Table of Contents

TABLE OF CONTENTS 1

STK504 USER GUIDE 2

Introduction 2

Features 2

Known Issues 4

Getting Started 5

Hardware overview 5

Mounting the STK504 6

Placing the AVR in the ZIF socket 6

Running the demo application 7

Programming the AVR 8

In-System programming 8

High-Voltage programming 9

JTAG programming 10

STK504 Clock Sources 12

The clock switch 12

EXT – STK500 as clock source 12

LF – Low-Frequency 32kHz crystal 12

HF – High-Frequency crystal 12

Fuse settings 13

Using the LCD 14

Connecting to the on-board LCD 14

Connecting to other displays 14

Debugging with JTAGICE mkII 15

Connecting the JTAGICE 15

Troubleshooting Guide 16

LCD problems 16

Programming problems 16

General problems 17

Appendix A Port Connectors 18

Appendix B LCD Pinout and Segment Mapping 19

STK504 User Guide

Introduction

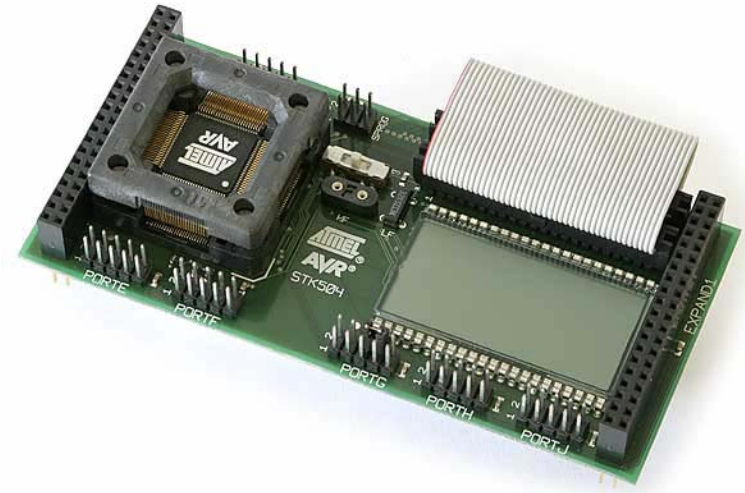
STK504 is a top module to the STK500 development board from Atmel Corporation. It adds support for the 100-pin AVR microcontrollers listed in the feature list below.

STK504 includes connectors and hardware allowing full utilization of the features of these devices, while the Zero Insertion Force (ZIF) socket makes it easy to use TQFP packages for prototyping.

This user guide is a general getting started guide as well as a complete technical reference for advanced users.

Included in the kit is a pre-programmed ATmega3290. Insert the device in the ZIF socket and the demonstration application will start immediately.

Figure 1-1: The STK504 starter kit



Features

- Supports the ATmega3290 and ATmega6490 with built-in LCD controller
- Supports the ATmega3250 and ATmega6450.
- LCD glass for demonstrating the LCD controller
- Connector for using an external LCD display
- Supported by AVR Studio 4
- Zero Insertion Force (ZIF) socket for 100-pin TQFP packages
- Supports High Voltage Parallel Programming through STK500
- Supports Serial programming through STK500
- Port connectors for port E, F G, H and J

- LCD and other peripherals can be disconnected from the device
- JTAG Connector for on-chip debugging using JTAGICE mkII
- On-board 32 kHz crystal for easy Real Time Clock implementations
- Pre-programmed ATmega3290 with example application

Known Issues

January 2005: There are no known issues.

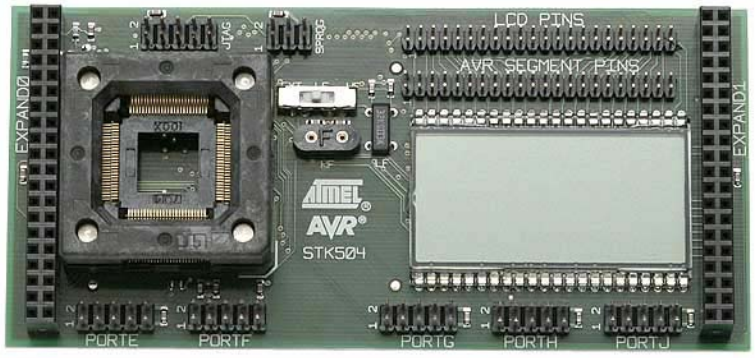
Getting Started

This section describes how to connect the STK504 onto the STK500, how to place the AVR in the ZIF socket and connect cables to different peripherals.

