STK200 Quick Start Guide

Kit Contents

- STK200 Board
- Atmega16
- AVRISP-U USB In System Programmer (ISP)
- Software CD and AVR Datasheet CD
- JTAGAVR - ICE kit only

The only extra item required is a power supply – see Power Supply section for details about suitable power supplies.

Installing Software and documentation

The CD contains an executable file – Kanda AVR.exe. Run this installer and it will copy all the documentation, sample code and software to your PC.

The default install folder for Kanda software and documentation is

C:\Program Files\Kanda AVR (Program Files(x86) on 64-bit PC)

This installer will install AVR Studio development environment. If you already have it on your PC, click cancel for the installs (AVRStudio v4.19 and WinAVR C Compiler).

There are four main pieces of software:

- **AVRISP** – This is the programmer software, used for transferring code from the PC into the AVR device on the board. The Kanda AVR installer will install this software.

AVRISP has a Documents folder that contains PDF files with useful information about AVRISP.

- **AVR Studio4** - AVR Studio is a complete development system for AVR devices, supplied by Atmel. It is probably the best available for any microcontroller. This environment is where you write new programs, and assemble them for the AVR chip. It also allows you to step through your code to debug it, using JTAG ICE tool. The documentation folder includes instructions on using AVR Studio.

  A later version of AVRStudio, **AVRStudio6,** is available for free download from Atmel site, but JTAG ICE debugger will not work in AVRStudio6. You also need a very fast PC and lots of disk space as it is about 750 MB.

The installer allows you to install AVR Studio. Please let it install USB Jungo files as these are the drivers for JTAG ICE. The default install path is
C:\Program Files\Atmel\AVR Tools\AVR Studio

- **WINAVR -** WINAVR is a C Compiler for AVR microcontrollers. Check box to install WinAVR if you want to use C language for your AVR development. Documentation is included. WinAVR will be automatically linked to AVR Studio.

- **App Builder** – Wizard for creating setup code in assembler or C for AVR peripherals.

Summary
The only software you need to install to start with are AVRStudio for code development, WinAVR if you want to write in C and AVRISP for programming AVR devices on the STK200 board. The other software and documentation is available if you need it. **AVRISP will be integrated into AVR Studio if AVRStudio is installed first.** The Kanda installer does this by default.

Getting Started

AVRISP is the In System Programming software, AVRStudio is the development environment and the STK200 board is the test platform. Most people prefer to connect up the hardware and program some sample files on to the board using AVRISP, before tackling writing code in AVRStudio. However, it is up to you.

Another good starting point is to read **Get Going with… AVR book** in Kanda AVR folder first, especially if your experience with microcontrollers is limited.

The rest of this manual describes how to connect the hardware and use AVRISP. This is followed by a short description of the STK200 board and finally by a brief introduction to AVRStudio and JTAGAVR debugger.

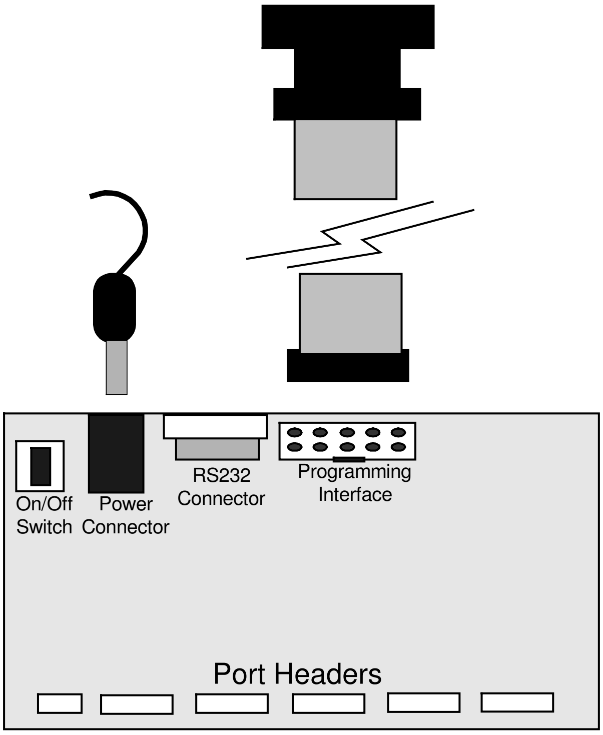
The only software you need to start with is AVRISP and AVR Studio. The rest can be used later if you want to experiment.

Connecting the hardware

Run Kanda AVR.exe from CD BEFORE connecting hardware

1) Connect the ISP dongle to the USB port on your PC. Windows should automatically install the USB drivers. If it does not install correctly, please see troubleshooting guide: C:\Program Files\Kanda AVR\AVRISP-U\ Troubleshooting USB Driver Install.pdf

2) Connect the 10-way ISP lead to the PC Adapter or dongle
3) Connect the 10-way ISP lead to the STK200 board – see diagram.



Make sure you use the correct header on the STK200 board – it is the box header next to the 9-way D-Type connector and power input.

If you have the ICE version, AVRISP uses the lead marked ISP Only

Power Supply

4) Connect a power supply to the board. The connector type required is 2.1mm barrel, centre negative or centre positive. It can be 7-12VAC or 9-15VDC, with a current capacity greater than 300mA.

