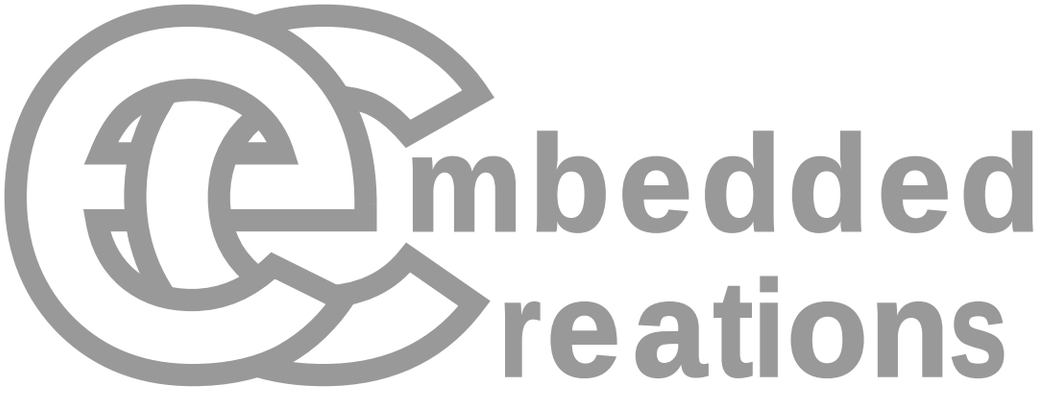

SP Duo
Users Manual

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Introduction

The SP Duo is an In-System Programmer for Atmel AVR micro controllers. The SP Duo is unique with its ability to program though both the normal SPI programming interface and the newer JTAG interface supported by the latest AVRs. The SP Duo communicates with the PC using the STK500 programming protocol created by Atmel, and is compatible with programming software that supports Atmel's STK500 board or AVRISP programmer.

Features

- Two programming interfaces: SPI + JTAG
- Fast programming with JTAG
- Fast programming with auto-adapting SPI clock
- STK500 compatible programmer - compatible with existing PC software and IDEs that support the STK500 protocol
- Supports all AVR devices using SPI or JTAG programming
- Supports all In-system-programming functions: programming + readback of Flash, EEPROM, Fuses, Lockbits, and oscillator calibration bytes
- Programmer is firmware-upgradeable to support future AVR devices
- RS-232 interface
- Draws power from target, no external power supply needed

Supported AVR Devices using SPI

ATmega8	ATmega8515	ATmega8535	ATmega16
ATmega162	ATmega32	ATmega169	ATmega64
ATmega128	ATmega161	ATmega163	ATmega323
ATmega103			
AT90S1200	AT90S2323	AT90S2343	AT90S2313
AT90S4433	AT90S8515	AT90S8535	AT90S2333
AT90S4414	AT90S4434		
ATtiny12	ATtiny15	ATtiny26	ATtiny22
ATtiny13	ATtiny2313		

Supported AVR Devices using JTAG

ATmega16	ATmega162	ATmega32	ATmega169
ATmega64	ATmega128	ATmega323	

*Note: all low-voltage counterparts are supported, e.g. ATmega8L, or AT90LS8535, but are omitted from the list for clarity

Future AVR devices will be supported when they are released. If this requires a firmware upgrade of the programmer, it will be made available on the SP Duo website.

Getting Started

Requirements

Target Requirements

Target voltage 3.0V-5.5V
Minimum target clock speed: 250kHz (only for SPI programming)
Minimum target clock speed for AT90S1200: 1MHz

System Requirements

115,200 baud RS-232 COM Port (USB to RS232 adapters are supported)

Supported Programming Software

AVR Studio 3.x	http://www.atmel.com
AVR Studio 4.x	
STK500.exe (installed with AVR Studio)	
Imagecraft AVR Compiler	http://www.imagecraft.com
Codevision AVR Compiler	http://www.hpinfotech.ro/
ChipBlasterAVR	
AVRDUDE	http://savannah.nongnu.org/projects/avrdude/ http://winavr.sourceforge.net/

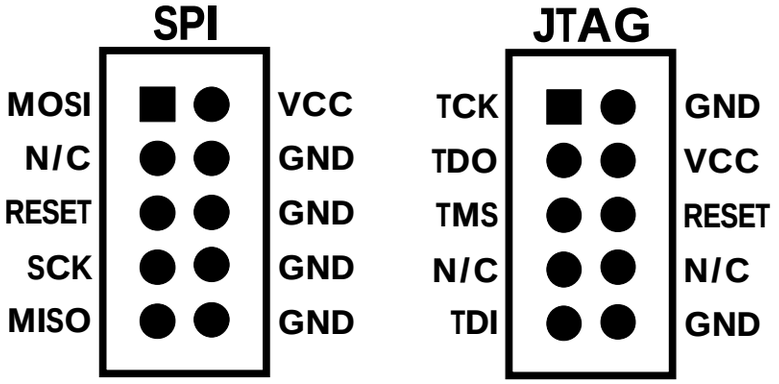
Hardware Description

LED Status

LED Color	Status
Solid Green	Programmer powered and Idle
Pulsing green and red	Connected to target, target in programming mode
Intermittent Blinking Red	Bootloader fail, use update software to reprogram
Solid Red (while running update software)	Currently reprogramming

Cable Pinouts

Only one connector should be connected to your target board at a time. The SP Duo auto-detects which connector is currently used.



