS	The chip select pin of the display screen. Specify the pin number. 1 will mean PORTC.1
RS	The RESET pin of the display
SCL	The clock pin of the display
SDA	The data pin of the display

As the color display does not have a built in font, you need to generate the fonts yourself. You can use the Fonteditor for this task.

A number of statements accept a color parameter. See the samples below in **bold**.

LINE	Line(0 , 0) -(130 , 130) , **Blue**
LCDAT	Lcdat 100 , 0 , "12345678" , **Blue , Yellow**
CIRCLE	Circle(30 , 30) , 10 , **Blue**
PSET	32 , 110 , **Black**
BOX	Box(10 , 30) -(60 , 100) , **Red**

See Also

LCD Graphic converter

Example

```
'
------------------------------------------------------------------------------
' The support for this display has been made possible by Peter Küsters from (c)
Display3000
' You can buy the displays from Display3000 or MCS Electronics
'
------------------------------------------------------------------------------'
'
$lib "lcd-pcf8833.lbx"                                      'special color
display support

$regfile = "m88def.dat"                                     'ATMega 8, change
if using different processors
$crystal = 8000000                                          '8 MHz

'First we define that we use a graphic LCD
Config Graphlcd = Color , Controlport = Portc , Cs = 1 , Rs = 0 , Scl = 3 ,
Sda = 2

'here we define the colors
```

```
Const Blue = &B00000011   'predefined contants are making programming easier
Const Yellow = &B11111100
Const Red = &B11100000
Const Green = &B00011100
Const Black = &B00000000
Const White = &B11111111
Const Brightgreen = &B00111110
Const Darkgreen = &B00010100
Const Darkred = &B10100000
Const Darkblue = &B00000010
Const Brightblue = &B00011111
Const Orange = &B11111000


'clear the display
Cls

'create a cross
Line(0 , 0) -(130 , 130) , Blue
Line(130 , 0) -(0 , 130) , Red

Waitms 1000

'show an RLE encoded picture
Showpic 0 , 0 , Plaatje
Showpic 40 , 40 , Plaatje

Waitms 1000

'select a font
Setfont Color16x16
'and show some text
Lcdat 100 , 0 , "12345678" , Blue , Yellow


Waitms 1000
Circle(30 , 30) , 10 , Blue

Waitms 1000
'make a box
Box(10 , 30) -(60 , 100) , Red

'set some pixels
Pset 32 , 110 , Black
Pset 38 , 110 , Black
Pset 35 , 112 , Black


End



Plaatje:
$bgf "a.bgc"


$include "color.font"
$include "color16x16.font"
```

LCD-EPSON

This chip is compatible with PCF8533.

AVR-DOS

AVR-DOS File System

The AVR-DOS file system is written by Josef Franz Vögel. He can be contacted via the BASCOM forum. Note that it is not permitted to use the AVR-DOS file system for commercial applications without the purchase of a license. A license comes with the ASM source.
You can buy a user license that is suited for most private users.
When you develop a commercial product with AVR-DOS you need the company license.
The ASM source is shipped with both licenses.

Josef has put a lot of effort in writing and especially testing the routines.
Josef nor MCS Electronics can be held responsible for any damage or data loss of your CF-cards.

The File-System works with Compact – Flash Cards (see AN 123 Accessing a Compact Flash Card from BASCOM and Compact Flash) and is written for the needs for embedded systems for logging data. There are further functions for binary read and write.

You do not need AN123. AN123 was used to develop AVR-DOS. So you should use AVR-DOS.

The intention in developing the DOS – filesystem was to keep close to the equivalent VB functions.

The Filesystem works with:

- FAT16, this means you need to use >= 32MB CF cards
- FAT32
- Short file name (8.3)
- (Files with a long file name can be accessed by their short file name alias)
- Files in Root Directory. The root dir can store 512 files. Take in mind that when you use long file names, less filenames can be stored.
- Files in SUBDIRS

Requirements:

- Hardware: see AN 123 on http://www.mcselec.com/an_123.htm
- Software: appr. 2K-Word Code-Space (4000 Bytes)
- SRAM: 561 Bytes for Filesystem Info and DIR-Handle buffer
- 517 Bytes if FAT is handled in own buffer (for higher speed), otherwise it is handled with the DIR Buffer
- 534 Bytes for each Filehandle
- This means that a Mega103 or Mega128 is the perfect chip. Other chips have too little internal memory. You could use XRAM memory too with a Mega8515 for example.

File System Configuration in CONFIG_AVR-DOS.BAS

cFileHandles:	Count of Filehandles: for each file opened at same time, a filehandle buffer of 534 Bytes is needed
cSepFATHandle:	For higher speed in handling file operations the FAT info can be stored in a own buffer, which needs additional 517 Bytes. Assign Constant cSepFATHandle with 1, if wanted, otherwise with 0.

Memory Usage of DOS – File System:

1. General File System information

Variable Name	Type	Usage
gbDOSError	Byte	holds DOS Error of last file handling routine
gbFileSystem	Byte	File System Code from Master Boot Record
glFATFirstSector	Long	Number of first Sector of FAT Area on the Card
gbNumberOfFATs	Byte	Count of FAT copies
gwSectorsPerFat	Word	Count of Sectors per FAT
glRootFirstSector	Long	Number of first Sector of Root Area on the Card
gwRootEntries	Word	Count of Root Entries
glDataFirstSector	Long	Number of first Sector of Data Area on the Card
gbSectorsPerCluster	Byte	Count of Sectors per Cluster
gwMaxClusterNumber	Word	Highest usable Cluster number
gwLastSearchedCluster	Word	Last cluster number found as free
gwFreeDirEntry	Word	Last directory entry number found as free
glFS_Temp1	Long	temorary Long variable for file system
gsTempFileName	String * 11	temporary String for converting file names

2. Directory

Variable Name	Type	Usage
gwDirRootEntry	Word	number of last handled root entry
glDirSectorNumber	Long	Number of current loaded Sector
gbDirBufferStatus	Byte	Buffer Status
gbDirBuffer	Byte (512)	Buffer for directory Sector

3. FAT

Variable Name	Type	Usage
glFATSectorNumber	Long	Number of current loaded FAT sector
gbFATBufferStatus	Byte	Buffer status
gbFATBuffer	Byte(512)	buffer for FAT sector

4. File handling

Each file handle has a block of 534 Bytes in the variable abFileHandle which is a byte-array of size (534 * cFileHandles)

Variable Name	Type	Usage
FileNumber	Byte	File number for identification of the file in I/O operations to the opened file

FileMode	Byte	File open mode
FileRootEntry	Word	Number of root entry
FileFirstCluster	Word	First cluster
FATCluster	Word	cluster of current loaded sector
FileSize	Long	file size in bytes
FilePosition	Long	file pointer (next read/write) 0-based
FileSectorNumber	Long	number of current loaded sector
FileBufferStatus	Byte	buffer Status
FileBuffer	Byte(512)	buffer for the file sector
SectorTerminator	Byte	additional 00 Byte (string terminator) for direct reading ASCII files from the buffer

Error Codes:

Code	Compiler – Alias	Remark
0	cpNoError	No Error
1	cpEndOfFile	Attempt behind End of File
17	cpNoMBR	Sector 0 on Card is not a Master Boot Record
18	cpNoPBR	No Partition Sector
19	cpFileSystemNotSupported	Only FAT16 File system is supported
20	cpSectorSizeNotSupported	Only sector size of 512 Bytes is supported
21	cpSectorsPerClusterNotSupported	Only 1, 2, 4, 8, 16, 32, 64 Sectors per Cluster is supported. This are values of normal formatted partitions. Exotic sizes, which are not power of 2 are not supported
33	cpNoNextCluster	Error in file cluster chain
34	cpNoFreeCluster	No free cluster to allocate (Disk full)
35	cpClusterError	Error in file cluster chain
49	cpNoFreeDirEntry	Directory full
50	cpFileExist	
65	cpNoFreeFileNumber	No free file number available, only theoretical error, if 255 file handles in use
66	cpFileNotFound	File not found
67	cpFileNumberNotFound	No file handle with such file number
68	cpFileOpenNoHandle	All file handles occupied
69	cpFileOpenHandleInUse	File handle number in use, can't create a new file handle with same file number
70	cpFileOpenShareConflict	Tried to open a file in read and write modus in two file handles
71	cpFileInUse	Can't delete file, which is in use
72	cpFileReadOnly	Can't open a read only file for writing
73	cpFileNoWildCardAllowed	No wildcard allowed in this function
97	cpFilePositionError	
98	cpFileAccessError	function not allowed in this file open mode

99	cpInvalidFilePosition	new file position pointe is invalid (minus or 0)
100	cpFileSizeToGreat	File size to great for function BLoad

Buffer Status: Bit definitions of Buffer Status Byte (Directory, FAT and File)

Bit	DIR	FAT	File	Compiler Alias	Remark
0 (LSB)			●	dBOF	Bottom of File (not yet supported)
1			●	dEOF	End of File
2			●	dEOFinSector	End of File in this sector (last sector)
3	●	●	●	dWritePending	Something was written to sector, it must be saved to Card, before loading next sector
4		●		dFATSector	This is an FAT Sector, at writing to Card, Number of FAT copies must be checked and copy updated if necessary
5			●	dFileEmpty	File is empty, no sector (Cluster) is allocated in FAT to this file

Validity of the file I/O operations regarding the opening modes

	Open mode			
Action	Input	Output	Append	Binary
Attr	●	●	●	●
Close	●	●	●	●
Put				●
Get				●
LOF	●	●	●	●
LOC	●	●	●	●
EOF	●	1)	1)	●
SEEK	●	●	●	●
SEEK-Set				●
Line Input	●			●
Print		●	●	●
Input	●			●
Write		●	●	●

1) Position pointer is always at End of File

Supported statements and functions:

INITFILESYSTEM , OPEN , CLOSE, FLUSH , PRINT, LINE INPUT, LOC, LOF , EOF , FREEFILE , FILEATTR , SEEK , BSAVE , BLOAD , KILL , DISKFREE , DISKSIZE , GET , PUT ,FILEDATE , FILETIME , FILEDATETIME , DIR , WRITE , INPUT , FILELEN

CF Card

Compact FlashCard Driver

The compact flash card driver library is written by Josef Franz Vögel. He can be contacted via the BASCOM user list.

Josef has put a lot of effort in writing and especially testing the routines.
Josef nor MCS Electronics can be held responsible for any damage or data loss of your CF-cards.

Compact flash cards are very small cards that are compatible with IDE drives. They work at 3.3V or 5V and have a huge storage capacity.

The FlashCard Driver provides the functions to access a Compact Flash Card.

At the moment there are six functions:
DriveCheck, DriveReset , DriveInit , DriveGetIdentity , DriveWriteSector , DriveReadSector

The Driver can be used to access the Card directly and to read and write each sector of the card or the driver can be used in combination with a file-system with basic drive access functions.

Because the file system is separated from the driver you can write your own driver.

This way you could use the file system with a serial eprom for example.

For a filesystem at least the functions for reading (DriveReadSector / _DriveReadSector) and writing (DriveWriteSector / _DriveWriteSector) must be provided. The preceeding underslash _ is the label of the according asm-routine. The other functions can, if possible implemented as a NOP – Function, which only returns a No-Error (0) or a Not Supported (224) Code, depending, what makes more sense.

For writing your own Driver to the AVR-DOS FileSystem, check the ASM-part of the functions-description.

Error Codes:

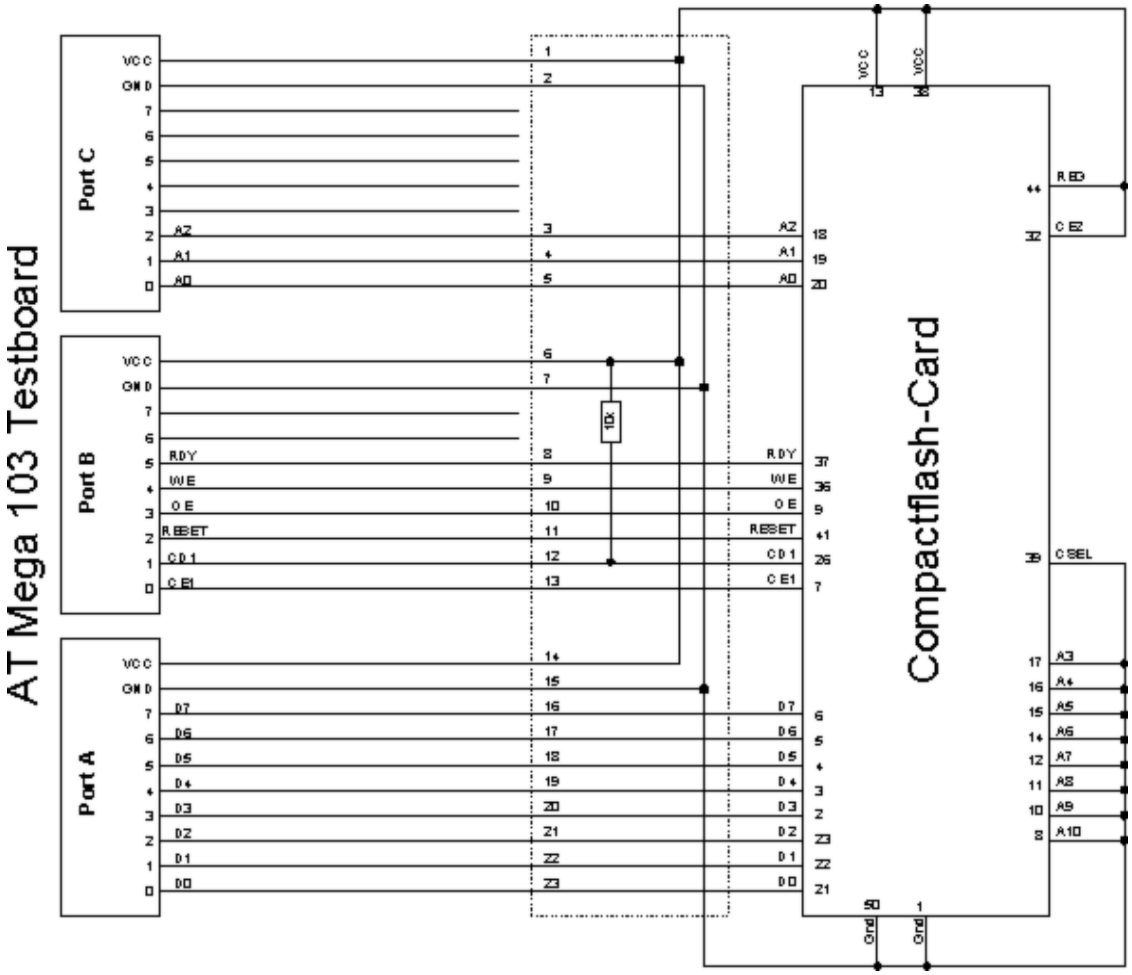
Code	Compiler – Alias	Remark
0	CpErrDriveNoError	No Error
224	cpErrDriveFunctionNotSupported	This driver does not supports this function
225	cpErrDriveNotPresent	No Drive is attached
226	cpErrDriveTimeOut	During Reading or writing a time out occured
227	cpErrDriveWriteError	Error during writing
228	cpErrDriveReadError	Error during reading

At the MCS Web AN section you can find the application note 123.