AVRISP software

Now run the AVRISP software and it should detect an Atmega16, which you select.

- You can change device in the Device drop down list
- A Green Light should appear at the bottom of the screen with the message ISP Initialized : Detected Device Atmega16

If a RED light appears on the status line, then check the following

1) The AVRISP is connected to the board as shown above
2) The board is powered
3) AVR appears in Programmer box at top of screen
4) Atmega16 is in ADC socket, correct way round

Load File

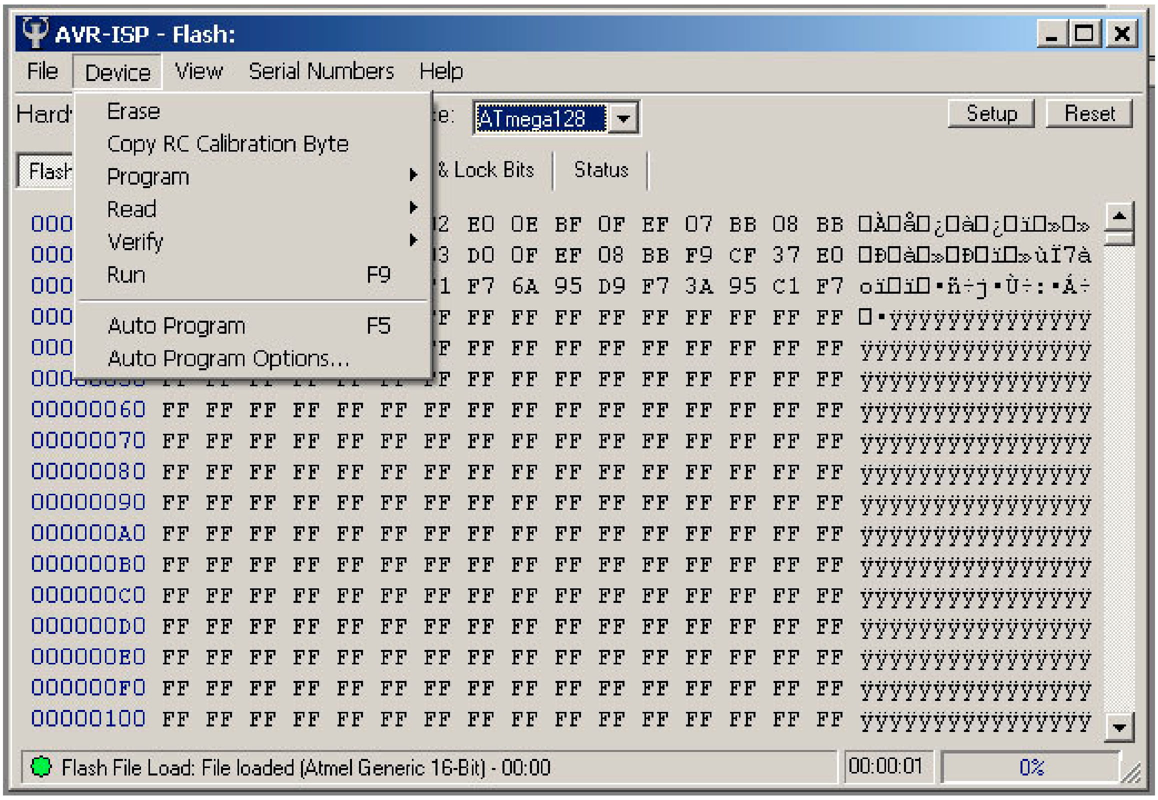
Once the board is connected properly, the next step is to load a file into the buffer. All operations are carried out on the data in the buffers. There are two buffers, one for code – Flash and one for data – EEPROM. Both are loaded with .HEX files, which are the output files from the assembler or C compiler.

Go to File Menu and choose Load > Flash, and select a file such as Samples > STK200 > LED Flash > LEDflash.hex

To load EEPROM data, follow the same procedure or type data directly into the buffer, in Hex numbers or ASCII characters.

Programming the AVR

All operations on the AVR chip are carried out from the Device Menu.



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Flash File Load: File loaded (Atmel Generic 16-Bit) - 00:00 | 00:00:01 | 0%

Note: **AVR devices must be erased first if they have been programmed before**.

To program and run the example file we have loaded into the buffer on to the STK200,

1) Choose Device > Erase – always erase before reprogramming
2) Choose Device > Program > Flash
3) Choose Device > Run – Run releases the chip from ISP so it can run its code

The LEDs on the board should begin to flash. Follow this procedure to program other code into the AVR on the STK200 board.

AVR microcontroller default fuses

New AVR devices come with the Clock Source set to RC Internal Oscillator by default. The actual speed of the oscillator varies from 0.5MHz to 4MHz depending on the device, 1MHz on Atmega16. This means that programs will run slower than expected, because the **AVR is NOT running from the 8MHz clock on the STK200 board.**

To change the Clock source, go to Fuses and Lockbits tab and change **CLKSEL** fuses from Internal Oscillator to External Crystal/Resonator 3 – 8MHz (1110 or 1111). Then go to *Device menu > Program > Fuses.*

Other features of AVRISP

Auto Program

It can get a bit tedious carrying out all these steps individually, especially if you want to check that the code has loaded properly (Verify) and program the EEPROM as well. This is where Device > Auto Program (F5 key) is useful.