Hardware overview

The STK504 is a flexible platform for debugging the 100-pin LCD AVRs. The card offers lots of connectors so you can connect to your own hardware, or you can use it as it is.

Figure 3-1: STK504



ZIF socket:

This is the place to put your AVR sample. See *Placing the AVR in the ZIF socket* chapter for more details.

LCD PINS:

This connector is wired to the on-board LCD. It is usually connected to the *AVR SEGMENT PINS* connector. Consult the LCD section for more information.

AVR SEGMENT PINS:

This connector is wired to the LCD pins on the AVR. It is usually connected to the *LCD PINS* connector. If you want to connect your own LCD, then use this connector. Consult the LCD section for more information.

Port connectors:

The AVR's PORTE, PORTF, PORTG, PORTH and PORTJ are available on five connectors, each one marked with the port name. Each of the connectors has the port signals and a target voltage and ground pin. See *Appendix A* for description and pinout.

Clock switch:

This switch select what clock course is routed to the XTAL/TOSC pins on the AVR. The switch has three states, X = clock signal from STK500, LF = onboard 32kHz crystal and HF is on-board crystal socket. See *Clock*

Sources for more information.

Crystal socket:

In this socket you can mount a crystal of your choosing. Set the clock switch to HF. See *Clock Sources* for more information.

32kHz crystal:

This 32kHz crystal can be routed to the AVR through the clock switch. Set the switch to LF. See *Clock Sources* for more information.

JTAG:

Here you can connect your JTAGICE mkII or other JTAG test equipment. See the *JTAG Connection* chapter for a detailed description.

SPROG:

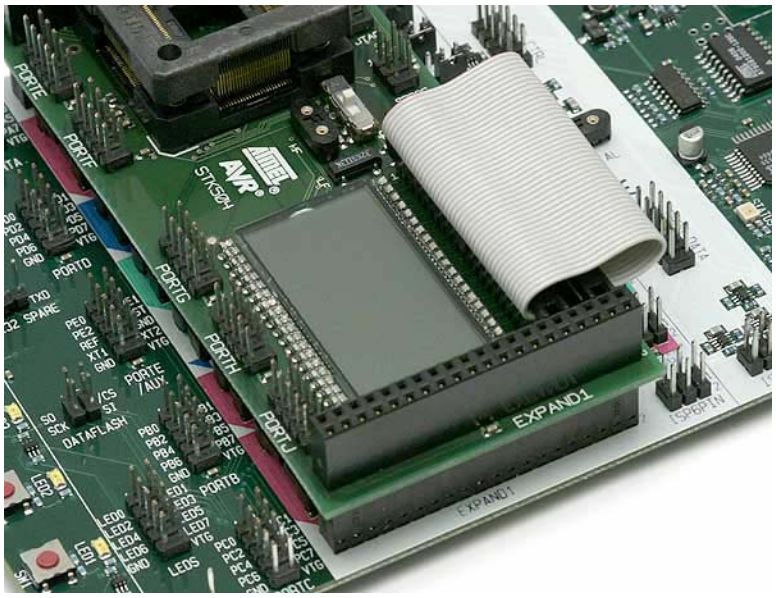
The AVR can be programmed through this connector using the ISP programming mode. See *In-System Programming* for more information.

Mounting the STK504

The first thing you should do is to mount the STK504 onto the STK500.

1. Turn off the power on STK500.
2. Remove any other top card from the STK500.
3. Remove any AVR mounted in any of the sockets on the STK500.
4. Place the STK504 on top of the STK500. Make sure the EXPAND0 and EXPAND1 connectors on both cards align properly (see figure 3-2).

Figure 3-2: Mounting the STK504



Placing the AVR in the ZIF socket

The ZIF socket located on the STK504 board takes AVRs with LCD controller in

100 pin TQFP packages.