Top view of programming connectors
The square pin is pin 1 (red conductor on the cable)

SPI

Signal	Pin #
VCC	2
GND	4, 6, 8, 10
RESET	5
SCK	7
MISO	9
MOSI	1

JTAG

Signal	Pin #
VCC	4
GND	2, 10
RESET	6
TCK	1
TDO	3
TDI	9
TMS	5

Power

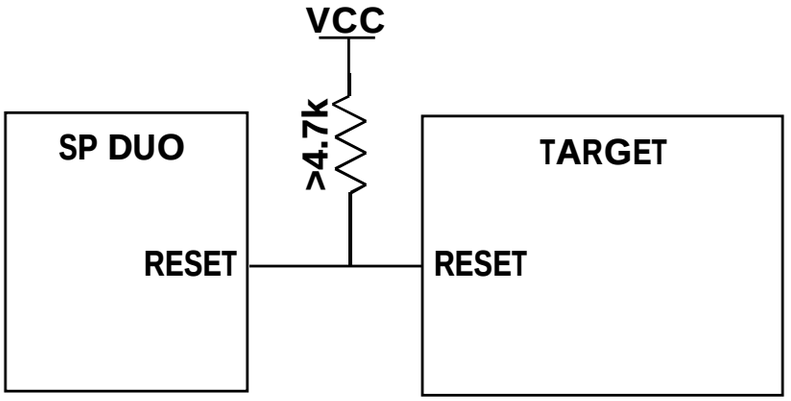
The SP Duo requires a voltage supply from the target of 3.0V to 5.5V. The maximum current draw from the target is under 50mA at 5.5V.

The target board's power must be turned off when connecting or disconnecting the SP Duo. 'Hot-Swapping' the programmer while the target board's power is on may damage the programmer.

Signals

Common

Vcc	Power supply to the programmer and the target micro controller, must be between 3.0-5.5V
Gnd	Ground reference
Reset	Connect directly to target reset pin (optional when using JTAG). The reset pin on the target must be pulled up to Vcc by a minimum 4.7k ohm resistor.



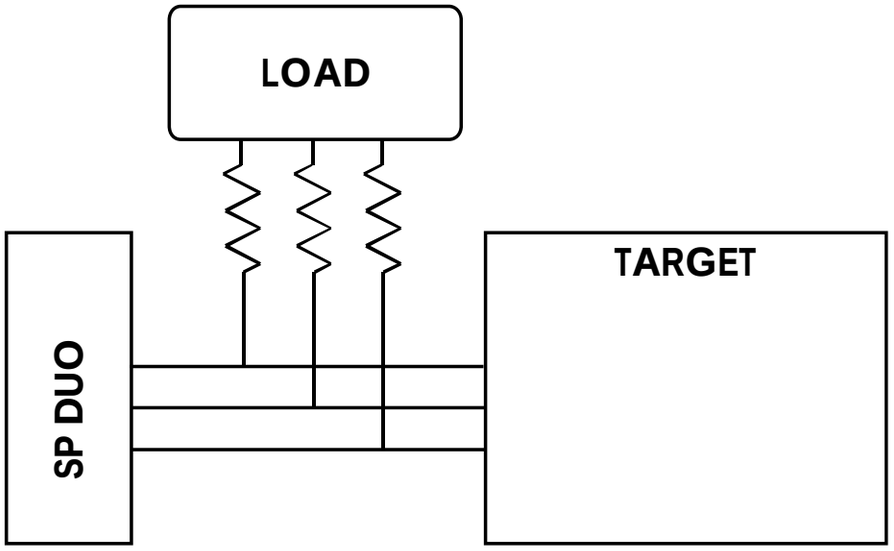
Reset connection

SPI

SCK	clock signal, from programmer
MISO	data signal, from target
MOSI	data signal, from programmer

JTAG

TCK	clock signal, from programmer
TMS	control signal, from programmer
TDI	data signal, from programmer
TDO	data signal, from target



Series resistors used on shared programming pins

The programming pins on the target micro controller can be connected to other parts of the system as general I/O lines, as long as the system does not interfere with the programmer's signals during programming. Series resistors can be used to separate the load from the programming lines. The programmer should be connected to the target micro controller directly without any series resistors.

Programming

SPI Programming

When SPI programming, the target needs to be supplied with a clock source, either connected to the external XTAL pins, or with an internal oscillator. The SP Duo supports target clock speeds of 250kHz and above (1MHz and above for the AT90S1200). If the target clock speed is lower than the minimum, entering program mode will fail.