To use Auto Program feature, first go to Device > Auto Program Options and set the operations you want to carry out. Now selecting Device > Auto Program or pressing F5 will carry out all these operations.

Auto program is especially useful if you call the programmer from AVRStudio. Make sure **Reload Files** is checked in Auto-program Options, and you just need to click on AVRISP-U and hit F5 key if you recompile your project in AVRStudio.

Fuses and Lockbits

Click on the Fuses and Lockbits Tab to view the Fuse screen. These are settings on the AVR devices that can be altered to affect the way the device runs and interacts with the circuit.

The default fuses will work happily on the STK200 board, but you may want to alter them to make the clock run from the 8MHz crystal on the board. **JTAGEN** fuse should also be left checked for JTAG ICE emulator. Full descriptions of each fuse and what they do are in the device datasheets – see AVR Datasheets folder on second CD for the datasheets on each AVR.

On the right of the Fuse screen is a second tab marked Lockbits and Boot Options. This screen displays the various security settings and block options available. Again, these are described in the AVR datasheets.

Status

The Status Tab lists the operations that have been carried out during the current programming session.

Serial Numbers

Serial numbers can be added to the Code space (Flash) or Data Memory (EEPROM) in a variety of formats. If Auto Program is used, the serial number will increment with every Auto-program cycle.

View Menu

CRC Checksums
This gives the checksum calculations in different formats for the whole buffer or just the used buffer. Applies to both Flash and EEPROM

Pop-up Warnings
This displays a message box if there is a verify error. Useful if repeated Auto Program operations are carried out, when it can be easy to ignore errors.

Setup
This can also be selected by clicking the Setup Button. It covers a variety of settings, which are not needed on STK200 board but are useful for your own circuits, especially if they have slower clocks, big capacitors or lower voltage..

Reset Button
This is used to Reset the AVR on the board. This is a way of resetting communications if errors occur or the programmer cannot find the chip.

STK200 Board Description

The schematics of the board are available in the Documentation > STK200 folder in the install folder. A full description of the board is given in **STK200 manual.pdf**

Voltage Selection
There is one jumper – JP1 – for setting the board voltage. If the jumper is on, the board operates at 5V. If it is off, the board operates at 3.3V.

Notes:

1) If the board is set to 3.3V, the brownout circuit should be set to 2.9V by removing JP2
2) The ISP interface is supplied with 5V regardless of the board voltage.
3) The AVR device supplied as standard can operate from 2.7-5.5V

Brownout Circuit
The STK200 has a brownout detector to reset the AVR if the voltage drops too low. The brownout level is set using JP2 and should match the voltage selected by JP1 i.e. JP1 and JP2 both off or both on.

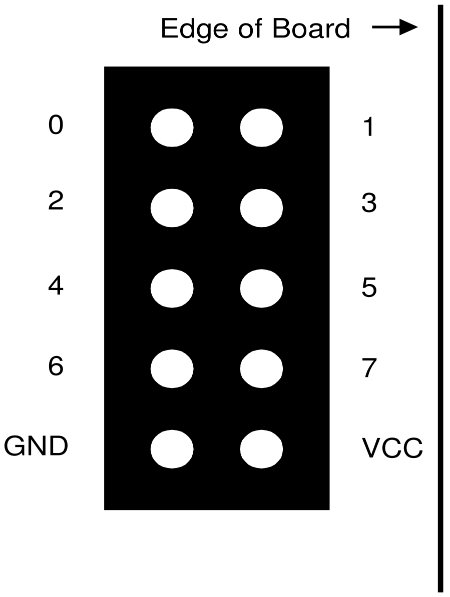
Clock Circuit
The board uses an 8MHz crystal connected to a 74HC00 external clock chip. The clock signal is connected to XTAL1 pin on AVR chip.

Serial Port
The AVR devices supplied have an hardware USART. It is connected through a MAX202 chip to give RS232 level signals.
USART0 (RXD0/TXD0) is connected to the female 9-way D-Type connector.

The USART is also available, at TTL levels, on the expansion headers on the edge of the board .
Details about Baud Rates, control and other settings are in AVR datasheets.

Expansion Headers

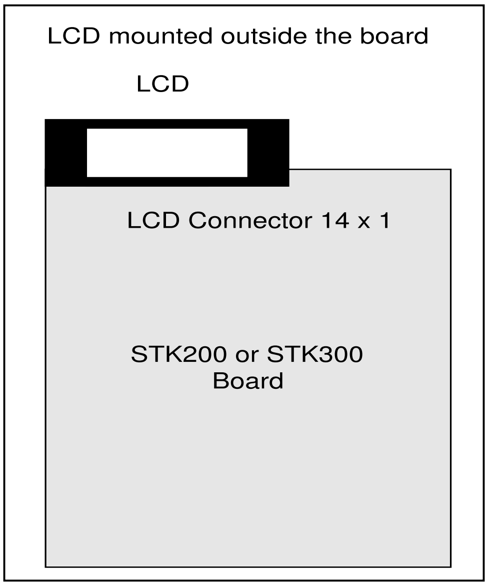
All the device port pins are brought-out to pin headers on the edge of the board. The layout of these connectors is shown below. Full details are in **STK200 manual.pdf**