1. Make sure the STK500 power is turned off
2. Place your AVR sample in the socket as shown in figure 3-3.

Figure 3-3: Placing the AVR in the ZIF socket



Pay attention to the pin 1 marking on the chip and on the socket. Pin 1 on the ZIF socket is identified by the chamfered corner. It is also marked with the white line on the STK504.

Running the demo application

The AVR device supplied with the kit comes pre-programmed with a demo application that uses the on-board LCD. Follow this check list:

1. Mount the STK504 on the STK500
2. Place the AVR with the programmed demo application in the ZIF socket
3. Connect the LCD cable
4. Make sure the VTARGET jumper on STK500 is mounted.
5. Set the switch on STK504 to the LF position.
6. Turn on power on STK500

The demo application should now run, flashing some of the LCD segments and displaying some text.

The source code and hex file for the demo can be downloaded from the Atmel web site.

Programming the AVR

There are four different ways of programming the AVR on STK504:

1. In-System Programming
2. High-Voltage Programming
3. JTAG Programming
4. Self-programming

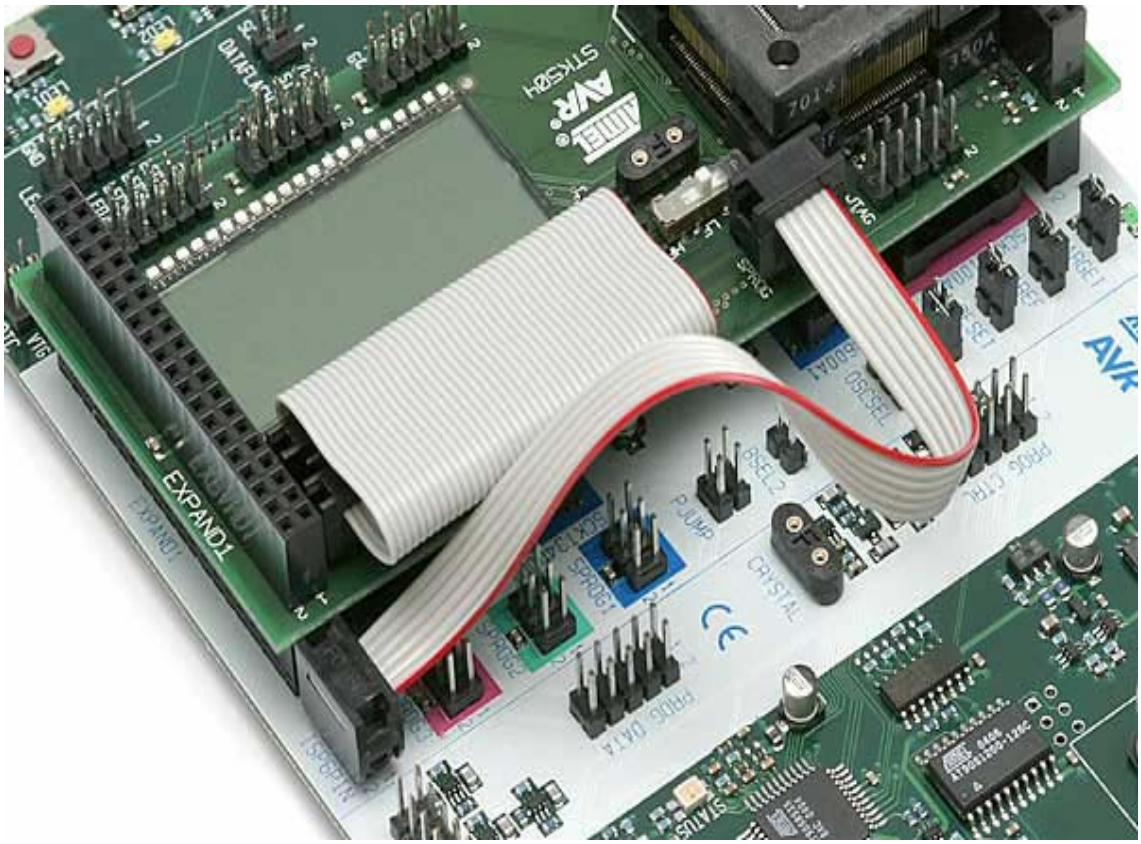
Self programming is not described in this document. Please consult the AVR's datasheet.