More info about Compact Flash you can find at :

http://www.sandisk.com/download/Product%20Manuals/cf_r7.pdf

A typical connection to the micro is shown below.



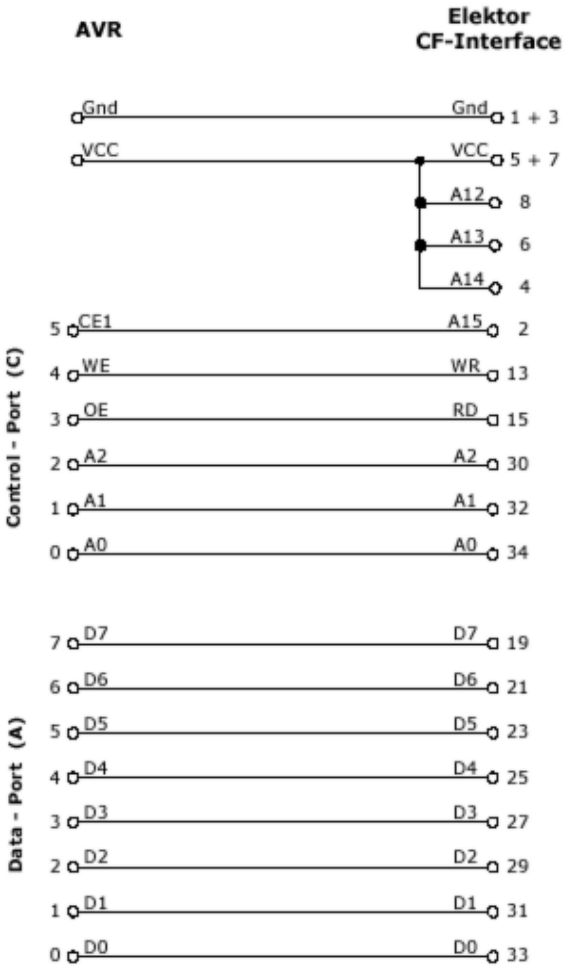
Elektor CF-Interface

The popular Electronics magazine Elektor, published an article about a CF-card interface. This interface was connected to an 89S8252. This interface can be used and will use little pins of the micro.

Note that because of the FAT buffer requirement, it is not possible to use a 8051 micro.,

At this moment, only the Mega128 and the Mega103 AVR micro's are good chips to use with AVR-DOS.

You can use external memory with other chips like the Mega162.



Changes of the hardware pins is possible in the file Config_FlashCardDrive_EL_PIN.bas.

The default library is FlashCardDrive.lib but this interface uses the library FlashCardDrive_EL_PIN.lib.

XRAM CF-Interface for simulation

The XRAM CF-Card interface is created for the purpose of testing the File System routines without hardware.

You can use an external RAM chip (XRAM) for the CF-interface but of course it is not practical in a real world application unless you backup the power with a battery.

For tests with the simulator it is ideal.

Just specify the Config_XRAMDrive.bas file and select a micro that can address external memory such as the M128. Then specify that the system is equipped with 64KB of external RAM.

You can now simulate the flashdisk.bas sample program !

In order to simulate Flashdisk.bas, set the constant XRAMDRIVE to 1. Then select 64KB of

esternal RAM and compile.

New CF-Card Drivers

New CF-Card drivers can be made relatively simple.

Have a look at the supplied drivers.

There are always a few files needed :

- A config file in the format : CONFIG_XXX.bas
- FlashCardDrive_XXX.LIB
- FlashCardDrive_XXX.lbx is derived from the LIB file

XXX stands for the name of your driver.

At the AVR-DOS web you can find more drivers.

Floating Point

FP_TRIG

The FP_TRIG library is written by Josef Franz Vögel.

All trig functions are stored in fp_trig.lib library.
The fp_trig.lbx contains the compiled object code and is used by BASCOM.

This sample demonstrates all the functions from the library:

```
'-----------------------------------------------------------------------------------------
'name                     : test_fptrig2.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : demonstates FP trig library from Josef Franz Vögel
'micro                    : Mega8515
'suited for demo          : no
'commercial addon needed  : no
'-----------------------------------------------------------------------------------------

$regfile = "m8515.dat"                                      ' specify the used micro
$crystal = 4000000                                          ' used crystal frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32 for the hardware
stack
$swstack = 10                                               ' default use 10 for the SW stack
$framesize = 40                                             ' default use 40 for the frame space


Dim S1 As Single , S2 As Single , S3 As Single , S4 As Single , S5 As Single , S6 As Single
Dim Vcos As Single , Vsin As Single , Vtan As Single , Vatan As Single , S7 As Single
Dim Wi As Single , B1 As Byte
Dim Ms1 As Single



Const Pi = 3.14159265358979

'calculate PI
Ms1 = Atn(1) * 4


Testing_power:
Print "Testing Power X ^ Y"
Print "X             Y          x^Y"
For S1 = 0.25 To 14 Step 0.25
   S2 = S1 \ 2
   S3 = Power(s1 , S2)
   Print S1 ; " ^ " ; S2 ; " = " ; S3
Next
Print : Print : Print

Testing_exp_log:

Print "Testing EXP and LOG"
Print "x    exp(x)       log([exp(x)])    Error-abs    Error-rel"
Print "Error is for calculating exp and back with log together"
For S1 = -88 To 88
   S2 = Exp(s1)
   S3 = Log(s2)
   S4 = S3 - S1
   S5 = S4 \ S1
   Print S1 ; "    " ; S2 ; "    " ; S3 ; "    " ; S4 ; "    " ; S5 ; " " ;
   Print
Next
Print : Print : Print


Testing_trig:
Print "Testing COS, SIN and TAN"
Print "Angle Degree   Angle Radiant         Cos         Sin         Tan"
For Wi = -48 To 48
   S1 = Wi * 15
   S2 = Deg2rad(s1)
   Vcos = Cos(s2)
   Vsin = Sin(s2)
```

```
   Vtan = Tan(s2)
   Print S1 ; "    " ; S2 ; "    " ; Vcos ; "    " ; Vsin ; "    " ; Vtan
Next
Print : Print : Print


Testing_atan:
Print "Testing Arctan"
Print "X    atan in Radiant,    Degree"
S1 = 1 / 1024
Do
   S2 = Atn(s1)
   S3 = Rad2deg(s2)
   Print S1 ; "      " ; S2 ; "      " ; S3
   S1 = S1 * 2
   If S1 > 1000000 Then
      Exit Do
   End If
Loop

Print : Print : Print

Testing_int_fract:
Print "Testing Int und Fract of Single"
Print "Value      Int       Frac"
S2 = Pi \ 10
For S1 = 1 To 8
   S3 = Int(s2)
   S4 = Frac(s2)
   Print S2 ; "    " ; S3 ; "    " ; S4
   S2 = S2 * 10
Next

Print : Print : Print

Print "Testing degree - radiant - degree converting"
Print "Degree   Radiant   Degree   Diff-abs   rel"

For S1 = 0 To 90
  S2 = Deg2rad(s1)
  S3 = Rad2deg(s2)
  S4 = S3 - S1
  S5 = S4 \ S1
  Print S1 ; "    " ; S2 ; "    " ; S3 ; "    " ; S4 ; "    " ; S5
Next

Testing_hyperbolicus:
Print : Print : Print
Print "Testing SINH, COSH and TANH"
Print "X        sinh(x)         cosh(x)       tanh(x)"
For S1 = -20 To 20
  S3 = Sinh(s1)
  S2 = Cosh(s1)
  S4 = Tanh(s1)
  Print S1 ; "    " ; S3 ; "    " ; S2 ; "    " ; S4
Next
Print : Print : Print

Testing_log10:
Print "Testing LOG10"
Print "X        log10(x)"
S1 = 0.01
S2 = Log10(s1)
Print S1 ; "    " ; S2
S1 = 0.1
S2 = Log10(s1)
Print S1 ; "    " ; S2
For S1 = 1 To 100
  S2 = Log10(s1)
  Print S1 ; "    " ; S2
Next

Print : Print : Print


'test MOD on FP
S1 = 10000
S2 = 3
S3 = S1 Mod S2
Print S3

Print "Testing_SQR-Single"
For S1 = -1 To 4 Step 0.0625
   S2 = Sqr(s1)
   Print S1 ; " " ; S2
Next
Print
For S1 = 1000000 To 1000100
   S2 = Sqr(s1)
```

```
   Print S1 ; " " ; S2
Next

Testing_atn2:
Print "Testing Sin / Cos / ATN2 / Deg2Rad / Rad2Deg / Round"
Print "X[deg]     X[Rad]      Sin(x)      Cos(x)      Atn2     Deg of Atn2    Rounded"
For S1 = -180 To 180 Step 5
   S2 = Deg2rad(s1)
   S3 = Sin(s2)
   S4 = Cos(s2)
   S5 = Atn2(s3 , S4)
   S6 = Rad2deg(s5)
   S7 = Round(s6)
   Print S1 ; " " ; S2 ; " " ; S3 ; " " ; S4 ; " " ; S5 ; " " ; S6 ; " " ; S7
Next
Print "note: -180° is equivalent to +180°"
Print
Testing_asin_acos:
Print "Testing ASIN, ACOS"
Print "X       asin(x)         acos(x)"
   For S1 = -1.125 To 1.125 Step 0.0625
   S2 = Asin(s1)
   S3 = Acos(s1)
   Print S1 ; " " ; S2 ; " " ; S3
Next
Print "Note: > 1.0 and < -1.0 are invalid and shown here for error handling"


Testing_shift:
S1 = 12
For B1 = 1 To 20
   S2 = S1 : S3 = S1
   Shift S2 , Left , B1
   Shift S3 , Right , B1
   Print S1 ; " " ; S2 ; " " ; S3
Next

Print "End of testing"

End
```

