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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



## JTAG-HS1™ Programming Cable for Xilinx® FPGAs

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### Overview

The joint test action group (JTAG)-HS1 programming cable is a high-speed programming solution for Xilinx field-programmable gate arrays (FPGAs). It is fully compatible with all Xilinx tools, and can be seamlessly driven from iMPACT, Chipscope™, and EDK. The HS1 attaches to target boards using Digilent's 6-pin, 100-mil spaced programming header, or Xilinx's 2x7, 2mm connector (using the included adaptor).

The JTAG-HS1 is powered from a PC's USB port, and will be recognized as a Digilent programming cable when connected to a PC, whether or not it is attached to the target board. A separate Vdd pin is provided on the HS1 to supply JTAG signal buffers. The high speed, 24mA, three-state buffers allow target boards to drive the HS1 with signal voltages from 1.8V to 5V, with bus speeds of up to 30Mbit/sec. The HS1's Vdd pin must be tied to the same voltage supply that drives the JTAG port on the FPGA (see Fig. 1).



*The JTAG-HS1.*

Features include:

- Small, complete, all-in-one JTAG programming solution for Xilinx FPGAs
- Separate Vref drives JTAG/SPI signal voltages; Vref can be any voltage between 1.8V and 5V.
- High-Speed USB2 port that can drive JTAG/SPI bus at up to 30Mbit/sec
- JTAG/SPI frequency settable by user
- Compatible with all Xilinx tools
- Uses micro-AB USB2 connector
- SPI programming solution (modes 0 and 2 supported)
- Fully supported by the Adept SDK, allowing custom JTAG/SPI applications to be created

JTAG signals are held in high-impedance except when actively driven during programming, so the JTAG bus can be shared with other devices. The HS1 uses a standard Type-A to Micro-USB cable (included with the HS1) that attaches to the end of the module opposite the system board connector. The HS1 is small and light, allowing it to be held firmly in place by the system board connector (see Fig. 2).

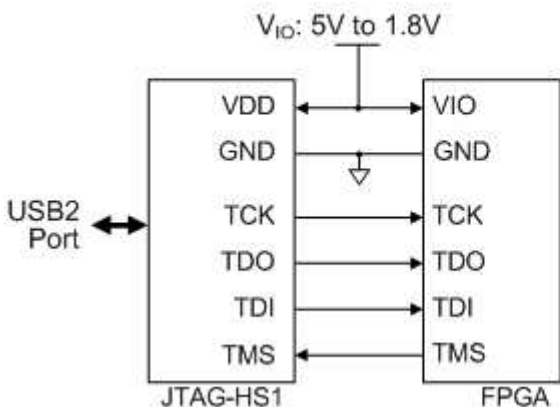


Figure 1. Diagram of signal voltages and connections.

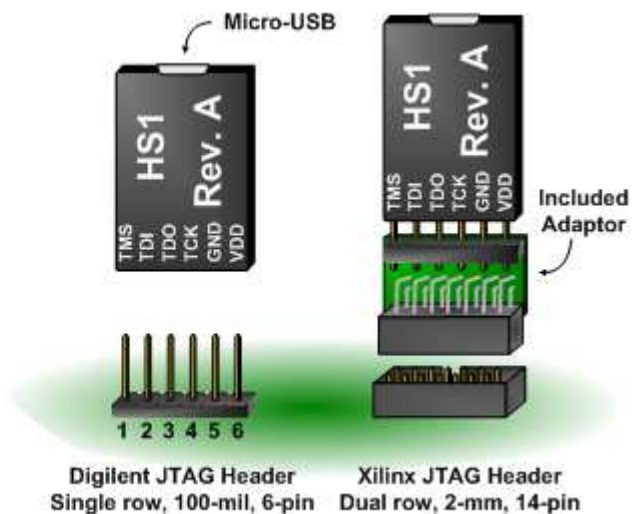


Figure 2. Xilinx JTAG headers.