The SCK clock signal used for programming is sampled by the target AVR, and must be at least twice as slow as the target's clock speed for programming to work. The SP Duo is able to detect the fastest SCK speed the target can support to program the target as quickly as possible. Especially when programming devices with large Flash, the speed difference between programming a target with a fast clock and a target with a slower clock can be seen. Targets at 8MHz and above are all clocked at the same SCK speed.

To program using the SPI interface, the target's SPIEN fuse needs to be programmed. New AVRs supporting SPI programming come from the factory with this fuse programmed. If this fuse is mistakenly cleared, it will need to be reprogrammed using either Parallel Programming (using the STK500 programmer from Atmel), or JTAG if the device supports

it. When programming the target's fuses, take care to ensure the fuse values are correct. (See Appendix 1)

JTAG Programming

The SP Duo does not support JTAG programming in a chain of devices. The SP Duo must be connected to the target AVR directly, and not to any other JTAG devices.

There is no minimum target clock frequency for JTAG programming. Programming will succeed even with the target clock stopped completely.

To program using the JTAG Interface, the JTAGEN fuse needs to be programmed. New AVRs supporting JTAG come from the factory with this fuse programmed. If this fuse is mistakenly cleared, it will need to be reprogrammed either using SPI programming, or Parallel Programming (using the STK500 programmer from Atmel). When programming the target's fuses, take care to ensure the fuse values are correct. (See Appendix 1)

The reset line only needs to be connected to the target micro controller in certain cases. The target AVR can disable the JTAG pins in firmware by setting the JTD bit in the MCUCSR register. If your target's

firmware sets this bit, the SP Duo must be able to reset the target to enable the JTAG pins during programming.

When programming the EEPROM through JTAG, bits are only cleared, never set. The chip must be erased to reset the EEPROM bits to all 1's before programming. If the EESAVE fuse is programmed (EEPROM memory is preserved through the chip erase cycle), the EEPROM will not be reset during a chip erase. To reset the EEPROM before programming, clear the EESAVE fuse, erase the chip, and reprogram the EESAVE fuse.

Programming Software

This section is intended to list any special notes on using programming software with the SP Duo. Please refer to the individual programming software's documentation for detailed instructions on its use.

AVR Studio 4.x and 3.x

If a firmware version message appears when opening the programming window, ignore and press cancel.

Under the Board tab, writing an oscillator value to the programmer fails. This feature is not needed with the SP Duo's auto-adapting SPI clock.

The upgrade feature is not supported, upgrade software will be available on the SP Duo website when new firmware is released.

The "Serial programming downloading (SPI) Enabled" fuse cannot be changed, even when programming using JTAG. You must use other software to change this bit.

STK500.EXE

This command-line program is found in the \stk500 directory where AVR Studio was installed.

Writing an oscillator value to the programmer fails, this feature is not needed with the SP Duo's auto-adapting SPI clock.

Imagecraft AVR Compiler

Choose STK-500 from the list of programmers under programming options.

Codevision AVR Compiler and ChipBlasterAVR

Choose STK-500 from the list of programmers.

AVRDUDE

Use the "stk500" programmer type.

Troubleshooting

The LED is off:

Power not supplied to target	Verify VCC pin is supplied with 3.0V-5.5V from target

Can’t enter programming mode on target:

Incorrect pinout	Verify pinout
SPIEN/JTAGEN fuse cleared	Program fuse using Parallel Programming
Reset pin used as general I/O	Clear fuse using Parallel Programming
Not enough power	Verify the target can supply enough power to the programmer
Target has no clock (SPI only)	Verify the target is clocked at 250kHz minimum (1MHz minimum for AT90S1200)
Programming pins are heavily loaded	Use series resistors to separate load from shared programming pins

Software can’t communicate with programmer:

COM port is in use	Verify the COM port is not being used by software

To test communication with the programmer, a terminal program can be used. Open the COM port the SP Duo is attached to at 115,200 baud, 8-N-1. Type Ctrl-V into the terminal window, and the programmer will reply “SP Duo vX.X” if communication is correct.

Appendix 1: Fuse Programming

It is easy to get confused when programming fuses, because a "programmed" fuse is a logical 0, and a "cleared" fuse is a logical 1. The easiest way to program fuses is using Atmel's AVR Studio software, which has a GUI where individual fuse settings can be selected with check boxes - a checked box represents the fuse is programmed. The options can be visually reviewed before programming. The other programming software represent the fuses with hexadecimal values, and more care must be taken by the user to ensure the correct fuse settings are being programmed.

Programming the wrong fuse values can prevent you from programming again. The most important fuses to avoid setting to the wrong value are:

- Programming enable fuses (SPIEN for SPI, and JTAGEN for JTAG)
- Clock source – if you change your clock from internal oscillator to external oscillator and you do not have one, you will not be able to use SPI
- Reset Disable – if the reset line is set as a general I/O pin, SPI programming will not work