Back

DOUBLE

The double.lbx (lib) is written by Josef Franz Vögel. The library supports the basic operations :

- Addition (+)
- Substraction (-)
- Multiplication (*)
- Division (/)
- Val() , INPUT
- Str() , PRINT
- Int()
- Frac()
- Fix()
- Round()
- Conversion from double to single and long
- Conversion from single and long to double

The double library uses special Mega instructions not available in all AVR chips. But as the old chips are not manufactured anymore, this should not be a problem.

All Trig() functions are supported by the double too!

I2C SLAVE

I2CSLAVE

The I2C-Slave library is intended to create I2C slave chips. This is an add-on library that is not included by default. It is a commercial add on library. It is available from MCS Electronics

All BASCOM I2C routines are master I2C routines. The AVR is a fast chip and allows to implement the I2C slave protocol.

You can control the chips with the BASCOM I2C statements like I2CINIT, I2CSEND, I2CRECEIVE, I2CWBYTE, etc. Please consult the BASCOM Help file for using I2C in master mode.

Before you begin

Copy the i2cslave.lib and i2cslave.lbx files into the BASCOM-AVR\LIB directory.
The i2cslave.lib file contains the ASM source. The i2cslave.lbx file contains the compiled ASM source.

Slave address

Every I2C device must have an address so it can be addressed by the master I2C routines.
When you write to an I2C-slave chip the least significant bit (bit0) is used to specify if we want to read from the chip or that we want to write to the chip.
When you specify the slave address, do not use bit 0 in the address!

For example a PCF8574 has address &H40. To write to the chip use &H40, to read from the chip, use &H41. When emulating a PCF8574 we would specify address &H40.

Use the CONFIG statement to specify the slave address:

Config I2cslave = &B01000000 ' same as &H40
Optional use : **CONFIG I2CSLAVE = address, INT= int , TIMER = tmr**

Where INT is INT0, INT1 etc. and TIMER is TIMER0, TIMER1 etc.
When using other interrupts or timers, you need to change the library source. The library was written for TIMER0 and INT0.

The I2C slave routines use the TIMER0 and INT0. You can not use these interrupts yourself. It also means that the SCL and SDA pins are fixed.

Note that new AVR chips have a TWI or hardware I2C implementation. It is better to use hardware I2C, then the software I2C. The slave library is intended for AVR chips that do not have hardware I2C.

CONFIG I2CSLAVE will enable the global interrupts.

After you have configured the slave address, you can insert your code.

A do-loop would be best:

Do

```
  ' your code here
Loop
```

This is a simple never-ending loop. You can use a GOTO with a label or a While Wend loop too but ensure that the program will never end.
After your main program you need to insert two labels with a return:

When the master needs to read a byte, the following label is always called.
You must put the data you want to send to the master in variable _a1 which is register R16

I2c_master_needs_data:

```
'when your code is short, you need to put in a waitms statement
'Take in mind that during this routine, a wait state is active and the master will wait
'After the return, the waitstate is ended
Config Portb = Input ' make it an input

_a1 = Pinb ' Get input from portB and assign it
Return
```

I2C_TWI

By default BASCOM will use software routines when you use I2C statements. This because when the first AVR chips were introduced, there was no TWI yet. Atmel named it TWI because Philips is the inventor of I2C. But TWI is the same as I2C.

So BASCOM allows you to use I2C on every AVR chip. Most newer AVR chips have build in hardware support for I2C. With the I2C_TWI lib you can use the TWI which has advantages as it require less code.

Read more about I2C in the hardware section.

To force BASCOM to use the TWI, you need to insert the following statement into your code:

```
$LIB "I2C_TWI.LBX"
```

You also need to choose the correct SCL and SDA pins with the CONFIG SCL and CONFIG SDA statements.
The TWI will save code but the disadvantage is that you can only use the fixed SCL and SDA pins.

I2C TWI Slave

The I2C Slave add on can turn some chips into a I2C slave device. You can start your own chip plant this way.

Most new AVR chips have a so called TWI interface. As a customer of the I2C slave lib, you can get both libs.
The TWI slave lib works in interrupt mode and is the best way as it adds less overhead and also less system resources.

In the following example the code for older compilers

Example

```
'-----------------------------------------------------------------------
-----------
```

```
'name                     : twi-slave.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows an example of the TWI in SLAVE mode
'micro                    : Mega128
'suited for demo          : yes
'commercial addon needed  : yes
'-------------------------------------------------------------------------------
-----------

$regfile = "m128def.dat"                                    ' specify the used
micro
$crystal = 8000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space


' Not all AVR chips have TWI (hardware I2C)
' IMPORTANT : this example ONLY works when you have the TWI slave library
' which is a commercial add on library, not part of BASCOM

Print "MCS Electronics TWI-slave demo"

Config Twislave = &H70 , Btr = 1 , Bitrate = 100000


'as you might need other interrupts as well, you need to enable them manual

Enable Interrupts

'this is just an empty loop but you could perform other tasks there
Do
  nop
Loop
End

'A master can send or receive bytes.
'A master protocol can also send some bytes, then receive some bytes
'The master and slave must match.

'the following labels are called from the library
Twi_stop_rstart_received:
  Print "Master sent stop or repeated start"
Return


Twi_addressed_goread:
  Print "We were addressed and master will send data"
Return


Twi_addressed_gowrite:
  Print "We were addressed and master will read data"
Return


'this label is called when the master sends data and the slave has received the
byte
'the variable TWI holds the received value
Twi_gotdata:
   Print "received : " ; Twi
Return
```

```
'this label is called when the master receives data and needs a byte
'the variable twi_btr is a byte variable that holds the index of the needed
byte
'so when sending multiple bytes from an array, twi_btr can be used for the
index
Twi_master_needs_byte:
  Print "Master needs byte : " ; Twi_btr
  Twi = 65                                                    ' twi must be
filled with a value
Return


'when the mast has all bytes received this label will be called
Twi_master_need_nomore_byte:
  Print "Master does not need anymore bytes"
Return
```

SPI

SPISLAVE

SPISLAVE.LIB (LBX) is a library that can be used to create a SPI slave chip when the chip does not have a hardware SPI interface.
Although most AVR chips have an ISP interface to program the chip, the 2313 for example does not have a SPI interface.

