

VX-Mega128

ATmega128 Microcontroller board

1. Features

- Support the ATmega128 with Flash memory of 128KB. Clock rate 14.7456MHz
- 34 I/O port of microcontroller are using INEX's standard PCB-3 pin connector.
- LCD16x2 module
- 4 of Button switches
- Binary Switch
- USB port with FT232RL USB to Serial converter circuit.
- ATmega128 pre-programmed Boot loader, programmable via USB port.
- 8-ch. Analog input with 10-bit Analog to Digital Converter
- 32KB RAM / 32KB EEPROM memory module plug on top
- Support In-system Programming via ISP connector with PX-400 Programmer
- Supply voltage +9V from external. +5V 500mA on-board regulator.

Includes : ATmega128 Microcontroller board, Pluggable Memory module, USB cable, CD-ROM and Documentation.

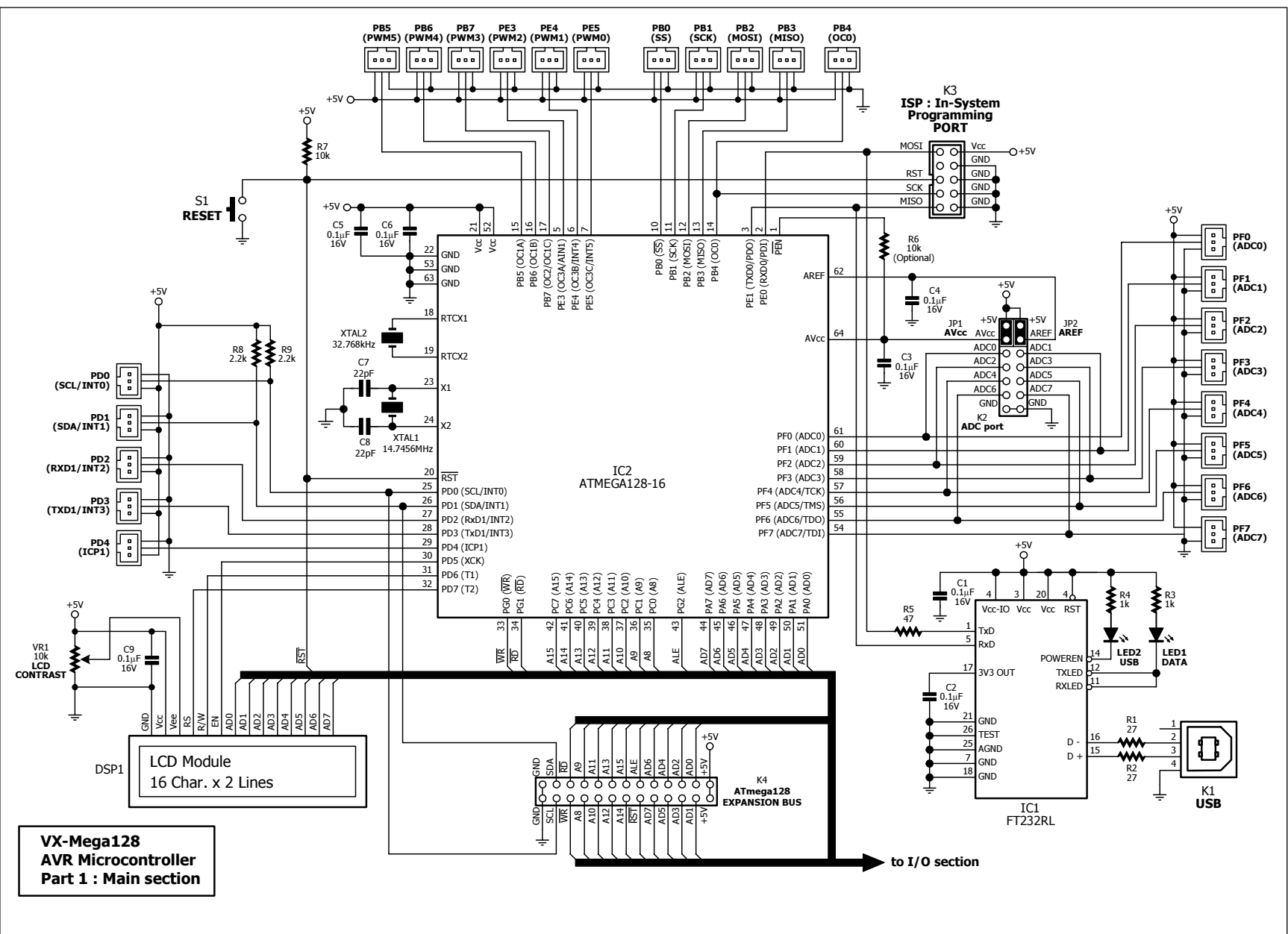


Figure 1 Microcontroller scetioB schematiuc diagram of VX-Mega128 board

2. Circuit and Memory map

The VX-Mega128 microcontroller board schematic diagram is splitted to 3 sections. The microcontroller section schematic diagram is shown in figure 1. Input/Output port and external device interface schematic diagram is shown in figure 2 and figure 3 shows the circuit of Memory extension module.