The following sections will describe how to connect the appropriate cables. See the STK500 user guide for how to use the AVR Studio *Programming Dialog*.

In-System programming

To program the device on STK504 using the In-System Programming (ISP) mode, you must connect a 6-pin cable between the ISP6PIN connector on STK500 and the SPROG connector on STK504 as shown in Figure 4-1. Also mount a jumper between pin 6 and 8 on the PORTG header. Then start the AVR Programmer found on the Tools menu in AVR Studio ("Tools/Program AVR/ Connect...").

Figure 4-1: ISP programming



To be able to program the AVR using ISP proramming, the AVR must have ISP programming enabled (the *ISP programming enable* fuse must be set). ISP programming can be enabled by *High-Voltage Programming* or *JTAG Programming*.

Please consult the Fuses section in the STK500 documentation.

High-Voltage programming

⚠High-Voltage Programming requires the target voltage to be set to 5V. If you have any external hardware connected to STK504/STK500 that doesn not tolerate 5V, it must be disconnected before you High-Voltage program the AVR.

To program the AVR mounted on STK504 using High-Voltage Programming, follow these steps:

1. Turn off the STK500 power switch
2. Disconnect from STK500 and STK504 any hardware that does not tolerate 5V.
3. Connect the PROGCTRL to PORTD and PROGDATA to PORTB on the STK500 as shown on the figure 4-2 below.
4. Set jumpers and switches accroding to this table 4-1.
5. Turn on STK500 power.
6. Then start the AVR Programmer found on the Tools menu in AVR Studio ("Tools/Program AVR/ Connect...")