When you want to control various micro's with the SPI protocol you can use the SPISLAVE library.

The spi-softslave.bas sample from the samples directory shows how you can use the SPISLAVE library.
Also look at the spi-slave.bas sample that is intended to be used with hardware SPI.

The sendspi.bas sample from the samples directory shows how you can use the SPI hardware interface for the master controller chip.

```
'-----------------------------------------------------------------------------
-----------
'name                     : spi-softslave.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to implement a SPI SLAVE with software
'micro                    : AT90S2313
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "2313def.dat"                                    ' specify the used
micro
$crystal = 4000000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space

'Some atmel chips like the 2313 do not have a SPI port.
'The BASCOM SPI routines are all master mode routines
'This example show how to create a slave using the 2313
'ISP slave code


'define the constants used by the SPI slave
Const _softslavespi_port = Portd                            ' we used portD
Const _softslavespi_pin = Pind                              'we use the PIND
register for reading
Const _softslavespi_ddr = Ddrd                              ' data direction of
port D

Const _softslavespi_clock = 5                               'pD.5 is used for
the CLOCK
Const _softslavespi_miso = 3                                'pD.3 is MISO
Const _softslavespi_mosi = 4                                'pd.4 is MOSI
```

```
Const _softslavespi_ss = 2                                  ' pd.2 is SS
'while you may choose all pins you must use the INT0 pin for the SS
'for the 2313 this is pin 2

'PD.3(7),  MISO  must be output
'PD.4(8),  MOSI
'Pd.5(9) , Clock
'PD.2(6),  SS /INT0

'define the spi slave lib
$lib "spislave.lbx"
'sepcify wich routine to use
$external _spisoftslave

'we use the int0 interrupt to detect that our slave is addressed
On Int0 Isr_sspi Nosave
'we enable the int0 interrupt
Enable Int0
'we configure the INT0 interrupt to trigger when a falling edge is detected
Config Int0 = Falling
'finally we enabled interrupts
Enable Interrupts

'
Dim _ssspdr As Byte                                         ' this is out SPI
SLAVE SPDR register
Dim _ssspif As Bit                                          ' SPI interrupt
revceive bit
Dim Bsend As Byte , I As Byte , B As Byte                   ' some other demo
variables

_ssspdr = 0                                                 ' we send a 0 the
first time the master sends data
Do
   If _ssspif = 1 Then
   Print "received: " ; _ssspdr
   Reset _ssspif
   _ssspdr = _ssspdr + 1                                    ' we send this the
next time
   End If
Loop
```

When the chip has a SPI interface, you can also use the following example:

```
'-----------------------------------------------------------------------------
-----------
'name                     : spi-slave.bas
'copyright                : (c) 1995-2005, MCS Electronics
'purpose                  : shows how to create a SPI SLAVE
'micro                    : AT90S8515
'suited for demo          : yes
'commercial addon needed  : no
'-----------------------------------------------------------------------------
-----------

$regfile = "8515def.dat"                                    ' specify the used
micro
$crystal = 3680000                                          ' used crystal
frequency
$baud = 19200                                               ' use baud rate
$hwstack = 32                                               ' default use 32
for the hardware stack
$swstack = 10                                               ' default use 10
for the SW stack
$framesize = 40                                             ' default use 40
for the frame space
```

```
' use together with sendspi.bas
'-----------------------------------------------------------------
' Tested on the STK500. The STK200 will NOT work.
' Use the STK500 or another circuit


Dim B As Byte , Rbit As Bit , Bsend As Byte

'First configure the MISO pin
Config Pinb.6 = Output                                          ' MISO

'Then configure the SPI hardware SPCR register
Config Spi = Hard , Interrupt = On , Data Order = Msb , Master = No , Polarity
= Low , Phase = 0 , Clockrate = 128

'Then init the SPI pins directly after the CONFIG SPI statement.
Spiinit


'specify the SPI interrupt
On Spi Spi_isr Nosave

'enable global interrupts
Enable Interrupts

'show that we started
Print "start"
Spdr = 0                                                        ' start with
sending 0 the first time
Do
  If Rbit = 1 Then
    Print "received : " ; B
    Reset Rbit
    Bsend = Bsend + 1 : Spdr = Bsend                            'increase SPDR
  End If
  ' your code goes here
Loop



'Interrupt routine
'since we used NOSAVE, we must save and restore the registers ourself
'when this ISR is called it will send the content from SPDR to the master
'the first time this is 0
Spi_isr:
  push r24    ; save used register
  in r24,sreg ; save sreg
  push r24
  B = Spdr
  Set Rbit                                                      ' we received
something
  pop r24
  !out sreg,r24 ; restore sreg
  pop r24        ; and the used register
Return                                                          ' this will
generate a reti
```

DATE TIME

EUROTIMEDATE

The CONFIG CLOCK statement for using the asynchrony timer of the 8535, M163, M103 or M128 (and others) allows you to use a software based clock. See TIME$ and DATE$.

By default the date format is in MM/DD/YY.

By specifying:
$LIB "EURODATETIME.LBX"

The DATE$ will work in European format : DD-MM-YY

Note that the eurotimedate library should not be used anymore. It is replaced by the DATETIME library which offers many more features.

DATETIME

The DateTime library is written by Josef Franz Vögel. It extends the clock routines with date and time calculation.

The following functions are available:

DayOfWeek	Returns the day of the week
DayOfYear	Returns the day of the year
SecOfDay	Returns the second of the day
SecElapsed	Returns the elapsed Seconds to a former assigned time-stamp
SysDay	Returns a number, which represents the System Day
SysSec	Returns a Number, which represents the System Second
SysSecElapsed	Returns the elapsed Seconds to a earlier assigned system-time-stamp
Time	Returns a time-value (String or 3 Byte for Second, Minute and Hour) depending of the Type of the Target
Date	Returns a date-value (String or 3 Bytes for Day, Month and Year) depending of the Type of the Target

Date and time not to be confused with Date$ and Time$!

PS2-AT Mouse and Keyboard Emulation

AT_EMULATOR

The PS2 AT Keyboard emulator library is an optional add on library you can purchase.

The library allows you to emulate an AT PS/2 keyboard or mouse.

The following statements become available:

CONFIG ATEMU

SENDSCANKBD

PS2MOUSE_EMULATOR

The PS2 Mouse emulator library is an optional addon library you can purchase.

The library allows you to emulate an AT PS/2 mouse.