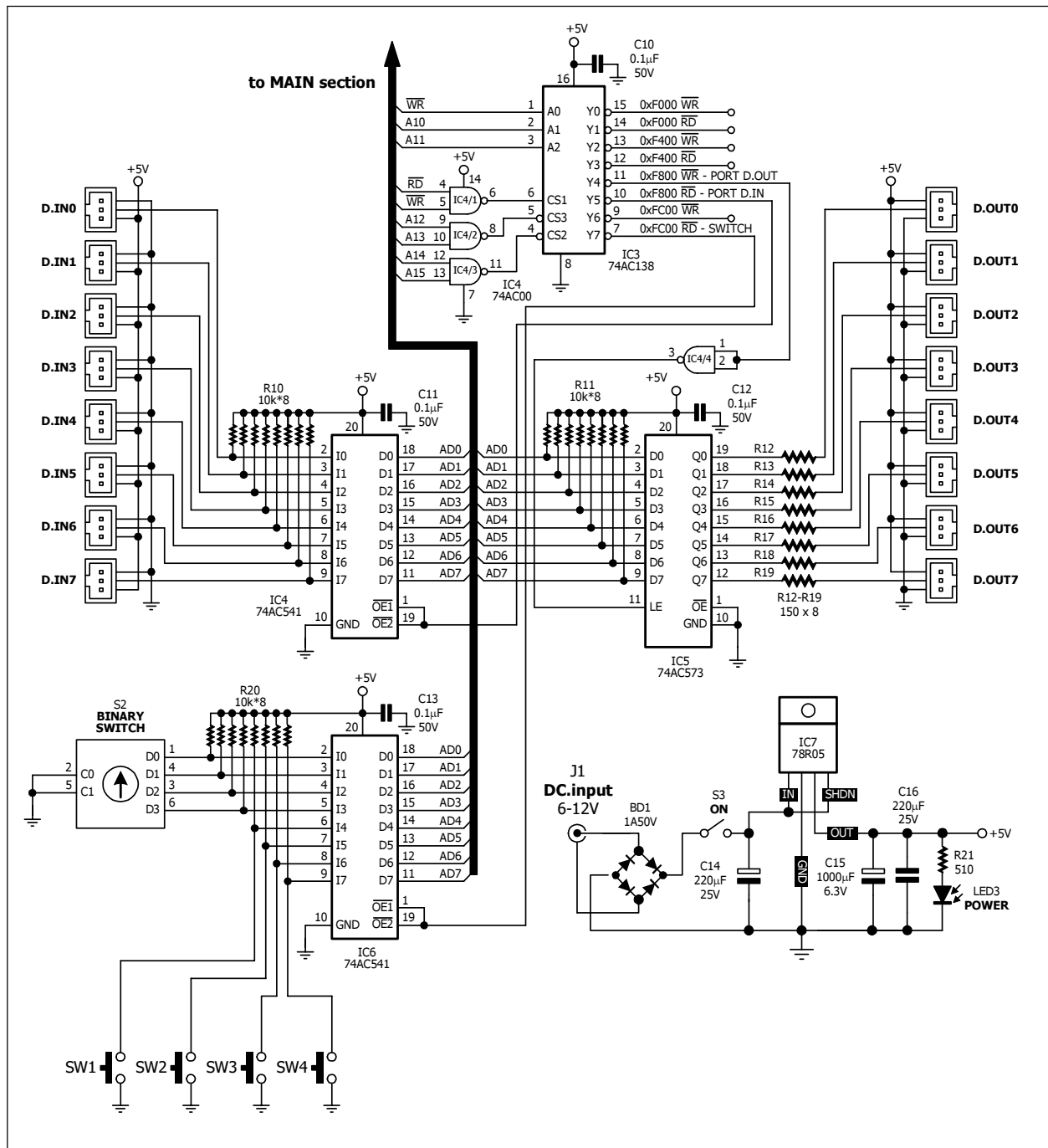


Figure 2 I/O port and external device interface schematic diagram of VX-Mega128 microcontroller board

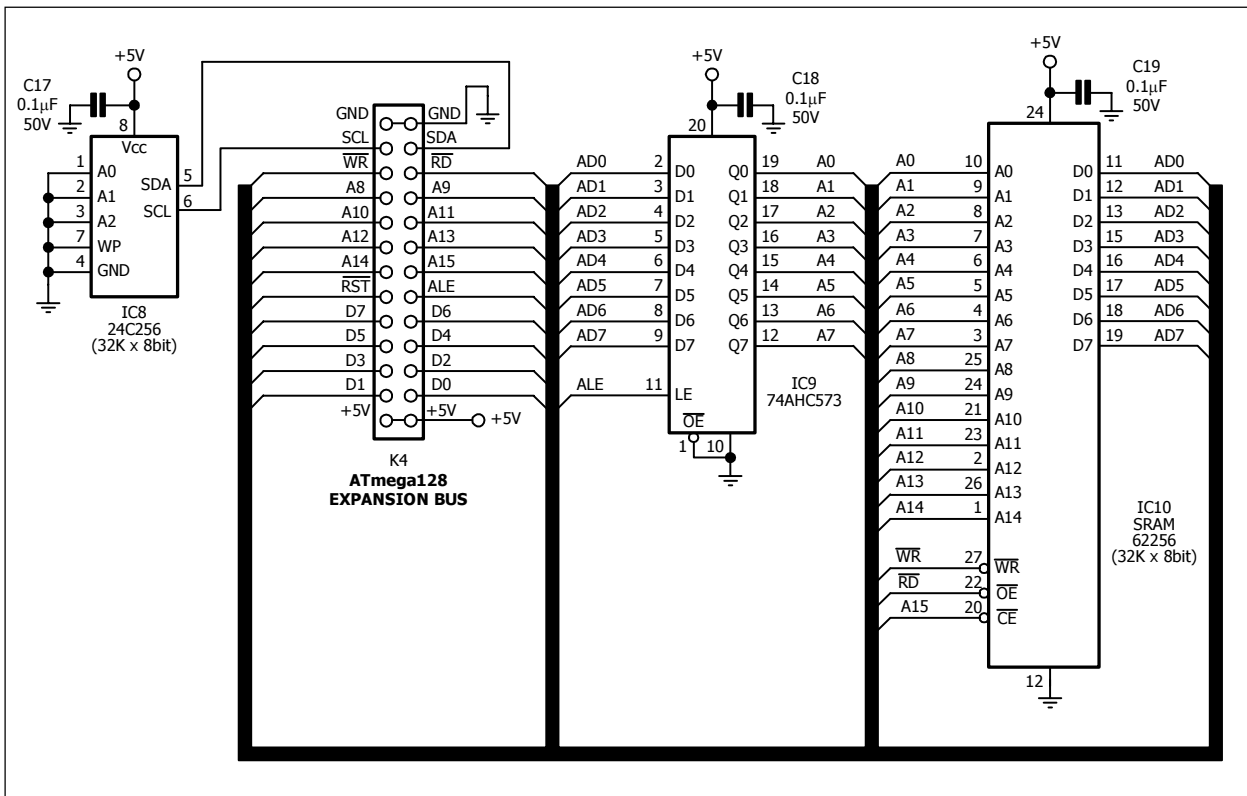


Figure 3 Data memory extension module schematic diagram

ATmega128 operates with clock frequency 14.7546MHz from external crystal circuit. The crystal 32.768kHz is connected to ATmega128 for setting the clock frequency to support internal Real-time counter. Supply voltage +5V comes from external DC adaptor +9V (+16V maximum) via +5V regulator circuit with 78R05 ICs.

VX-Mega128 supports both in Single chip microcontroller mode and Microprocessor mode. ATmega128 interfaces with all external device via address assignment. In figure 4 shows the memory and I/O map of VX-Mega128 board.

External device that connected with ATmega128 are assigned in address F000H to FFFFH included :

(1) **LCD module 16x2** : connect 8-bit data bus with AD0 to AD7 of ATmega128. It causes reading and writing via data bus instead direct interface.

(2) **4 of Input Switches (SW1 to SW4)** : address at upper nibble of FC00H. Signal is buffered via 74AC541 IC.

(3) **4-bit binary Switch** : this switch gives 4 binary bits. It means 16 different data 0000 to 1111 in binary base or 0 to 15 in decimal and 0 to F in HEX. Data from Binary switch are tranfered to data bus ; AD0 to AD3 via 74AC541 buffer IC and assigned at lowewr nibble of *FC00H*.

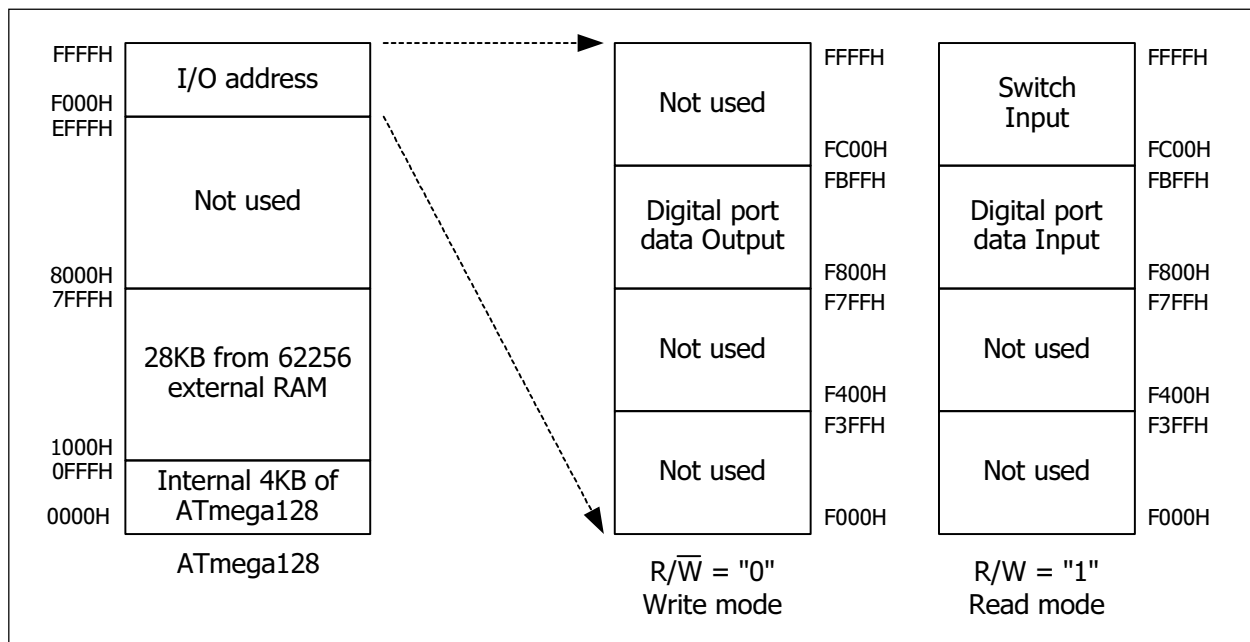


Figure 4 Memory and Input Output port organization of VX-Mega128 microcontroller board

Also the digital input and output port of VX-Mega128 board are assigned via address map system as follows :

Digital input port D.IN0 to D.IN7 are assigned at F800H address.