Figure 4-2: High-Voltage programming setup

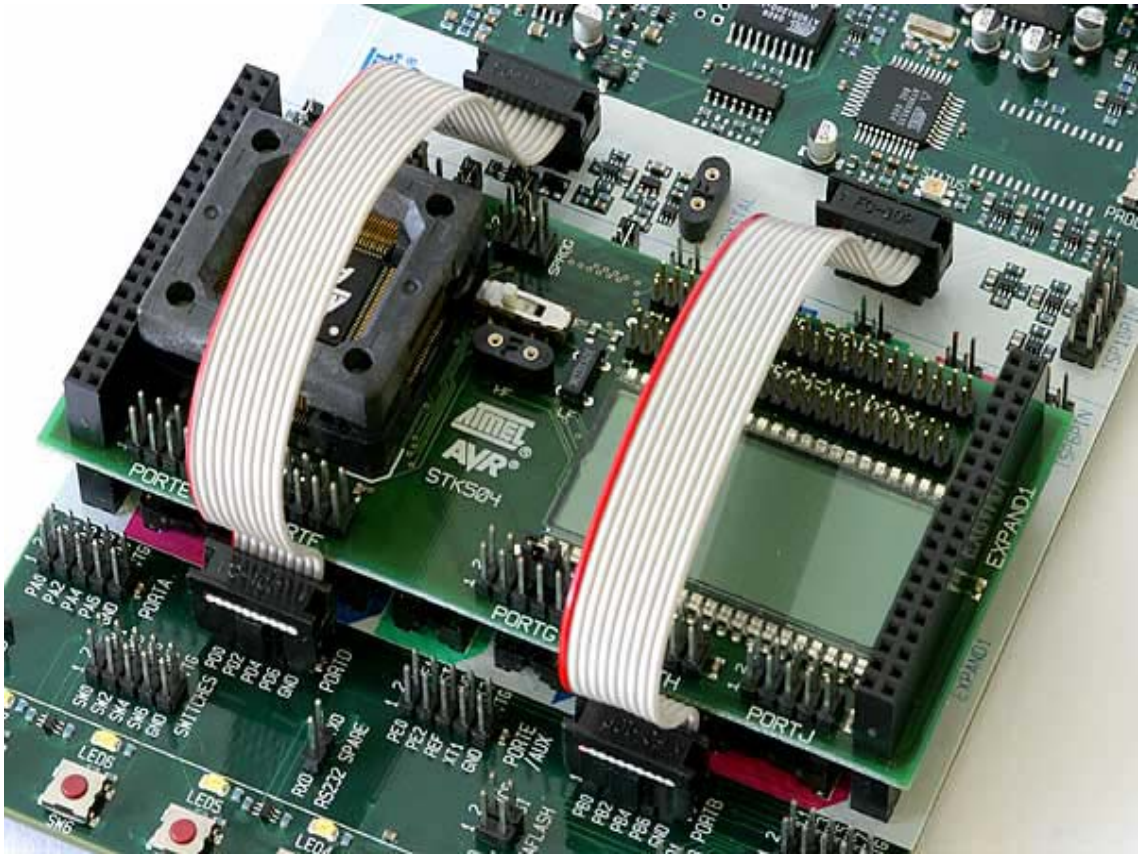


Table 4-1: High-Voltage programming jumper settings

STK500	
VTARGET	Mounted
AREF	Optional
RESET	Mounted
XTAL1	Mounted
OSCSEL	Mounted, pin 1 and 2
BSEL2	Mounted
PJUMP	Open
STK504	
XTAL switch	EXT position
PORTG	Short pin 6 and 8

After programming is completed, make sure you remove the cables between PROGCTRL, PORTD, PROGDATA and PORTB. Also remove the BSEL2 jumper.

JTAG programming

You can also use the *JTAGICE mkII* to prorgam an AVR mounted on the STK504. In order to do this, the AVR's *OCD Enable* fuse must be set. This fuse can be enabled by *ISP Programming or High-Voltage Programming*.

Follow these steps to JTAG program the AVR:

1. Turn off the STK500 power switch
2. Remove the RESET jumper on STK500
3. Mount a jumper between pin 6 and 8 on the PORTG header on STK504
4. Connect the JTAGICE probe to the STK504 JTAG connector as shown in figure 4-3
5. Turn on STK500 and JTAGICE power
6. Then start the AVR Programmer found on the Tools menu in AVR Studio ("Tools/Program AVR/ Connect...")

Figure 4-3: JTAG programming



STK504 Clock Sources

The STK504 can supply three kinds of external clock sources to the AVR mounted in the ZIF socket: On-board 32kHz crystal, a higher frequency crystal mounted in the on-board socket and a clock supplied from STK500.

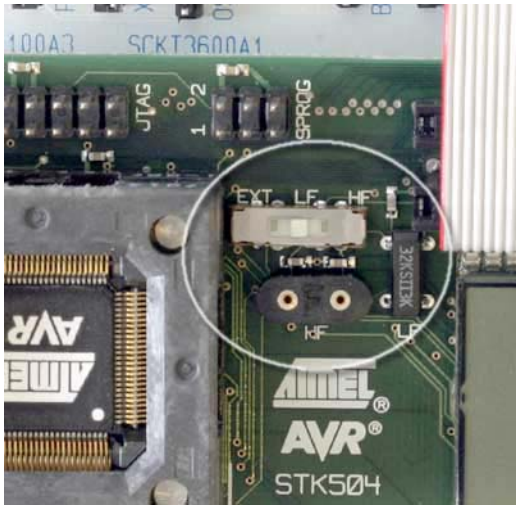
The clock switch

The clock switch has three positions, EXT, LF and HF as shown in figure 5-1. See table 5-1 for function.

Table 5-1: Clock switch positions

Position	Function
EXT	Clock from STK500. (See STK500 documentation for more information.)
LF	On-board 32kHz crystal
HF	Crystal placed in the socket marked HF on STK504

Figure 5-1: Clock switch



EXT – STK500 as clock source

If you put the switch in the EXT position, you will supply the externally generated clock (from STK500) to the XTAL/TOSC pins of the AVR. Check the STK500 help file for more information on how to set the different clock options.

LF – Low-Frequency 32kHz crystal

The STK504 has a 32kHz (32,768Hz) crystal that can be connected to the XTAL/TOSC pins when the switch is set to the LF position.