LCD Circuit

The 14 x 1 header marked LCD is for a standard 2 X 16 character LCD. The connections are shown on the board and in the following table. The LCD display is fitted with the display side facing out from the board

Connection Name	Function
0V	Ground 0V
+5	Vcc - must be 5V
Vo	Contrast
RS	Register Select- A14
Wr	Not Write
E	Enable
D0	Data Bit 0
D1	Data Bit 1
D2	Data Bit 2
D3	Data Bit 3
D4	Data Bit 4
D5	Data Bit 5
D6	Data Bit 6
D7	Data Bit 7



The board is designed for use with an LCD with a Hitachi driver chip built-in, with a contrast pin voltage of 0 to 5 Volts. If no characters appear on LCD, then you may need to change resistors R22 and R23 to alter the contrast voltage, especially if you use a different LCD.

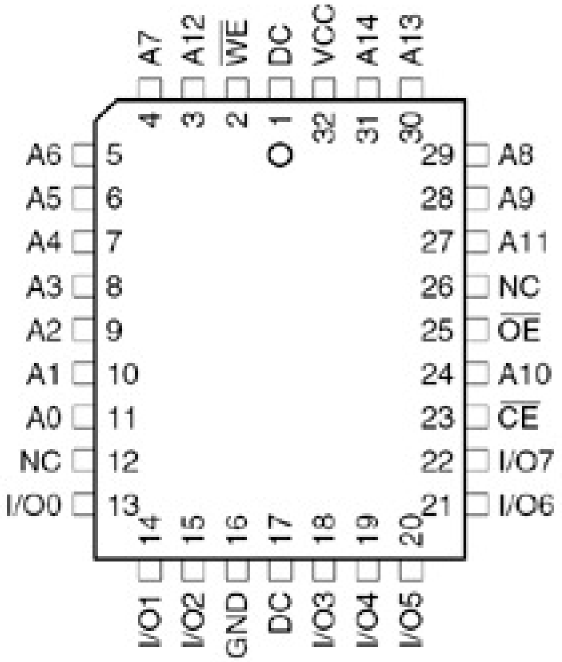
This board is not designed for use with back lit LCD modules, so the extra connections needed are not included and the power supply will not supply the current required.

The LCD can be driven in Memory Mapped or I/O Mode - see data sheet. If the crystal has been changed to a faster crystal frequency, memory mapped operations will not work.
A suitable LCD is available on the Kanda site (http://www.kanda.com/go/570910-PM)
Sample files for memory mapped and direct I/O operation are included on the CD in Samples directory.

External Memory

The board is fitted with sockets for an address latch (74HC573) and a Flash RAM chip (29C256). These are available as a pair from Kanda –
http://www.kanda.com/go/STK200-RAM

29C256 Pin-outs

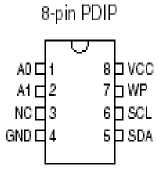


24C EEPROM Socket

The board is fitted with a socket for 24C EEPROM Chip. This is an I^{2}C device, or in Atmel speak, a Two Wire Serial Interface (TWI).

The socket is connected to SCL and SDA pins on the AVR microcontroller.

The socket layout is shown below.



A full description of the TWI is given in the AVR datasheet.
Note: Pull-ups must be enabled on these two lines, PORTC.0 and 1

Switches and Bar LED
There is a 10-way bar LED fitted to the board.

- One LED is Power (labeled ON), and should be on when the board is powered.
- The next LED is labeled ISP and should be on when the board is in ISP mode.

Note: The AVR will not run its code if the board is in ISP mode. To exit ISP on run your code, choose Device > Run command or disconnect the ISP lead from the board

- The other 8 LEDs (0-7) are for user code. They are active low (0 switches them On), and they are connected to a 10-way header marked LED'S. A short 10-way lead connects this header to the Port B header by default. Move the lead to another Port header if you want to use a different AVR Port for LED output.

The 8 switches are also active low (0 when pressed), and are connected to the 10-way header marked SWITCHES. A 10-way ribbon cable connects them to Port D by default. Again, move the cable to another header if a different port is required.

Both the LED and SWITCH headers also have GRD and VCC pins.

Note: AVR ports have three registers controlling them:
1) Port – value to write
2) DDR – direction register (0 is input)
3) Pin – value to read

So, to read switches, set DDR register to 0 and read PIN register – 0 is switch pressed. To write to LEDs, set DDR to 0xFF and write values to Port register, where 0 is on.

Summary

There is sample code in the install folder. The board schematics are also available in Kanda AVR folder.

AVR Studio 4

AVR Studio is Atmel's development environment. Documentation is available in the AVR Studio folder in *C:\Program Files\Kanda AVR\AVR Studio\Documentation*.

There is a sub-folder called Documentation that contains

- Getting started guide. This explains how to set up AVR Studio and create programs.
- Instruction set guide, that lists the AVR instruction set
- Tools set up guide, which explains how to add AVRISP to AVR Studio Tools menu if it is not already added

Here is a brief guide to using one of the sample files in AVR Studio, but more information is available in the Getting Started guide and at www.atmel.com

AVR Studio is project based, so you need to create a project before you can do anything. Follow this procedure.