Digital output port D.OUT0 to D.OUT7 are assigned at F800H address too. but active with WR signal insterad.

All interface port include Analog to Dital converter module input are connect to INEX 3-pin PCB connector. User can connect with INEX many sensors and modules.

VX-Mega128 board supports 8-channel of Analog to digital converter. User can select supply voltage and reference for ADC module with 2 jumpers JP1 and JP2. If fit all, selects ADC module to use supply and reference voltage at +5V. If remove all, user can apply the voltage at these points. The limitation is reference voltage must lower or equal the supply voltage of ADC module. Normally, fit both jumpers on the board.

Computer interface of VX-Mega128 board via USB. The heart of this function is FT232RL the USB to Serial converter chip. Thus, interface signal is serial and connect to UART1 module in ATmega128. The programming shall be easier and supports all modern computer includes labtop which not serial port available.

Addition user can program microcontroller's flah memory via USB interface. Because ATmega128 microcontroller will be pre-programmed the bootloader ready. It means this microcontroller baord can program the flash 2 ways. One is via ISP connector with external In-System Programmer such as PX-400. Another is via USB with bootloader (Atmega128 must pre-rpogrammed ready).

3. How to program the VX-Mega128 board

Flash programming ATmega128 on VX-Mega128 board has 2 methods.

(1) **via ISP connector with external In-System Programmer** : The suggestion programmer is INEX's PX-400 and Atmel's AVR ISP In-System Programmer

(2) **via USB with bootloader** : This method ATmega128 must pre-programmed bootloader firmware. INEX prepare ready to using. However user can re-program the bootloader with yourself by external programmer via ISP connector. In CD-ROM contain the HEX file of this bootloader. On VX-Mega128 board has FT232RL USB to Serial converter chip to interface the USB but in software will look as COM port. Signal from FT232RL are connected to SPI programming pin PDI (PE0) and PDO (PE1) of ATmega128. With this method, user no need the external programer to flash programming. Only plug USB cable between board and computer. Open the suitable software. You can work with this microcontroller board.

4. Extension memory board

The memory board of VX-Mega128 is 64KB. Divides 2 parts. One is Static RAM 32KB ; 62256. However user can work only lower 28KB. Because upper 4KB is reserved by internal RAM data memory of ATmega128. Interfacing of this RAM work via the EXPANSION BUS. This bus provides 8-bit data/address lines; AD0 to AD7 and Address line A8 to A15, and all control signal.

Another memory part is serial EEPROM 32KB; 24C256. ATmega128 interfaces via I²C bus or Two-Wire Interface (TWI).

If you need to use this memory board with VX-Mega128 board, must plug this module on top at EXPANSION connector.

5. Software in VX-Mega128 board

The related software work with VX-Mega128 microcontroller board that suggestion has 4 softwares as follows :

(1) IDE development tool - introduce **AVR Studio**. It support both Assembly and C programming. Download the latest version at www.atmel.com

(2) C compiler - suggest **WinAVR**. It is powerful GCC compiler and important Free of charge. It can work with AVR Studio. User can develop C program under AVR Studio and use WinAVR to compile. Download the latest version at <http://sourceforge.net/projects/winavr>

(3) Flash programming software - suggest 2 softwares; **AVR Prog** and **AVR-OSP II**. The AVR Prog will install with AVR Studio. Avr-Osp II is separated. But user can add Avr-OSP II into AVR Studio for easier to using. Download the latest version at <http://esnips.com/web/AtmelAVR>

(4) Boot loader - It is small firmware that program into Flash program memory of ATmega128. Its function is write the HEX code with itself via controlling from computer via serial port. Programming this code into ATmga128 must use external In-System Programmer in first time. However the manufacturer pre-program the bootloader ready.

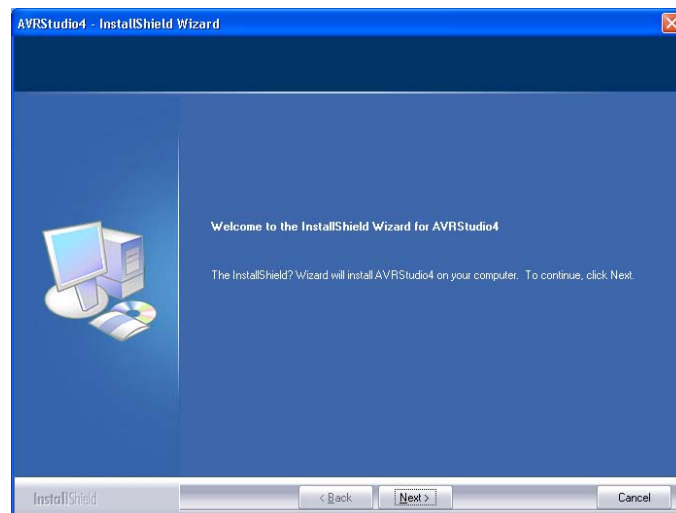
The installation must do following these step as follows

- (1) Install AVR Studio
- (2) Install WinAVR compiler
- (3) Install Virtual COM port (VCP) driver
- (4) Install Avr-Osp II software if require

5.1 AVR Studio installation

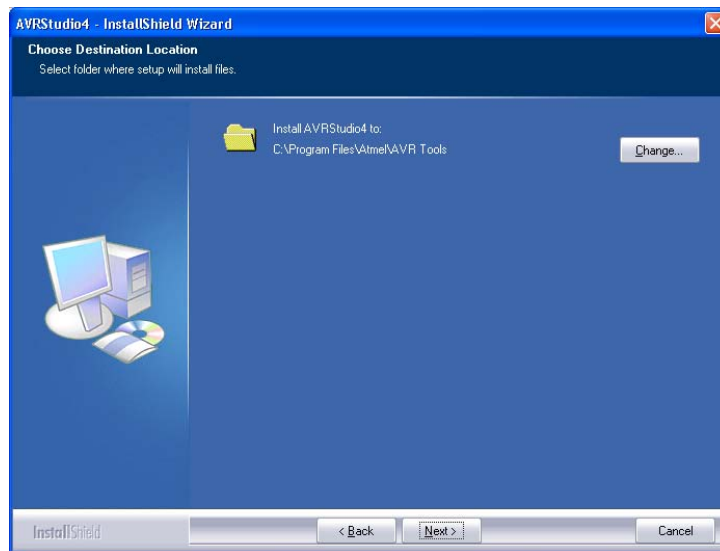
5.1.1 Insert the AVR CD-ROM and look for this file in the AVR Studio directory; aStudio4b460.exe. Double-click this file.