The following statements become available:

CONFIG PS2EMU

PS2MOUSEXY

SENDSCAN

BCCARD

BCCARD

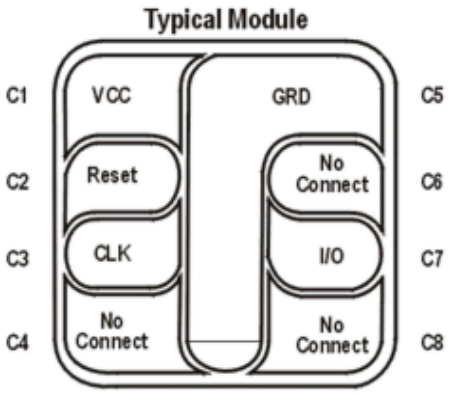
BCCARD.LIB is a commercial addon library that is available separately from MCS Electronics.

With the BCCARD library you can interface with the BasicCards from www.basiccard.com

BasicCards are also available from MCS Electronics

A BasicCard is a smart card that can be programmed in BASIC.

The chip on the card looks like this :



Card Contacts

C1 - Vcc (+5 VDC)
C2 - reset
C3 - clock
C4 - reserved
C5 - ground
C6 - reserved
C7 - input/output
C8 - reserved

To interface it you need a smart card connector.

In the provided example the connections are made as following:

Smart Card PIN	Connect to
C1	+5 Volt
C2	PORTD.4 , RESET
C3	PIN 4 of 2313 , CLOCK
C5	GND
C7	PORTD.5 , I/O

The microprocessor must be clocked with a 3579545 crystal since that is the frequency the Smart Card is working on. The output clock of the microprocessor is connected to the clock pin of the Smart card.

Some global variables are needed by the library. They are dimensioned automatic by the compiler when you use the CONFIG BCCARD statement.

These variables are:

_Bc_pcb : a byte needed by the communication protocol.
Sw1 and SW2 : both bytes that correspondent to the BasicCard variables SW1 and SW2

The following statements are especially for the BasicCard:

CONFIG BCCARD to init the library

BCRESET to reset the card

BCDEF to define your function in the card

BCCALL to call the function in the card

Encryption is not supported by the library yet.

CONFIG BCCARD

Action
Initializes the pins that are connected to the BasicCard.

Syntax
CONFIG BCCARD = port , IO=pin, RESET=pin

Remarks

Port	The PORT of the micro that is connected to the BasicCard. This can be B or D for most micro's. (PORTB and PORTD)
IO	The pin number that is connected to the IO of the BasicCard. Must be in the range from 0-7
RESET	The pin number that is connected to the RESET of the BasicCard. Must be in the range from 0-7

The variables SW1, SW2 and _BC_PCB are automatically dimensioned by the CONFIG BCCARD statement.

This statements uses BCCARD.LIB, a library that is available separately from MCS Electronics.

See Also
BCRESET , BCDEF , BCCALL

Example
```
'--------------------------------------------------------------------------
'                          BCCARD.BAS
' This AN shows how to use the BasicCard from Zeitcontrol
'                          www.basiccard.com
'--------------------------------------------------------------------------
```

```
'connections:
' C1 = +5V
' C2 = PORTD.4 - RESET
' C3 = PIN 4   - CLOCK
' C5 = GND
' C7 = PORTD.5 - I/O

'  /--------------------------------\
'  |                                |
'  |     C1  C5                     |
'  |     C2  C6                     |
'  |     C3  C7                     |
'  |     C4  C8                     |
'  |                                |
'  \--------------------------------/
'
'

'----------- configure the pins we use ------------
Config Bccard = D , Io = 5 , Reset = 4
'                                    ^ PORTD.4
'                          ^------------ PORTD.5
'               ^---------------------- PORT D

'Load the sample calc.bas into the basiccard


' Now define the procedure in BASCOM
' We pass a string and also receive a string
Bcdef Calc(string)

'We need to dim the following variables
'SW1 and SW2 are returned by the BasicCard
'BC_PCB must be set to 0 before you start a session


'Our program uses a string to pass the data so DIM it
Dim S As String * 15

'Baudrate might be changed
$baud = 9600
' Crystal used must be 3579545 since it is connected to the Card too
$crystal = 3579545


'Perform an ATR
Bcreset


'Now we call the procedure in the BasicCard
'bccall funcname(nad,cla,ins,p1,p2,PRM as TYPE,PRM as TYPE)
S = "1+1+3"                                                 ' we want to
calculate the result of this expression

Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
'                                  ^--- variable to pass that holds the
expression
'                              ^------- P2
'                          ^----------- P1
'                      ^--------------- INS
'                 ^-------------------- CLA
'           ^-------------------------- NAD
'For info about NAD, CLA, INS, P1 and P2 see your BasicCard manual
'if an error occurs ERR is set
' The BCCALL returns also the variables SW1 and SW2
Print "Result of calc : " ; S
Print "SW1 = " ; Hex(sw1)
```

```
Print "SW2 = " ; Hex(sw2)
'Print Hex(_bc_pcb)  ' for test you can see that it toggles between 0 and 40
Print "Error : " ; Err

'You can call this or another function again in this session

S = "2+2"
Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
Print "Result of calc : " ; S
Print "SW1 = " ; Hex(sw1)
Print "SW2 = " ; Hex(sw2)
'Print Hex(_bc_pcb)  ' for test you can see that it toggles between 0 and 40
Print "Error : " ; Err


'perform another ATR
Bcreset
Input "expression " , S
Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
Print "Answer : " ; S


'----and now perform an ATR as a function
Dim Buf(25) As Byte , I As Byte
Buf(1) = Bcreset()
For I = 1 To 25
  Print I ; "  " ; Hex(buf(i))
Next
'typical returns :
'TS = 3B
'T0 = EF
'TB1 = 00
'TC1 = FF
'TD1 = 81  T=1 indication
'TD2 = 31  TA3,TB3 follow T=1 indicator
'TA3 = 50 or 20  IFSC ,50 =Compact Card, 20 = Enhanced Card
'TB3 = 45  BWT blocl waiting time
'T1 -Tk = 42 61 73 69 63 43 61 72 64 20 5A 43 31 32 33 00 00
'         B  a  s  i  c  C  a  r  d     Z  C   1  2  3


'and another test
'define the procedure in the BasicCard program
Bcdef Paramtest(byte , Word , Long )


'dim some variables
Dim B As Byte , W As Word , L As Long

'assign the variables
B = 1 : W = &H1234 : L = &H12345678

Bccall Paramtest(0 , &HF6 , 1 , 0 , 0 , B , W , L)
Print Hex(sw1) ; Spc(3) ; Hex(sw2)
'and see that the variables are changed by the BasicCard !
Print B ; Spc(3) ; Hex(w) ; "  " ; Hex(l)


'try the echotest command
Bcdef Echotest(byte)
Bccall Echotest(0 , &HC0 , &H14 , 1 , 0 , B)
Print B
End                                                    'end program
```

BCDEF

Action
Defines a subroutine name and it's parameters in BASCOM so it can be called in the BasicCard.

Syntax
BCDEF name([param1 , paramn])

Remarks

name	The name of the procedure. It may be different than the name of the procedure in the BasicCard but it is advised to use the same names.
Param1	Optional you might want to pass parameters. For each parameter you pass, you must specify the data type. Supported data types are byte, Integer, Word, Long, Single and String

This statements uses BCCARD.LIB, a library that is available separately from MCS Electronics.

BCDEF Calc(string)

Would define a name 'Calc' with one string parameter.
When you use strings, it must be the last parameter passed.

BCDEF name(byte,string)

BCDEF does not generate any code. It only informs the compiler about the data types of the passed parameters.

See Also
CONFIG BCCARD , BCCALL , BCRESET

Partial Example
```
Bcdef Calc(string)
```

BCCALL

Action
Calls a subroutine or procedure in the BasicCard.