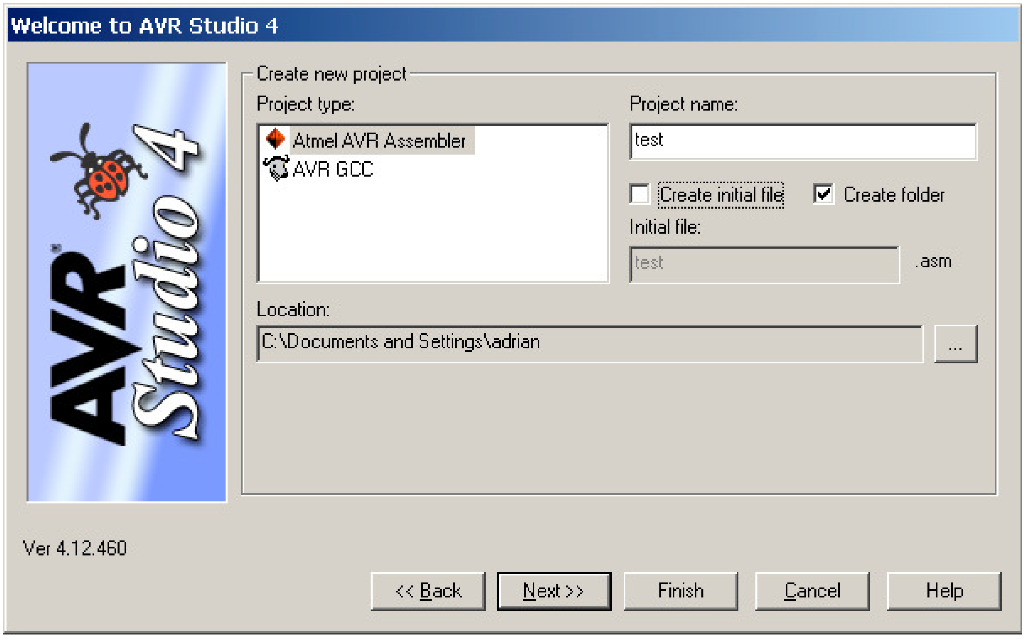
1) Run AVRStudio and select New Project from Welcome screen. If Welcome screen does not appear, select Project Menu > Project Wizard

2) Choose Atmel AVR Assembler as Project Type. See note and end of this section for C Projects.

3) Give the Project a name

4) Uncheck Create Initial File box

5) Set location of where to save Project files



Welcome to AVR Studio 4

Create new project

Project type: Atmel AVR Assembler

Project name: test

□ Create initial file ☑ Create folder

Initial file: test .asm

Location: C:\Documents and Settings\adrian

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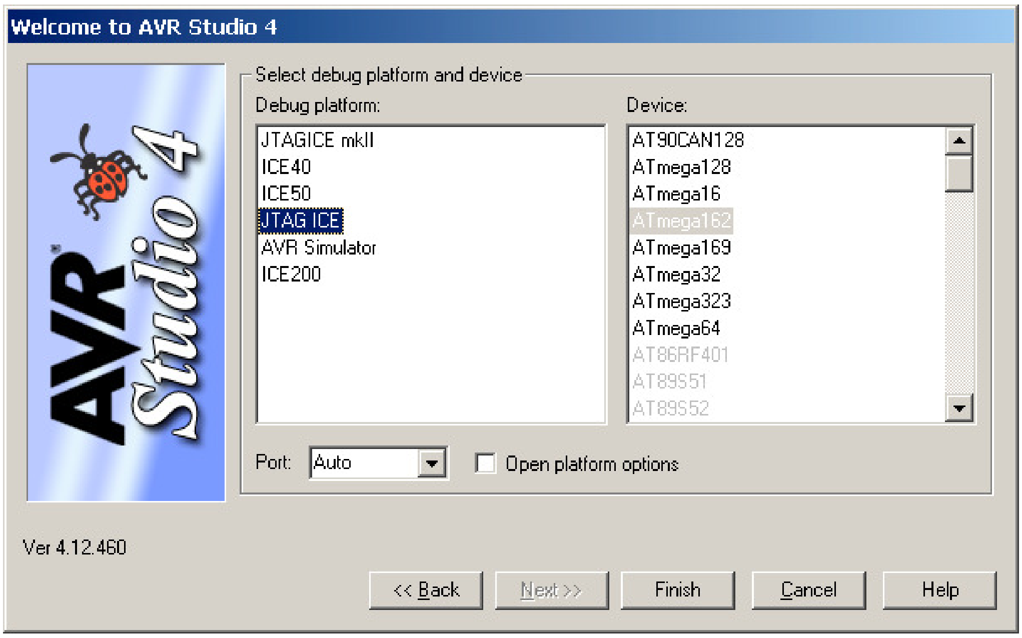
6) Click Next Button

On the next screen,
1) Set Debug platform JTAG ICE.