5.1.2 Enter the Installation Wizard. Click on the Next button to continue.



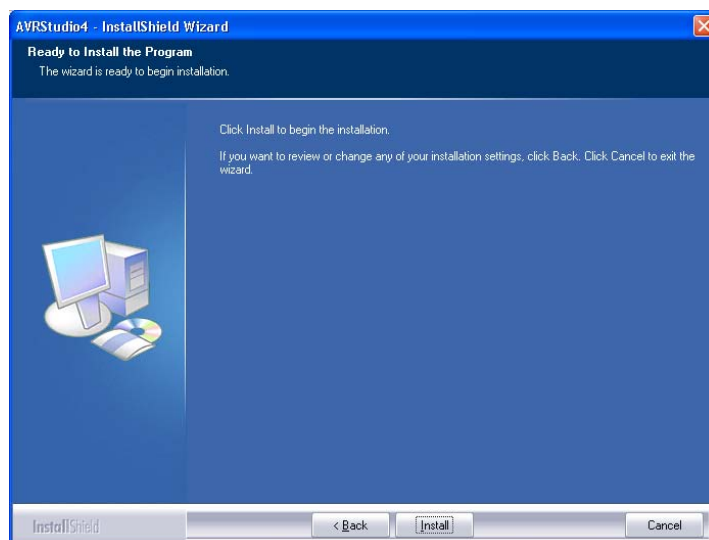
5.1.3 In the license agreement window, Select the box : **I accept the terms of the license agreement** and Click on the **Next** button.

5.1.4 Choose Destination Location windows will appear. You can change the path by clicking on the **Change** button and setting a new path. After this, click on the **Next** button.



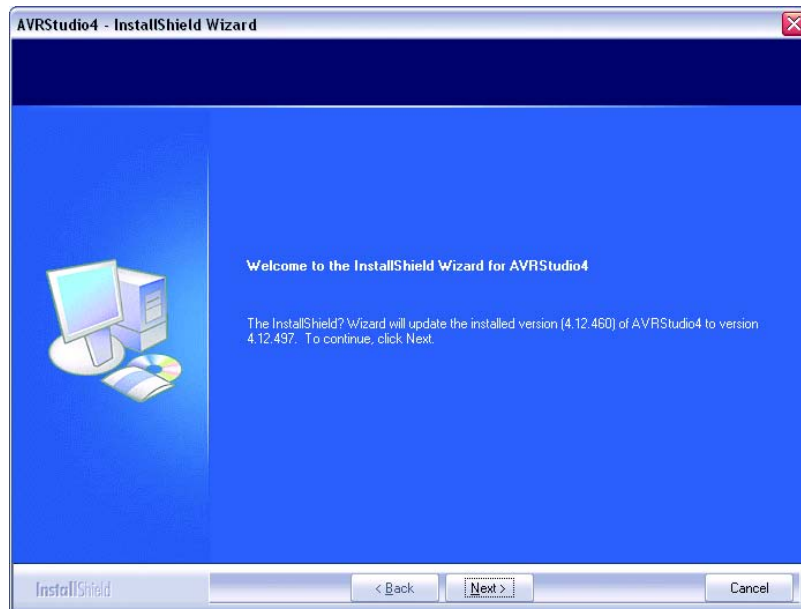
5.1.5 The Driver USB Upgrade window will now appear. Click on the **Next** button to pass this step.

5.1.6 In the begin installation window, click on the **Install** button to start installation.

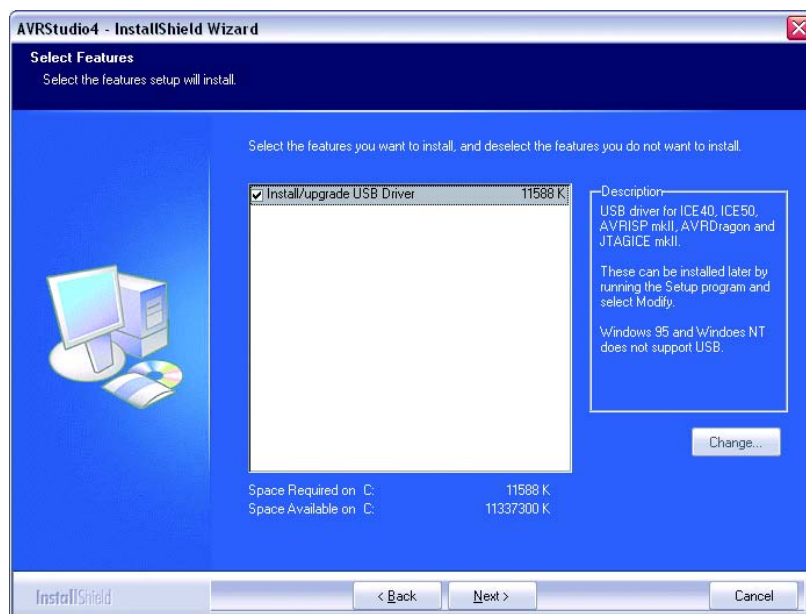


5.1.7 After the installation is complete, click on the **Finish** button to end the installation of AVR Studio.

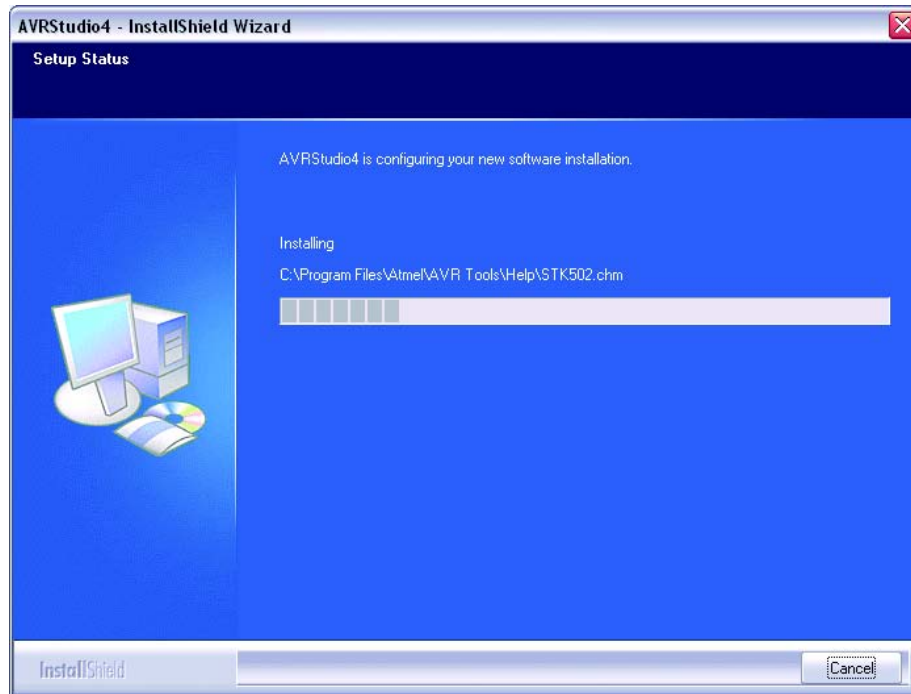
5.1.8 Next step is updating the software with service pack 4. Open CD-ROM . Enter to **Software folder** → **AVR Studio 4.12**. Look for this file in the Update folder ; **aStudio412SP4b497.exe**. Double-click this file. The welcome installation windows will appear. Click the **Next** button to continue.