Syntax
BCCALL name(nad , cla, ins, p1, p2 [param1 , paramn])

Remarks

name	The name of the procedure to all in the BasicCard. It must be defined first with BCDEF. The name used with BCDEF and BCCALL do not need to be the same as the procedure in the BasicCard but it is advised to use the same names.
NAD	Node address byte. The BasicCard responds to ao all node address values. Use 0 for default.
CLA	Class byte. First byte of two byte CLA-INS command. Must match the value in the BasicCard procedure.
INS	Instruction byte. Second byte of two byte CLA-INS command. Must match the value in the BasicCard procedure.
P1	Parameter 1 of CLA–INS header.
P2	Parameter 2 of CLA-INS header

This statements uses BCCARD.LIB, a library that is available separately from MCS Electronics.

When in your BasicCard basic program you use:

```
'test of passing parameters
Command &hf6 &h01 ParamTest( b as byte, w as integer,l as long)
b=b+1
w=w+1
l=l+1
end command
```

You need to use &HF6 for CLA and 1 for INS when you call the program:

```
Bccall Paramtest(0 , &HF6 , 1 , 0 , 0 , B , W , L)
                                    ^ NAD

                                ^CLA

                             ^INS

                          ^P1

                       ^P2
```

When you use BCCALL, the NAD, CLA, INS, P1 and P2 are sent to the BasicCard. The parameter values are also sent to the BasicCard. The BasicCard will execute the command defined with CLA and INS and will return the result in SW1 and SW2.

The parameter values altered by the BasicCard are also sent by the BasicCard.

You can not sent constant values. Only variables may be sent. This because a constant can not be changed.

See Also

CONFIG BCCARD , BCDEF , BCRESET

Example

```
'-------------------------------------------------------------------------------
'                          BCCARD.BAS
' This AN shows how to use the BasicCard from Zeitcontrol
'                          www.basiccard.com
'-------------------------------------------------------------------------------
'connections:
' C1 = +5V
' C2 = PORTD.4 - RESET
' C3 = PIN 4   - CLOCK
' C5 = GND
' C7 = PORTD.5 - I/O

'  /--------------------------------\
'  |                                |
'  |     C1  C5                     |
'  |     C2  C6                     |
'  |     C3  C7                     |
'  |     C4  C8                     |
'  |                                |
'  \--------------------------------/
'
'

'----------- configure the pins we use ------------
Config Bccard = D , Io = 5 , Reset = 4
'                                    ^ PORTD.4
'                           ^------------ PORTD.5
'                ^---------------------- PORT D

'Load the sample calc.bas into the basiccard


' Now define the procedure in BASCOM
' We pass a string and also receive a string
Bcdef Calc(string)

'We need to dim the following variables
'SW1 and SW2 are returned by the BasicCard
'BC_PCB must be set to 0 before you start a session


'Our program uses a string to pass the data so DIM it
Dim S As String * 15

'Baudrate might be changed
$baud = 9600
' Crystal used must be 3579545 since it is connected to the Card too
$crystal = 3579545


'Perform an ATR
Bcreset


'Now we call the procedure in the BasicCard
'bccall funcname(nad,cla,ins,p1,p2,PRM as TYPE,PRM as TYPE)
S = "1+1+3"                                                 ' we want to calculate the result of
this expression

Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
'                                ^--- variable to pass that holds the expression
'                              ^------- P2
'                           ^----------- P1
'                      ^---------------- INS
'                  ^--------------------- CLA
'            ^--------------------------- NAD
'For info about NAD, CLA, INS, P1 and P2 see your BasicCard manual
'if an error occurs ERR is set
' The BCCALL returns also the variables SW1 and SW2
Print "Result of calc : " ; S
Print "SW1 = " ; Hex(sw1)
Print "SW2 = " ; Hex(sw2)
'Print Hex(_bc_pcb)  ' for test you can see that it toggles between 0 and 40
Print "Error : " ; Err

'You can call this or another function again in this session

S = "2+2"
Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
Print "Result of calc : " ; S
Print "SW1 = " ; Hex(sw1)
Print "SW2 = " ; Hex(sw2)
'Print Hex(_bc_pcb)  ' for test you can see that it toggles between 0 and 40
Print "Error : " ; Err
```

```
'perform another ATR
Bcreset
Input "expression " , S
Bccall Calc(0 , &H20 , 1 , 0 , 0 , S)
Print "Answer : " ; S


'----and now perform an ATR as a function
Dim Buf(25) As Byte , I As Byte
Buf(1) = Bcreset()
For I = 1 To 25
  Print I ; "  " ; Hex(buf(i))
Next
'typical returns :
'TS = 3B
'T0 = EF
'TB1 = 00
'TC1 = FF
'TD1 = 81  T=1 indication
'TD2 = 31  TA3,TB3 follow T=1 indicator
'TA3 = 50 or 20  IFSC ,50 =Compact Card, 20 = Enhanced Card
'TB3 = 45  BWT blocl waiting time
'T1 -Tk = 42 61 73 69 63 43 61 72 64 20 5A 43 31 32 33 00 00
'         B  a  s  i  c  C  a  r  d     Z  C   1  2  3


'and another test
'define the procedure in the BasicCard program
Bcdef Paramtest(byte , Word , Long )


'dim some variables
Dim B As Byte , W As Word , L As Long

'assign the variables
B = 1 : W = &H1234 : L = &H12345678

Bccall Paramtest(0 , &HF6 , 1 , 0 , 0 , B , W , L)
Print Hex(sw1) ; Spc(3) ; Hex(sw2)
'and see that the variables are changed by the BasicCard !
Print B ; Spc(3) ; Hex(w) ; "  " ; Hex(l)


'try the echotest command
Bcdef Echotest(byte)
Bccall Echotest(0 , &HC0 , &H14 , 1 , 0 , B)
Print B
End                                                    'end program
```

```
Rem BasicCard Sample Source Code
Rem ------------------------------------------------------------------
Rem Copyright (C) 1997-2001 ZeitControl GmbH
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Rem ------------------------------------------------------------------

#Include CALCKEYS.BAS

Declare ApplicationID = "BasicCard Mini-Calculator"

Rem  This BasicCard program contains recursive procedure calls, so the
Rem  compiler will allocate all available RAM to the P-Code stack unless
Rem  otherwise advised. This slows execution, because all strings have to
Rem  be allocated from EEPROM. So we specify a stack size here:

#Stack 120

' Calculator Command (CLA = &H20, INS = &H01)
'
' Input: an ASCII expression involving integers, and these operators:
```

```
'
'    * / % + - & ^ |
'
' (Parentheses are also allowed.)
'
' Output: the value of the expression, in ASCII.
'
' P1 = 0: all numbers are decimal
' P1 <> 0: all numbers are hex

' Constants
Const SyntaxError = &H81
Const ParenthesisMismatch = &H82
Const InvalidNumber = &H83
Const BadOperator = &H84

' Forward references
Declare Function EvaluateExpression (S$, Precedence) As Long
Declare Function EvaluateTerm (S$) As Long
Declare Sub Error (Code@)


'test for passing a string
Command &H20 &H01 Calculator (S$)

   Private X As Long
   S$ = Trim$ (S$)
   X = EvaluateExpression (S$, 0)
   If Len (Trim$ (S$)) <> 0 Then Call Error (SyntaxError)
   If P1 = 0 Then S$ = Str$ (X) : Else S$ = Hex$ (X)

End Command


'test of passing parameters
Command &hf6 &h01 ParamTest( b as byte, w as integer,l as long)
   b=b+1
   w=w+1
   l=l+1
end command



Function EvaluateExpression (S$, Precedence) As Long

   EvaluateExpression = EvaluateTerm (S$)

   Do
      S$ = LTrim$ (S$)
      If Len (S$) = 0 Then Exit Function

      Select Case S$(1)

      Case "*"
         If Precedence > 5 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression * _
            EvaluateExpression (S$, 6)
      Case "/"
         If Precedence > 5 Then Exit Function
```

```
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression / _
            EvaluateExpression (S$, 6)
      Case "%"
         If Precedence > 5 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression Mod _
            EvaluateExpression (S$, 6)
      Case "+"
         If Precedence > 4 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression + _
            EvaluateExpression (S$, 5)
      Case "-"
         If Precedence > 4 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression - _
            EvaluateExpression (S$, 5)
      Case "&"
         If Precedence > 3 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression And _
            EvaluateExpression (S$, 4)
      Case "^"
         If Precedence > 2 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression Xor _
            EvaluateExpression (S$, 3)
      Case "|"
         If Precedence > 1 Then Exit Function
         S$ = Mid$ (S$, 2)
         EvaluateExpression = EvaluateExpression Or _
            EvaluateExpression (S$, 2)
      Case Else
         Exit Function
      End Select

   Loop

End Function

Function EvaluateTerm (S$) As Long

   Do                          ' Ignore unary plus
      S$ = LTrim$ (S$)
      If Len (S$) = 0 Then Call Error (SyntaxError)
      If S$(1) <> "+" Then Exit Do
      S$ = Mid$ (S$, 2)
   Loop

   If S$(1) = "(" Then       ' Expression in parentheses
      S$ = Mid$ (S$, 2)
      EvaluateTerm = EvaluateExpression (S$, 0)
      S$ = LTrim$ (S$)
      If S$(1) <> ")" Then Call Error (ParenthesisMismatch)
      S$ = Mid$ (S$, 2)
      Exit Function

   ElseIf S$(1) = "-" Then   ' Unary minus
      S$ = Mid$ (S$, 2)
```

```
      EvaluateTerm = -EvaluateTerm (S$)
      Exit Function

   Else                          ' Must be a number
      If P1 = 0 Then               ' If decimal
         EvaluateTerm = Val& (S$, L@)
      Else
         EvaluateTerm = ValH (S$, L@)
      End If
      If L@ = 0 Then Call Error (InvalidNumber)
      S$ = Mid$ (S$, L@ + 1)
   End If

End Function

Sub Error (Code@)
   SW1 = &H64
   SW2 = Code@
   Exit
End Sub
```