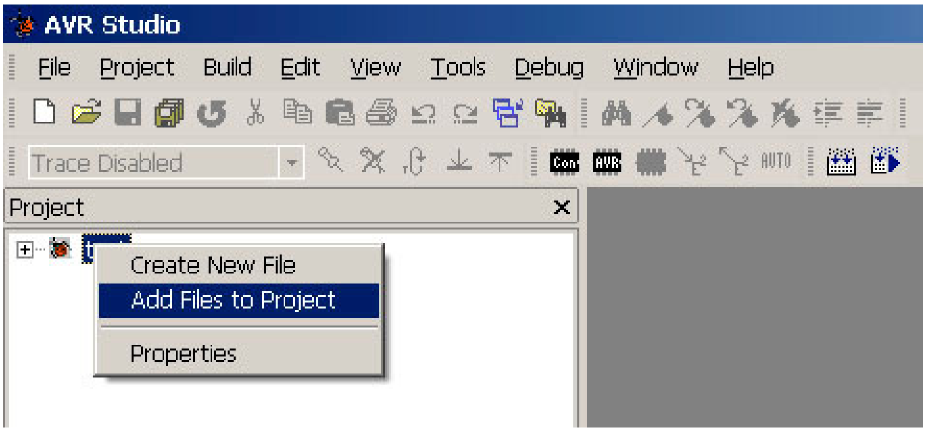
2) Set Device to Atmega16

3) Click Finish Button



Now the project is created, we need to add a sample file.

1) The Project is displayed at the left of the screen. Right click on the Project name and choose Add Files to Project



2) Select an assember file from Sample Code > STK200 folder in Kanda AVR folder, such as LedFlash200.asm

3) Now go to Build Menu > Build. This will assemble the file and create object code file (.hex) for AVRISP programmer.

Running AVRISP from AVR Studio

AVRISP will be added to AVR Studio Tools menu, if it is installed after AVR Studio. The Kanda AVR installer will install them in the correct order.

To run AVRISP from AVR Studio, go to **Tools Menu > Kanda Tools > AVRISP-U** AVRISP will open a project with the correct files and device choice, using your AVR Studio project. It will also set Auto-program Options to

- Reload File
- Erase
- Program and Verify Flash
- Program and Verify EEPROM, if an EEPROM file exists
- Run the device

This means that you just need to use Auto-Program (F5) in AVRISP software to load your code into the AVR on the STK200 board, once you have built it, or re-built it..

AVR Studio 4 C Projects

Winavr (on CD) is a C Compiler for AVR. When you run AVR Studio you can select project type as AVR GCC – use this for WinAVR. If Winavr is not installed, AVRStudio will prompt for installation.

There are example C Projects in Sample Code folder in Kanda AVR folder. Create a project without creating an initial file and then add a C file as source file, just like assembler.

Alternatively, you can open a C project file (*.aps) from C Sample code folder.

Important
The C compiler is a plug-in for AVR Studio and is not directly controlled by it, so there are some important points to be aware of

1. C projects must have AVR device set correctly, unlike assembler files which are not so fussy, otherwise code will not run.

2. Changing device in AVR Studio project does NOT change device in C compiler. You need to go to **Project > Configuration Options** and change device there as well. Also on this screen, make sure **Create Hex File** is checked.

3. Output files are stored in a sub-folder called Default

Embedded C Book

There is a PDF book on Embedded C Programming in Embedded C Book folder. It covers the basics of writing C for AVR microcontrollers but uses IAR C compiler instead of WinAVR and AVR Studio. A free 4KB limited version of the IAR compiler, called Kick Start, is available for download. It is similar to WinAVR but produces smaller code and has lots of advanced features.