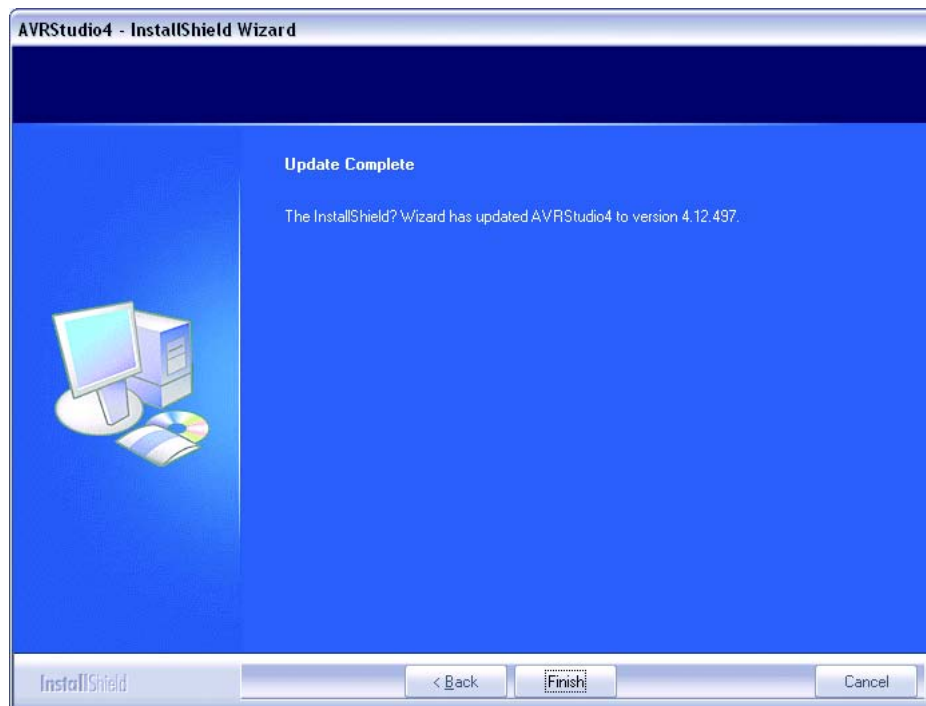
5.1.9 The Select Features window appear. Click the Next button to install the update files.



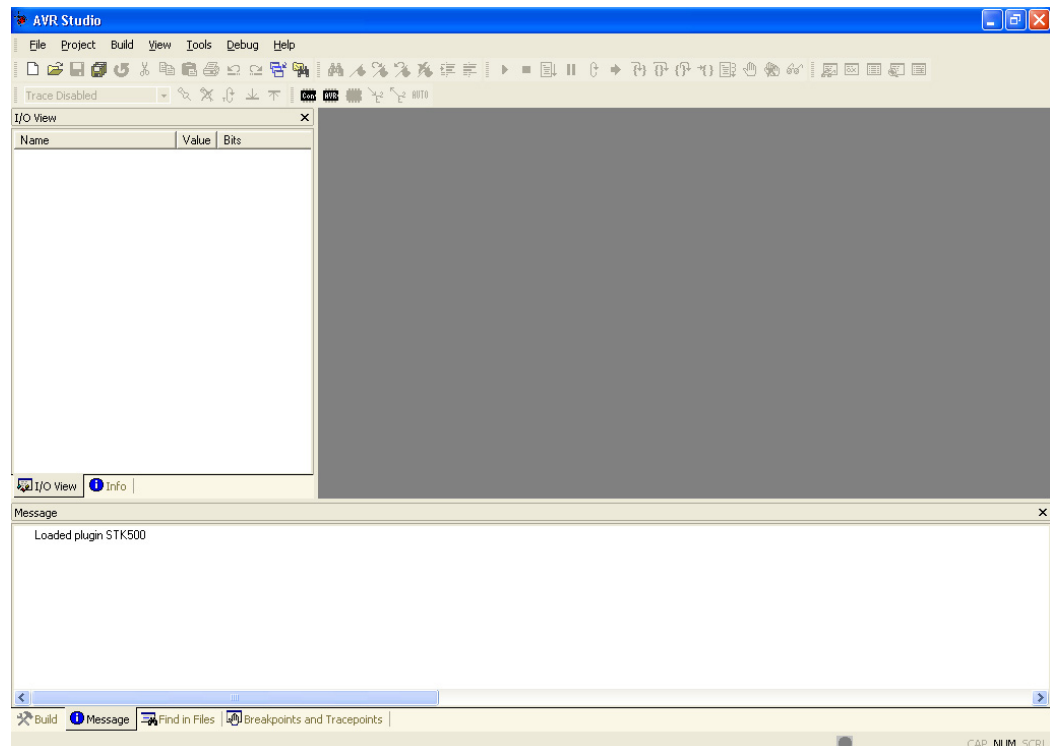
5.1.10 The Setup Status window appear and shows the installation progress bar. Wait until finish.



5.1.11 After installation complete, click the **Finish** button.



5.1.12 To Launch the AVR Studio program, click on **Start → Programs → Atmel AVR Tools → AVR Studio 4**. The main window of the AVR Studio program will appear.



5.2 WinAVR installation

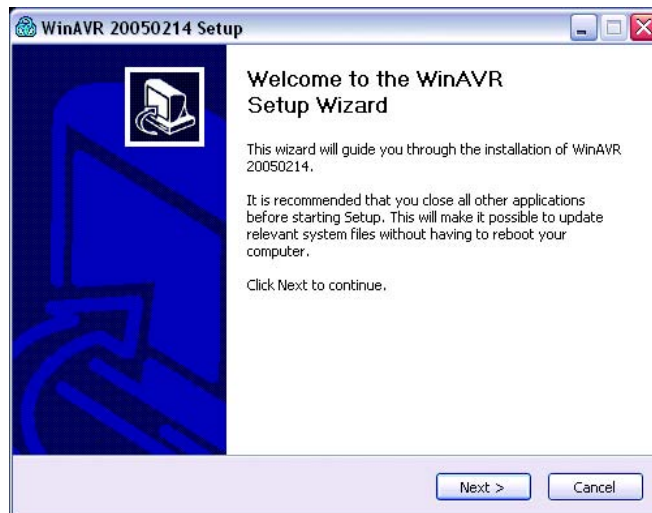
Please note that installation of WinAVR is done after the installation of AVR Studio. Please ensure this is being done before proceeding.

5.2.1 Insert the AVR CD-ROM, and find the installation file of WinAVR ; **WinAVR-20060421-install.exe** in folder **Software → WINAVR 20060421**. Double-click this file.

5.2.2 Installation language dialog box will appear for selection the language of this installation. Select your preferred language from the sliding bar. After that click on the **OK** button.



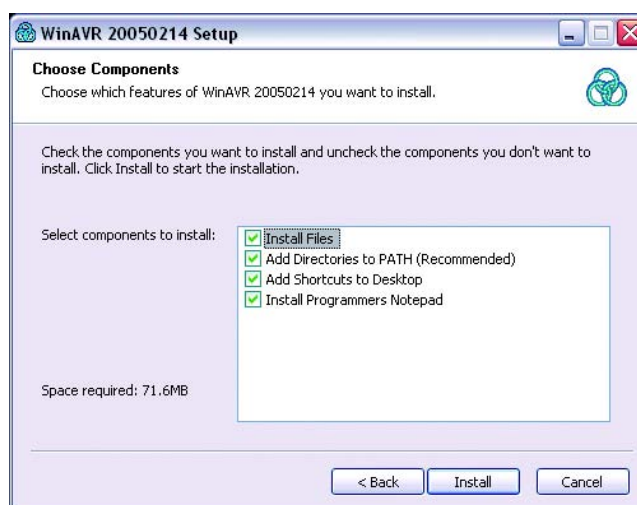
5.2.3 The Welcome installation software window appears and shows the installation information. Click on the **Next** button.



5.2.4 In the License agreement window, Click on the **I agree** button.

5.2.5 Choose Install Location window appears. User can change the path and the folder for the installation of WinAVR by clicking at the **Browse** button and selecting the respective folder. The proposed folder is **C:\WinAVR**. After selection, click **Next** button to continue to the next step.

5.2.6 In the Choose Components window, select the components which you want to install or follow according to the below diagram. Click on the **Install** button to begin the installation.



5.2.7 The installation process starts and reports the status back on the screen. The User needs to wait until the installation is complete. Click on the **Finish** button to end once its done.