HF – High-Frequency crystal

There is also a crystal socket on STK504 where you can place a crystal. This is to enable high-frequency crystals (>8MHz) to be used. Because of long wires and large capacitances on the clock nets on STK500, you should put your HF crystal on STK504 and not in the socket on STK500.

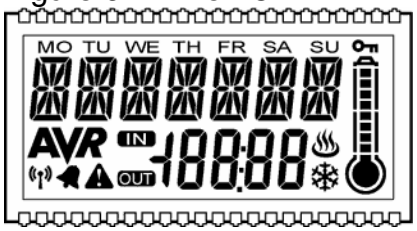
Fuse settings

To use the different clock options, the AVR's programmable fuses must be set right. Consult the AVR's datasheet and the STK500 programming section on how to set the appropriate fuses.

Using the LCD

The STK504 comes with a LCD glass that AVRs with LCD controller can utilize. The 100-pin members of the LCD AVR family can drive LCDs with up to 160 segments on four back-planes. The on-board LCD has 160 segments as shown below.

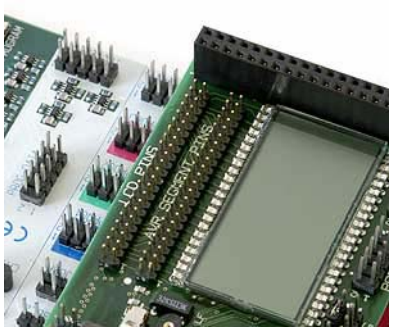
Figure 6-1: The LCD

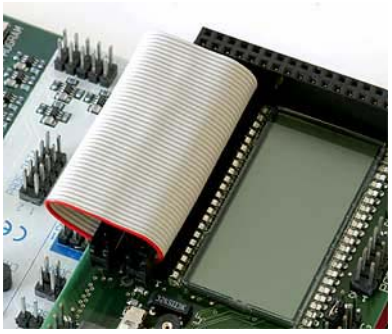


Connecting to the on-board LCD

To utilize the on-board LCD, connect the supplied 44-lead flat cable between the LCD PINS connector and the AVR SEGMENT PINS as shown on the picture below. This will connect the AVR's LCD segment pins and common pins to the appropriate pins on the display. The LCD segment mapping can be found in Appendix B.

Figure 6-2: The LCD cable





Connecting to other displays

If you have your own LCD you would like to use with the STK504, you can do so by connecting it to the AVR SEGMENT PINS connector. Pay attention to the pin 1 marking. The connector pinout can be found in Appendix B.

Debugging with JTAGICE mkII

ATMEL's JTAGICE mkII can debug AVRs that supports the JTAG or the debugWire debugger interface.

Connecting the JTAGICE

Figure 7-1: Connecting the JTAGICE to STK504



Connect the JTAGICE probe to the JTAG connector as show in the figure above.

To be able to use this interface for debugging, you must also remove the RESET jumper from STK500.

Troubleshooting Guide

This section contains information on common problems and solutions.

LCD problems

Problem	Cause	Solution
Nothing is shown on the LCD	**LCD not connected to AVR**	**Connect the flat cable between the *AVR SEGMEN PINS* and *LCD PINS* connectors. See also *Using the LCD*.**
Nothing is shown on the LCD	**Faulty LCD initialization**	Check your code that initializes the LCD driver. The Application Note "AVR065 LCD driver for the STK502 LCD" describes how to control the LCD-display
Nothing is shown on the LCD	The update frequency is not correct.	Check the clock prescaling in your initialization. Check that the clock source selected on STK504 is correct. See STK504 Clock Sources for more information.
Some LCD segments seem stuck.	Some of the port pins used for driving the LCD are also connected to something else.	Check that the pins used to drive the LCD are not connected to something else on either STK500 or STK504.