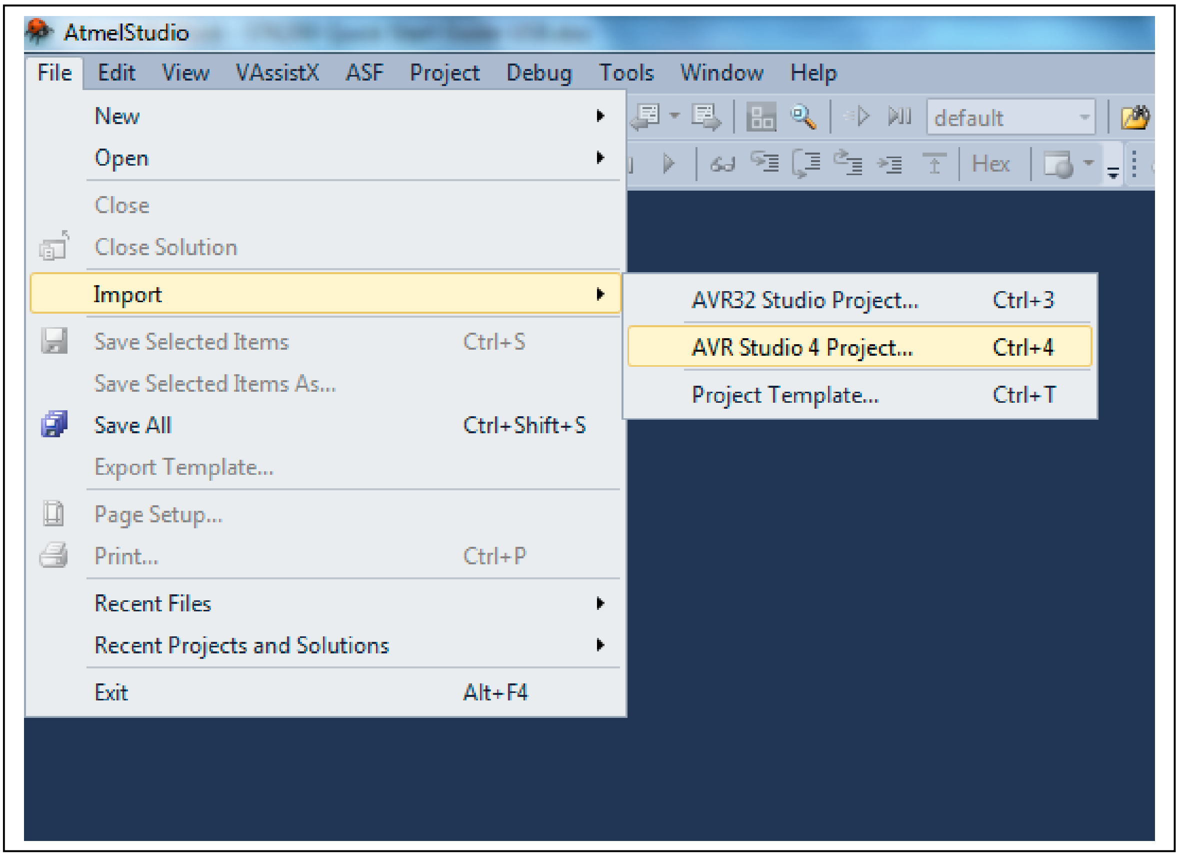
AVR Studio 6

AVRSudio 6 can be downloaded for free from www.atmel.com, you just need to register. It is large, about 750 MB and needs a fast PC. All the example code will work but needs a bit of tweaking.

C Projects

As all projects are for AVRStudio 4, you will need to import them rather than use Open.

File menu -> Import -> AVRStudio 4 Project



AVRStudio 6 will create a Solution, which is the new fancy name for a project. The rest of the instructions are the same.

Assembler Projects

Create a new Assembler Project/solution and use one of the sample files as the main file.

Using AVRISP-U with AVRStudio 6

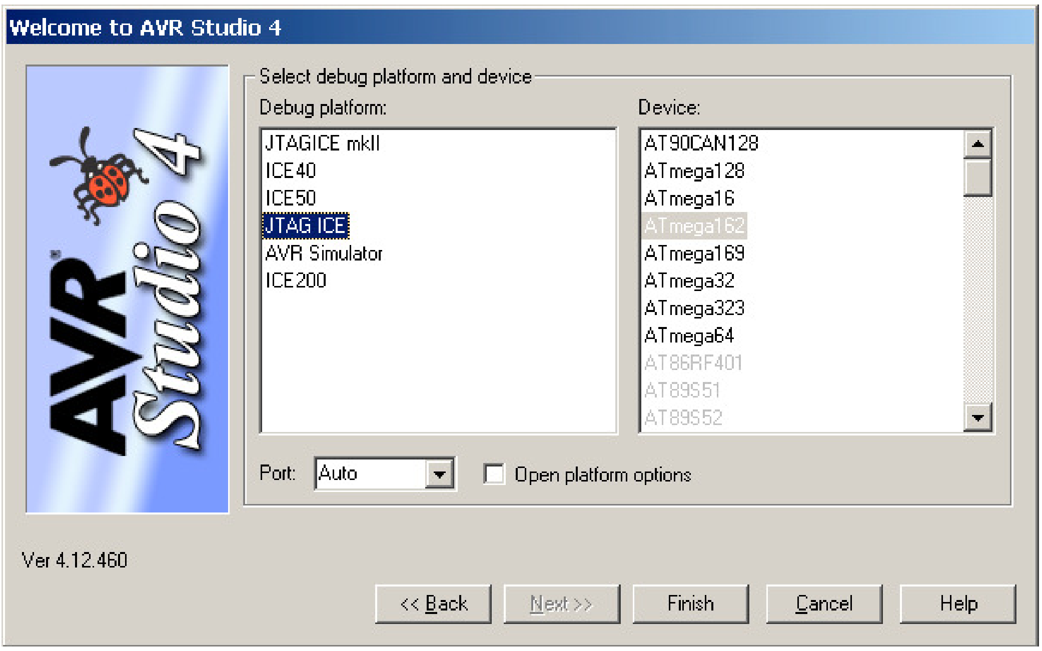
You will need to add AVRISP-U to the Tools menu -> External Tools. See Adding AVRISP-U to AVRStudio.pdf in AVRISP-U folder.

Using JTAGICE with STK200

If you have the JTAGAVR Tool as part of the package or you have purchased it separately, then it is simple to use with the ST200 board. Please note that the JTAGAVR is an In Circuit Emulator and not primarily a programmer, so AVRISP is still used as a separate tool.

Using JTAGAVR with AVR Studio

You can check that project device is set to JTAG ICE and Atmega16 in Debug Menu > Select Platform and Device.