5.3 Install Virtual COM port (VCP) driver

5.3.1 Connect USB cable between VX-Mega128 board and computer's USB port. Put the ACR CD-ROM in CD-ROM drive. Apply the supply voltage to VX-Mega128 board.

5.3.2 Computer will detect the new hardware.



5.3.3 After that the New Hardware window appear. Select **Install from a list or specific location (Advanced)** header and click the **Next >** button to continue.



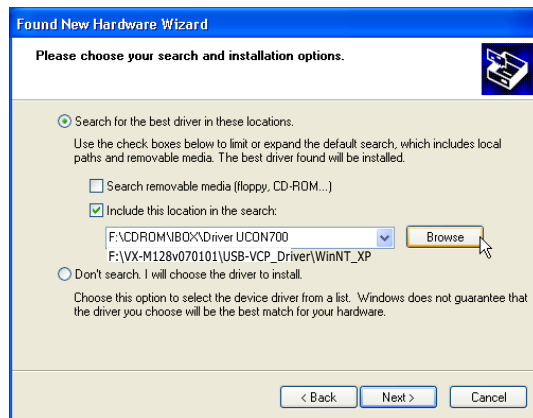
5.3.4 Next, click to select at **Search for the best driver in theses location** and **Include this location in the search** header. After that click **Browse** button to looks for Driver directory in CD-ROM. The driver file will contain in folder **USB-VCP_driver → WinNT_XP** Click the **Next** button to continue.

5.3.5 All driver files will install to computer.

5.3.6 The USB High Speed Serial Converter installation complete window appear. Click the **Finish** button. USB indicator on VX-Mega128 board lights.

5.3.7 Wait a moment, the Virtual COM port installation driver window will appear. Select **Install from a list or specific location (Advanced)** header similar step 5.1.3.3 and click the **Next >** button.

5.3.8 Select **Search for the best driver in these locations** and **Include this location in the search** header. Click **Browse** button to look for Driver directory in CD-ROM. Must select the same destination from step 5.1.3.4. Click the **Next >** button to continue.



5.3.9 All driver files will install to computer.

5.3.10 The USB Serial port installation complete window appear. Click the **Finish** button to finish installation.

5.3.11 After installation complete, user can check the position of the Virtual COM port or USB Serial port. Open **Control Panel**. Select **System → Hardware → Device Manager** and see **Port (COM & LPT)**. You will found **USB Serial Port** position. Remember it for interfacing later.

6. Flash programming on VX-Mega128 board

6.1 Via USB port with Bootloader

6.1.1 Apply the supply voltage in range +6 to 12Vdc to VX-Mega128 board. Press the SW1 switch and turn-on power switch. The green POWER LED lights. Release the SW1. At LCD screen shows message below :

```
VX-Mega128
Run > Bootloader
```

Now the VX-Mega128 board enter to Bootloader mode. Ready for flash programming via USB port.

6.1.2 Connect USB cable between PC's USB port and VX-Mega128 board. Check the USB Serial port position from Device Manager following the figure 5.

6.1.3 Open AVR Studio to develop C program and compile to HEX file ready.

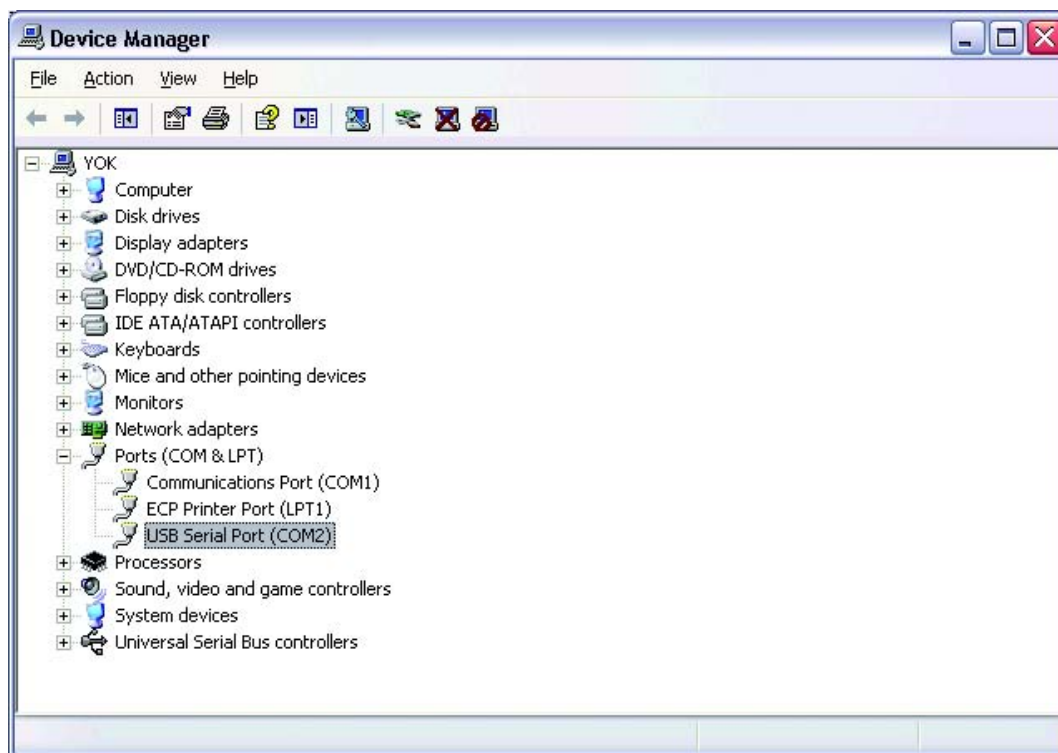
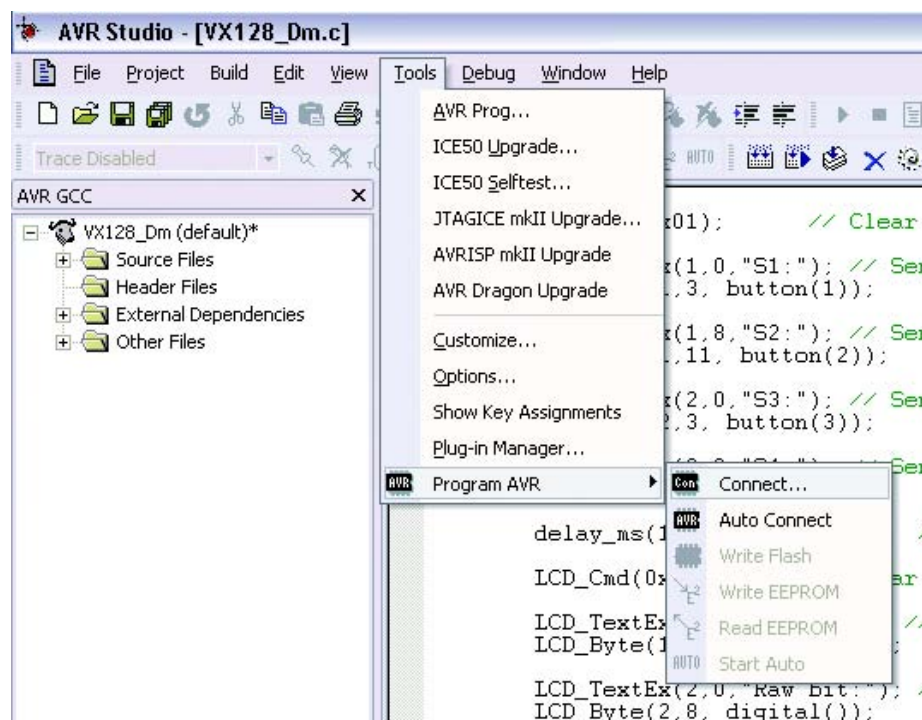
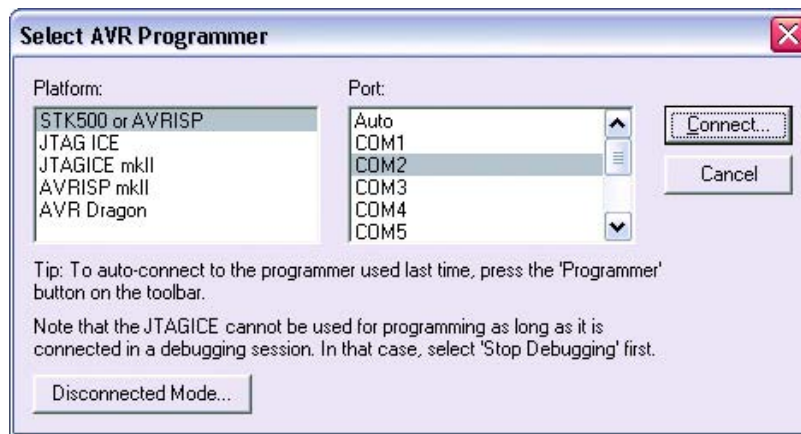