Programming problems

Problem	Cause	Solution
ISP programming does not work	**ISP cable is not connected**	**Connect a 6-pin cable between the ISP6PIN connector on STK500 and the ISP connector on STK504. See also Programming the AVR.**
ISP programming does not work	**The reset signal is not connected to the AVR on STK504**	**Mount a jumper on pin 6 and 8 on PORTG.**
ISP programming does not work	**The AVR is running at too low clock frequency.**	**Make sure the clock switch on STK500 is in the right position. In the *Board* page of the programming dialog in AVR Studio, try reducing the clock frequency to less or equal to the frequency the AVR is running at.**
High-Voltage programming does not work.	**The 10-pin cables are not connected correctly.**	**See the Programming the AVR chapter for setup.**

High-Voltage programming does not work.	**The BSEL2, OSCSEL, RESET and VTARGET jumpers on STK500 are not set right. The jumper on pin 6 and 8 on the PORTG header is not mounted**	**See the Programming the AVR chapter for setup.**
High-Voltage programming does not work.	**The STK504 clock switch is in the wrong position.**	**Set the switch to the EXT position. See also Programming the AVR.**

General problems

Problem	Cause	Solution
Some of the port pins are not working .	**The AVR is not properly mounted in the ZIF socket.**	**Make sure the chip is properly aligned in the socket. When the spring-loaded latch is released, the chip should fit nicely into the bottom of the socket.**
The code isn't running.	**The AVR has no/wrong clock source.**	**According to the clock fuse setting, select the appropriate clock source on STK500 and STK504. Check the OSCSEL jumper on STK500 and clock switch on STK504. If you are using a crystal in one of the sockets, check that it is firmly mounted in its socket.**
The AVR will not run on x MHz, but works ok on lower frequencies.	**The clock frequency is exceeding the clock rate of the AVR (at a certain operating voltage).**	**Check that you are running the AVR within specifications. Check the speed grade of the AVR and consult the datasheet for operating frequencies and voltages.**
The AVR will not run on x MHz, but works ok on lower frequencies. I have a x MHz crystal mounted on STK500	**Crystals should be placed in the crystal socket on STK504.**	**Place the crystal in the socket on STK504. Set the clock switch to the HF position.**

Appendix A Port Connectors

The STK504 has five port connectors in addition to those available on STK500. These are PORTE, PORTF, PORTG, PORTH and PORTJ. The pinout of each connector is described below.

Figure A-1: STK504 port connectors



Table A-2: STK504 port connectors pinout

	PORTE				PORTF				PORTG		
PE0	1	2	PE1	PF0	1	2	PF1	PG0	1	2	PG1
PE2	3	4	PE3	PF2	3	4	PF3	PG2	3	4	PG3
PE4	5	6	PE5	PF4	5	6	PF5	PG4	5	6	PG5
PE6	7	8	PE7	PF6	7	8	PF7		7	8	RST
GND	9	10	VTG	GND	9	10	VTG	GND	9	10	VTG
	PORTH				PORTJ						
PH0	1	2	PH1	PJ0	1	2	PJ1				
PH2	3	4	PH3	PJ2	3	4	PJ3				
PH4	5	6	PH5	PJ4	5	6	PJ5				
PH6	7	8	PH7	PJ6	7	8					
GND	9	10	VTG	GND	9	10	VTG				

Appendix B LCD Pinout and Segment Mapping

This appendix shows the LCD connector pinout and the LCD segment mapping.

Table B-1: AVR SEGMENT PINS

Segment	Port	Connector pins	Port	Segment
COM0	PA0	1	2	PA1	COM1
COM2	PA2	3	4	PA3	COM3
SEG0	PA4	5	6	PA5	SEG1
SEG2	PA6	7	8	PA7	SEG3
SEG4	PG2	9	10	PC7	SEG5
SEG7	PC6	11	12	PH3	SEG7
SEG8	PH2	13	14	PH1	SEG9
SEG10	PH0	15	16	PC5	SEG11
SEG12	PC4	17	18	PC3	SEG13
SEG14	PC2	19	20	PC1	SEG15
SEG16	PC0	21	22	PG1	SEG17
SEG18	PG0	23	24	PD7	SEG19
SEG20	PD6	25	26	PD5	SEG21
SEG22	PD4	27	28	PD3	SEG23