Welcome to AVR Studio 4

Select debug platform and device

Debug platform:

- JTAGICE mkII
- ICE40
- ICE50
- JTAG ICE
- AVR Simulator
- ICE200

Device:

- AT90CAN128
- ATmega128
- ATmega16
- ATmega162
- ATmega169
- ATmega32
- ATmega323
- ATmega64
- AT86RF401
- AT89S51
- AT89S52

Port: Auto

□ Open platform options

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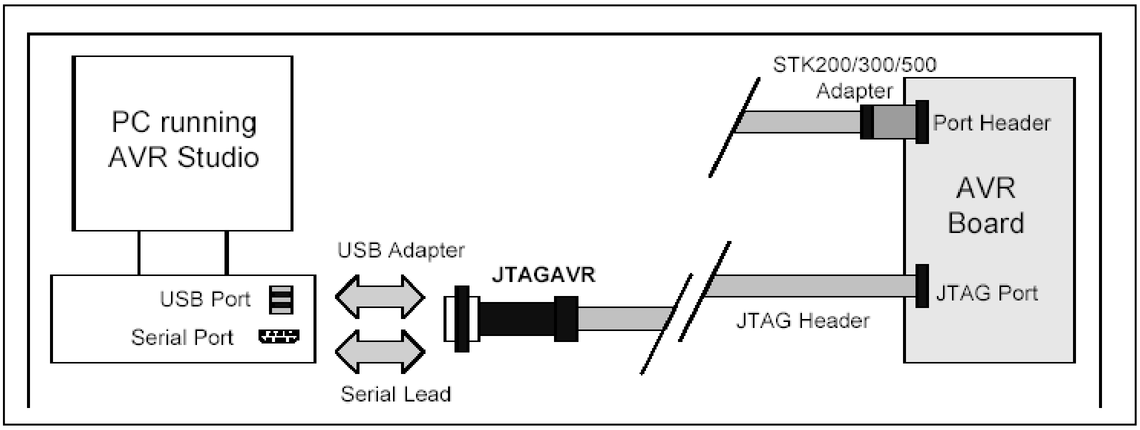
The list of available devices is very small with JTAGICE, which is an Atmel marketing decision. For more device support, you will need AVR Dragon or ICE3. Choose Atmega16 as device.

The Port setting on this screen defaults to Auto. This means that AVR Studio will scan all Serial Ports looking for the ICE tool, including Virtual Serial Ports used by USB. It only looks on COM1 to 4 in some versions of AVR Studio, more information in **JTAGAVR Quick Start Guide** in **Documentation > ICE** folder

Connecting JTAGAVR to STK200 Board

1) Connect the JTAGAVR Tool to the PC serial port (or use a USB to Serial cable). Users with USB version should just connect directly to USB Port
2) Connect the 10-way ribbon cable to the JTAGAVR
3) Connect adapter A to the end of the 10-way lead for Atmega162 OR Adapter B for Atmega16
4) Plug the adapter into PORT C header on the STK200 board, with headers facing in towards the board



JTAGAVR Documentation
JTAGAVR uses AVR Studio software, so no extra software needs installing. There is documentation on the tool. It is in a Folder called ICE, in Documentation folder.

These PDF files give more detail about using the JTAG AVR or JTAG ICE tool.

Firmware Updates
If you change AVR Studio to a different version or install a new Service Pack, then it may want to do a firmware update using the built-in AVRProg software. Serial port versions of JTAGAVR will update fine but USB versions will not be found by AVRProg, because it only looks at COM1 to COM4. See **JTAGAVR Quick Start Guide** in **Documentation > ICE** folder for details on changing COM Port setting.

Application Builder

Application or App Builder is found in its own folder in Kanda AVR folder in program Files, or it can be launched from desktop icon. There is a manual in this folder as well. App Builder creates setup code for any selected peripheral, including interrupts and port settings needed.

Outputs can be in C or assembler. Once an output file is created, it can be opened in AVRStudio just like any other sample code.

Conclusion

This guide has briefly described the main features of the STK200 package. There is more information about AVR Studio on the CD, in its Help file and online at www.atmel.com

AVRISP has a help file, and there are AVR datasheets and instruction set documentation on the CD.

The other packages on the CD have help and documentation included.

Further Information

More information about AVR code and programming can be found online

- www.avrfreaks.com – a forum and help site for AVR
- www.kanda.com/support – new software versions, FAQ and documents about AVR and kanda tools
- www.atmel.com/products/avr - more information about AVR microcontrollers
- Books are available at Amazon. Kanda supply a basic book at www.kanda.com/go/KB0010

Other tools and accessories

We supply add-ons for the STK200, including LCD modules, keypads, Flash RAM, 24C EEPROMs, extra AVR devices, ICE and a universal power supply.

- AVR Dragon emulator for more devices and AVRStudio6 support www.kanda.com/go/AVR-DRAGON
- Flash RAM and Address Latch – see www.kanda.com/go/STK200-RAM
- LCD module – see www.kanda.com/go/570910-PM
- Data Entry Keypad – see www.kanda.com/go/780305-PM
- JTAGAVR ICE – see www.kanda.com/go/JTAGAVR
- Power supply – see www.kanda.com/go/PSU9V-UNI
- AVR devices – see www.kanda.com/go/AVR-MAIN
- 24C Serial EEPROM – see www.kanda.com/go/EE-02

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