Figure 5 The Device Manager window shows the USB Serial port that installed in computer

6.1.4 At menu, selects **Tool → Program AVR → Connect...** following the illustrated below for setting the VX-Mega128 baord to connect with AVR Studio.



6.1.5 The Select AVR Programmer window appears below.



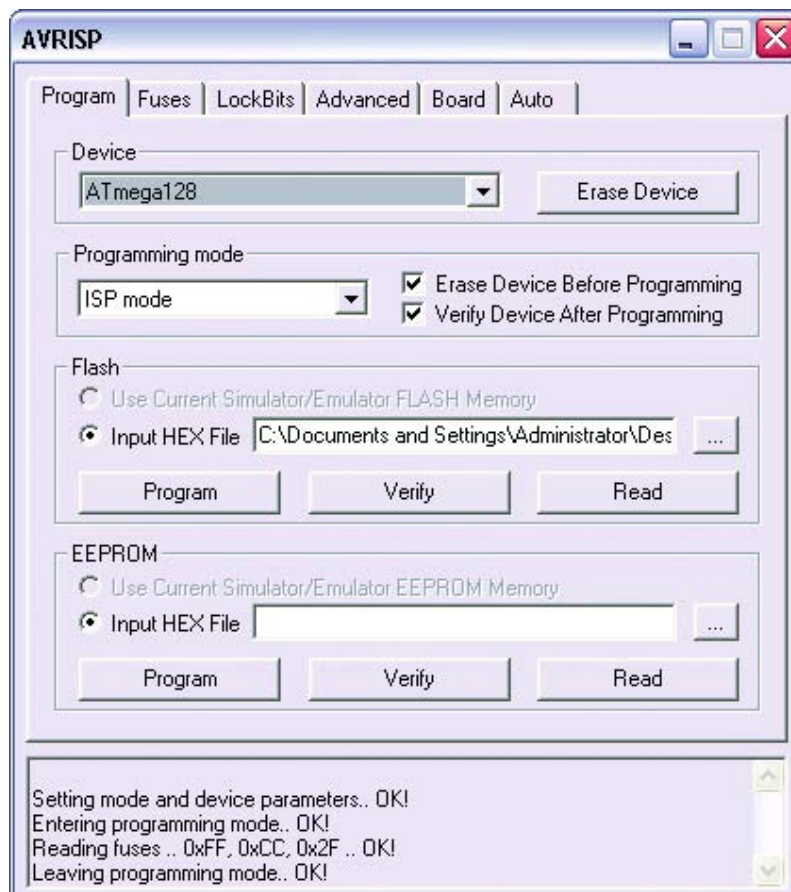
Set all parameter as follows

Platform: STK500 or AVRISP

Port: COM2 (the USB Serial port position that set by computer)

Click on the Connect button to connecting.

6.1.6 The AVRISP window appears below.



Set all parameter as follows

Device :	Atmega128
Programming mode :	ISP mode
Flash :	Input Hex File

After that click on the Browse button to select HEX file which required to download. Example file is **VX128_Dm.HEX**. Its path is **C:\Documents and Settings\Administrator\Desktop\VX128_Dm\default** (The result file - HEX file from compiler will be store in default folder)

6.1.7 Click on the Program button in Flash header for downloading VX128_Dm.HEX file to Atmega128 microcontroller on the VX-Mega128 board.

The programming steps are :

6.1.7.1 Erase

6.1.7.2 Program the HEX file. It is VX128_Dm.HEX file.

6.1.7.3 Verify programming

At AVRISP window will show the status at the bottom left corner of AVR Studio main window. Until the donwload finish, screen will show the message **Leaving programming mode.. OK!**

6.1.8 Now the flash programming ready. Press **RESET** switch to run the program. Observe the operation of VX-Mega128 board.

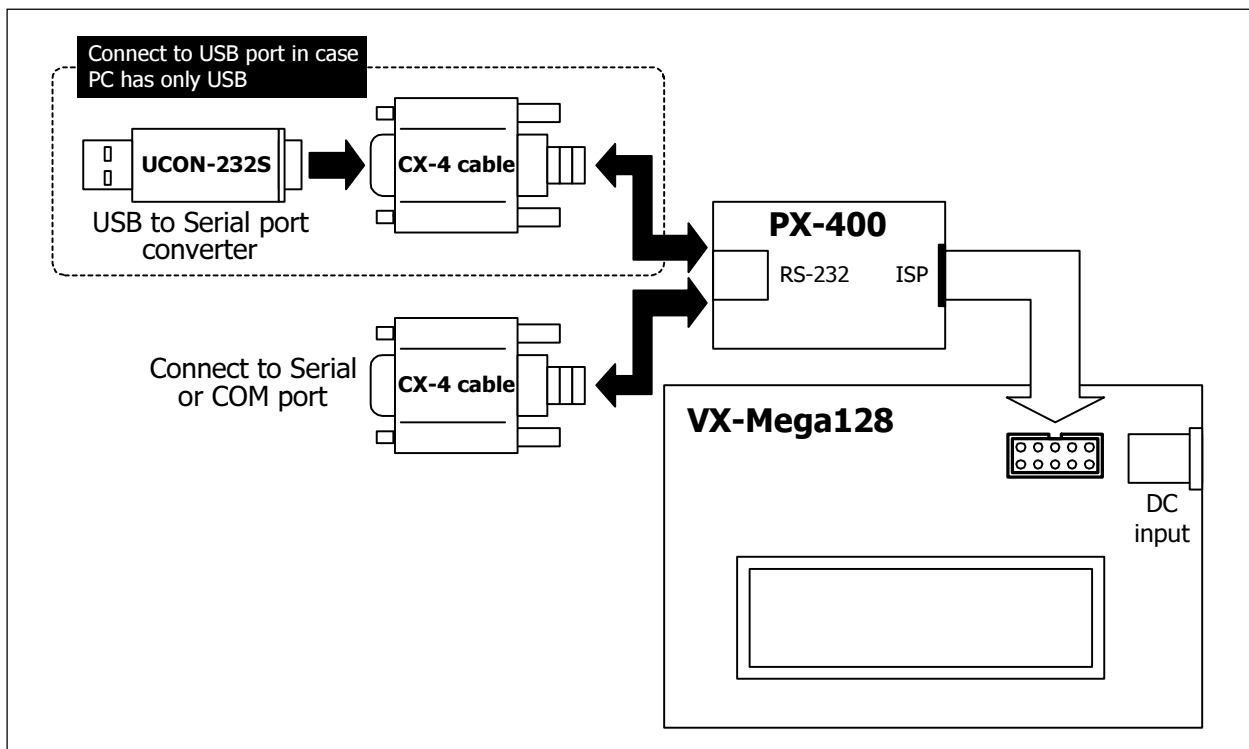


Figure 5 The diagram of Flash programming via ISP connector with PX-400 programmer