Table B-2: LCD PINS

LCD pin	Connector pins	LCD pin	
21	1	2	22
23	3	4	24
37	5	6	38
39	7	8	40
41	9	10	42
43	11	12	44
1	13	14	2
3	15	16	4
5	17	18	6
7	19	20	8
9	21	22	10
11	23	24	12
13	25	26	14
15	27	28	16
17	29	30	18
19	31	32	20
21	33	34	22
23	35	36	24
25	37	38	26
27	39	40	28
29	41	42	30
31	43	44	32

SEG24	PD2	29	30	PD1	SEG25
SEG26	PD0	31	32	PJ6	SEG27
SEG28	PJ5	33	34	PJ4	SEG29
SEG30	PPJ3	35	36	PJ2	SEG31
SEG32	PG4	37	38	PG3	SEG33
SEG34	PJ1	39	40	PJ0	SEG35
SEG36	PH7	41	42	PH6	SEG37
SEG38	PH5	43	44	PH4	SEG39

The STK504's on-board LCD display is mapped into the AVR's LCD data registers as shown below.

Figure B-1: LCD segments

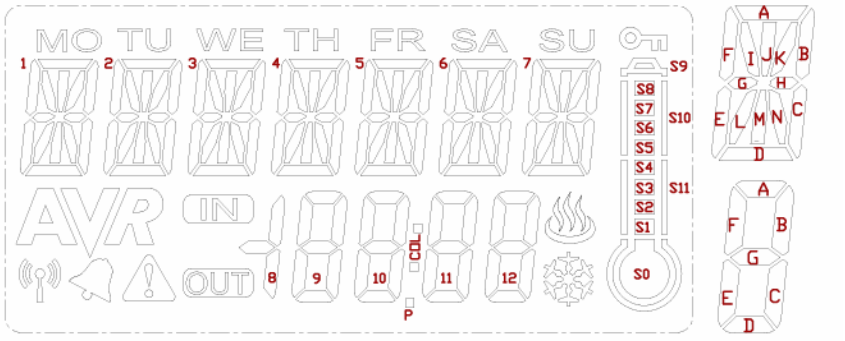


Table B-3: LCD segment mapping

Common lines	Bits	Registers							
7	6	5	4	3	2	1	0		
COM3	9A	9B	10A	10B	11A	11B	12A	12B	LCDDR19

COM3	AVR	S7	S8	S9	7C	KEY	7M	7D	LCDD R18
COM3	6C	WRM	6M	6D	5C	8BC	5M	5D	LCDD R17
COM3	4C	8G	4M	4D	3C	IN	3M	3D	LCDD R16
COM3	2C	NB	2M	2D	1C	BEL	1M	1D	LCDD R15
COM2	9F	9G	10F	10G	11F	11G	12F	12G	LCDD R14
COM2	SG2	S5	S6	S10	7H	7N	7L	7E	LCDD R13
COM2	6H	6N	6L	6E	5H	5N	5L	5E	LCDD R12
COM2	4H	4N	4L	4E	3H	3N	3L	3E	LCDD R11
COM2	2H	2N	2L	2E	1H	1N	1L	1E	LCDD R10
COM1	9E	9C	10E	10C	11E	11C	12E	12C	LCDD R9
COM1	SG1	S3	S4	S11	7B	7K	7J	7G	LCDD R8
COM1	6B	6K	6J	6G	5B	5K	5J	5G	LCDD R7
COM1	4B	4K	4J	4G	3B	3K	3J	3G	LCDD R6
COM1	2B	2K	2J	2G	1B	1K	1J	1G	LCDD R5
COM0	9D	OUT	10D	P	11D	COL	12D	ICE	LCDD R4
COM0	SG0	S1	S2	S0	SU	7A	7I	7F	LCDD R3
COM0	SA	6A	6I	6F	FR	5A	5I	5F	LCDD R2
COM0	TH	4A	4I	4F	WE	3A	3I	3F	LCDD R1
COM0	TU	2A	2I	2F	MO	1A	1I	1F	LCDD R0

© Atmel Corporation 2005. All rights reserved. Atmel®, logo and combinations thereof, AVR®, and AVR Studio® are registered trademarks, and Everywhere You Are℠ are the trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.