BCRESET

Action

Resets the BasicCard by performing an ATR.

Syntax

BCRESET
Array(1) = **BCRESET**()

Remarks

Array(1)	When BCRESET is used as a function it returns the result of the ATR to the array named array(1). The array must be big enough to hold the result. Dim it as a byte array of 25.

This statements uses BCCARD.LIB, a library that is available separately from MCS Electronics.

An example of the returned output when used as a function:

```
'TS = 3B
'T0 = EF
'TB1 = 00
'TC1 = FF
'TD1 = 81 T=1 indication
'TD2 = 31 TA3,TB3 follow T=1 indicator
'TA3 = 50 or 20 IFSC ,50 =Compact Card, 20 = Enhanced Card
'TB3 = 45 BWT block waiting time
'T1 -Tk = 42 61 73 69 63 43 61 72 64 20 5A 43 31 32 33 00 00

' B a s i c C a r d Z C 1 2 3
```

See the BasicCard manual for more information
When you do not need the result you can also use the BCRESET statement.

See Also
CONFIG BCCARD , BCDEF , BCCALL

Partial Example (no init code shown)
```
'----and now perform an ATR as a function
Dim Buf(25)AsByte, I AsByte
Buf(1)=Bcreset()
For I = 1 To 25
Print I ;" ";Hex(buf(i))
Next
'typical returns :
'TS = 3B
'T0 = EF
'TB1 = 00
'TC1 = FF
'TD1 = 81 T=1 indication
'TD2 = 31 TA3,TB3 follow T=1 indicator
'TA3 = 50 or 20 IFSC ,50 =Compact Card, 20 = Enhanced Card
'TB3 = 45 BWT blocl waiting time
'T1 -Tk = 42 61 73 69 63 43 61 72 64 20 5A 43 31 32 33 00 00
' B a s i c C a r d Z C 1 2 3
```

Tools

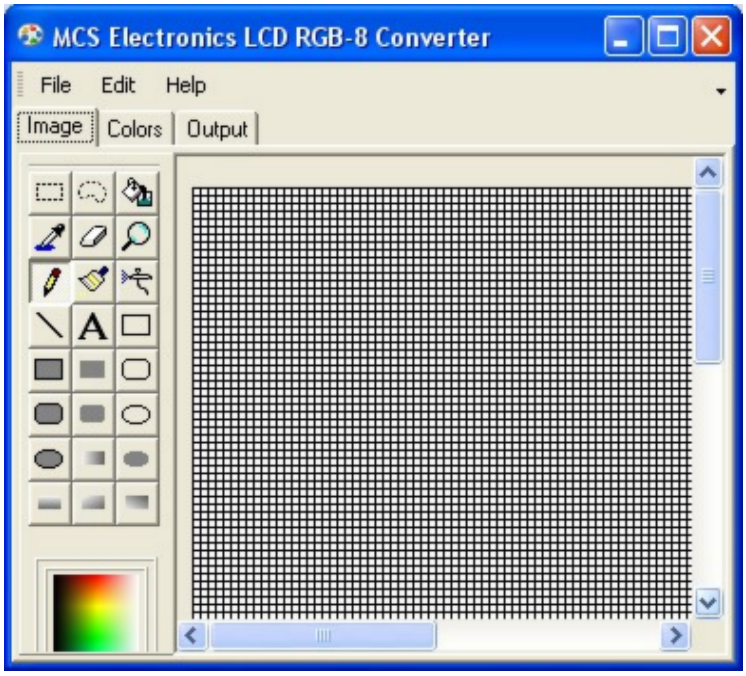
LCD RGB-8 Converter

Action

This tool is intended to convert normal bitmaps into BGC files.
The BGC format is the **B**ascom **G**raphic **C**olor Format.
This is a special RLE compressed format to save space.

The SHOWPIC statement can display graphic bitmaps.
The color display uses a special RGB8 format.
The LCD converter has the task to convert a normal windows bitmap into a 256-color RGB8 coded format.

When you run the tool you will see the following window :



You can use File , Open, to load an image from disk.
Or you can use Edit, Paste, to paste an image from the clipboard.

Option	Description
File, Open	Open a graphical file from disk.
File, Save, Image	Save the file as a windows graphical file
File, Save, Binary	Save the BGC file, the file you need with SHOWPIC
File, Save , Data Lines	Save the file as data lines into a text file
File, Convert	Converts the bitmap into a RGB8 bitmap
Edit, Bitmap height	height of the image. Change it to make the image smaller or larger
Edit, Bitmap width	width of the image. Change it to make the image wider.
Edit, Select All	Select entire image

Edit, Copy	Copy selection to the clipboard
Edit, Paste	Paste clipboard to the selection. You must have an area selected !
Edit, Delete	Delete the selected area

The Output TAB, has an option : Save as RLE. This must be checked. By default it is checked. When you do not want the image to be RLE encoded, you can uncheck this option.

The bottom area is used to store the DATA lines.

The Color TAB shows the effect on the table inside the color display.
When a picture uses a lot of different red colors, you can put the most used into the table.
It is well explained in the manuals from display3000.

By clicking on the color , you can view which colors are used by the picture.
You can match them with the color table.

You can download the LCD Converter tool from :
http://www.mcselec.com/index.php?option=com_docman&task=doc_download&gid=168&Itemid=54

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