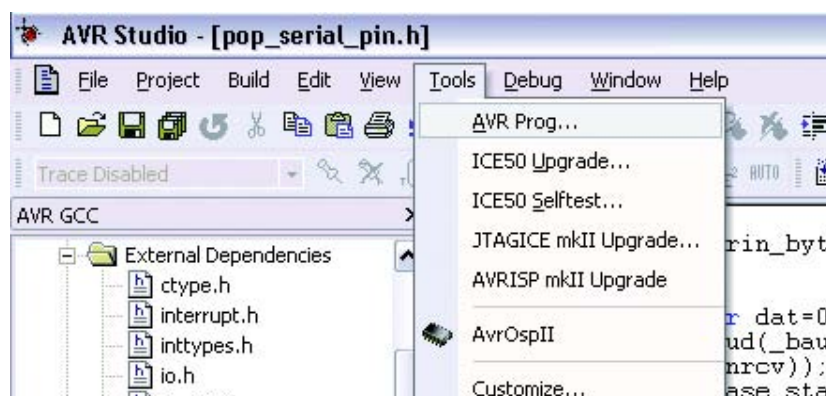
6.2 With PX-400 programmer via ISP connector

6.2.1 Apply the supply voltage during 6 to 12Vdc to VX-Mega128 board. Turn-on power switch. The green POWER indicator lights.

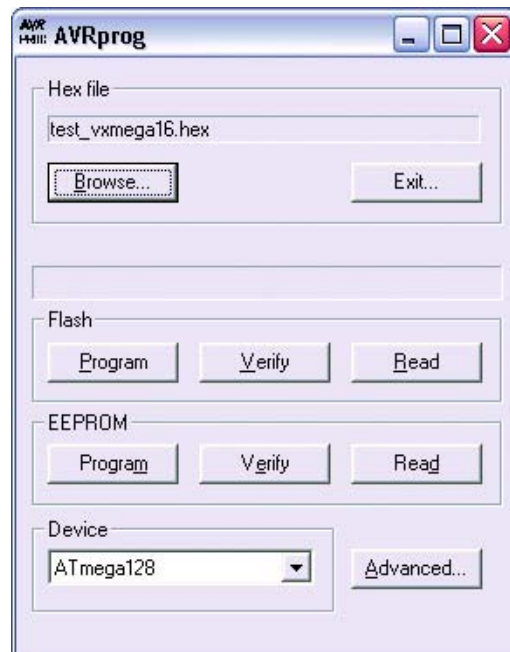
6.2.2 Connect PX-400 between Serial port and ISP connector on VX-Mega128 board. If your computer has only USB port, the USB to Serial port converter required. The UCON-232S is recommended. See the diagram in figure 5.

6.2.3 Open AVR Studio to develop C program and compile to HEX file ready.

6.2.4 At menu, Select **Tool → AVR Prog...**



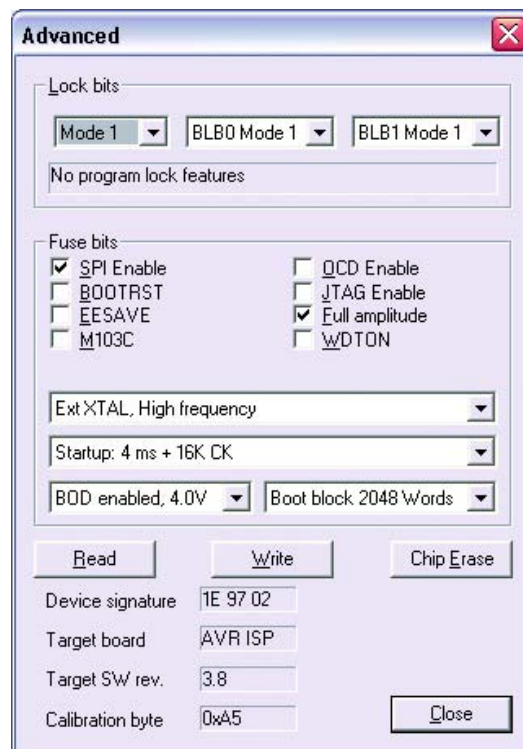
6.2.5 The AVRprog window appear.



6.2.6 For first time using AVRProg program, developer must set some parameter of flash programming for AVR Prog. The step is as follows :

6.2.6.1 **Device** box select **ATmega128**

6.2.6.2 Click on the **Advance..** button. The Advance window appear.



6.2.6.3 Set all parameters identical the illustrate in step 6.2.6.2. After that click on the Write button once for writing the parameters. Theses parameters will store and set to default value for next working.

6.2.6.4 Click on the Close button to exit this window.

6.2.7 Back to the main window of AVRProg, at **Hex file** border, click on the **Browse** button to find the HEX file. For example, load file **VX128_Dm.HEX** from this path **C:\Documents and Settings\Administrator\Desktop\VX128_Dm\default**

6.2.8 Click on the **Program** button in **Flash** border. The progress bar will active to shows the progress status.

6.2.9 After downloading finished, the program will run immediately. *The file VX128_Dm.HEX is Hardware testing program for VX-Mega128 board.*

6.3 How to program bootloader with your own.

If you make the flash programming of the VX-Mega128 board with the external In-System Programmer, possible to delete the Bootloader firmware. If you need to program Flash memory with bootloader again. Your can re-program the bootloadr by your own with the external programmer via ISP connector.

The bootloder HEX file is **VX-M128_Boot.HEX**. It is contained in folder **Bootloader in CD-ROM that bundled with VX-Mega128 set**. **Programming** procedure is similar the flash programming with ant HEX file with extrenal programmer.

After the bootloader is programmed ready, you can program ATmega128 flash memory with Bootloader procedure at topic 6.1

7. Summary of Teting file of VX-Mega128 board

The VX128_Dm.HEX is HEX file for testing the operation of VX-Mega128 board. Normally, maker will pre-programmed ready to test. In first time operation, after apply the supply voltage. LCD screen on the board will show this message :

VX-Mega128

Run > User code

and change to

VX-Mega128

Demo

After that MCU will read data from 4-bit Binary Switch to display on the LCD screen. The binary switch can supply 4-bit digital data and is called Knob. User can change the shaft at Binary switch and see the correct position.

Summay of all functuion can show as follows :

- 0 : Display the Knob's value "000" on LCD16x2 module
- 1 : Testing the switches SW1 to SW4
- 2 : ADC module testing
- 3 : Test D.IN0 to D.IN7 input digital port
- 4 : Test the D.OUT0 to D.OUT7 for output port
- 5 : Read port B (PB0 to PB7)
- 6 : Read port D (PD2 to PD4)
- 7 : Read port E (PE2 to PE7)
- 8 : Test the RAM on the memory extension module (must plug the memory board on top of VX-Mega128 board at EXPANSION connector).
- 9 : Test the EEPROM on the memory extension module (must plug the memory board on top of VX-Mega128 board at EXPANSION connector).
- A : Display the Knob's value "010" on LCD16x2 module
- B : Display the Knob's value "011" on LCD16x2 module
- C : Display the Knob's value "012" on LCD16x2 module
- D : Display the Knob's value "013" on LCD16x2 module
- E : Display the Knob's value "014" on LCD16x2 module
- F : Display the Knob's value "015" on LCD16x2 module

8. Resource

All sourcecode in C program is contained in Example code > VX128_Dm. You can see and edit by your own to make the new code.

For more information of ATmega128 microcontroller, can see and download datasheet and many applicatiobn notes from www.atmel.com.

Special thanks for

1. Atmel Corp. about the perfect IDE software; AVR Studio.
2. Many people who develops the nicely C compiler in name WinAVR.



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www.inexglobal.com