## Software Support

In addition to working seamlessly with all Xilinx tools, the HS1 is supported by Digilent's Adept software and the Adept SDK (the SDK can be freely downloaded from Digilent's website). Adept includes a full-featured programming environment, and a set of public APIs that allow user applications to directly drive the JTAG chain.

Using the Adept SDK, custom applications can be created to drive JTAG ports on virtually any device. The HS1 also supports SPI modes 0 and 2. Users may utilize the APIs provided by the SDK to create applications that can drive any SPI device supporting those modes. Please see the Adept SDK reference manual for more information.

The HS1 is also supported by Digilent's AVR programmer that can target any AVR device

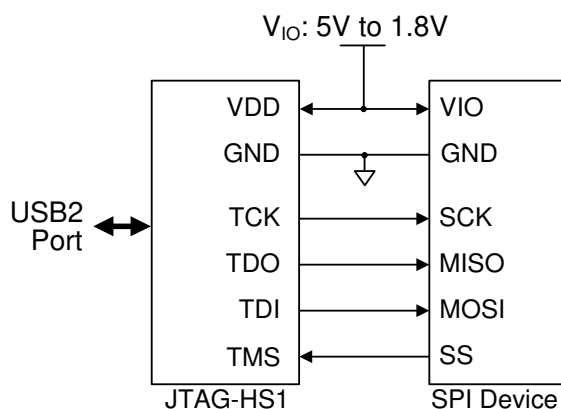


Figure 3. JTAG-HS1 SPI Device Connections.

## Absolute Maximum Ratings

Symbol	Parameter	Condition	Min	Max	Unit
Vdd	Operating supply voltage		-0.3	4.0	V
Vref	I/O reference/supply voltage		-0.3	6	V
VIO	Signal Voltage		-0.3	6	V
I <sub>IK</sub> , I <sub>OK</sub>	TMS, TCK, TDI, TDO DC Input/Output Diode Current	VIO < -0.3V		-50	mA
		VIO > 6V		+20	
I <sub>OUT</sub>	DC Output Current			±50	mA
T <sub>STG</sub>	Storage Temperature		-20	+120	°C
ESD	Human Body Model JESD22-A114			2000	V
	Charge Device Model JESD22-C101			500	V

## DC Operating Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
Vdd	Operating supply voltage	2.97	3.3	3.63	Volts
Vref	I/O reference/supply voltage	1.65	2.5/3.3	5.5	Volts
TDO	Input High Voltage (V <sub>IH</sub> )	0.75 x Vref		5.5	Volts
	Input Low Voltage (V <sub>IL</sub> )	0		0.25 x Vref	Volts
TMS, TCK, TDI	Output High (V <sub>OH</sub> )	0.85 x Vdd	0.95 x Vdd	Vdd	Volts
	Output Low (V <sub>OL</sub> )	0	0.05 x Vdd	0.15 x Vdd	Volts

## AC Operating Characteristics

HS1 JTAG/SPI signals are driven according to the timing diagram below in Fig. 4. TCK frequencies from 30 MHz to 8 KHz are supported at integer divisions of 30 MHz from 1 to 3750. Common frequencies include 30 MHz, 15 MHz, 10 MHz, and 6 MHz (see Table 1).

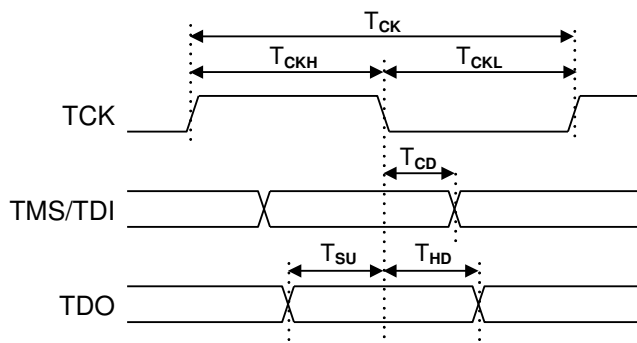


Figure 4. Timing diagram.

Symbol	Parameter	Min	Max
$T_{CK}$	$T_{CK}$ period	33ns	2.185ms
$T_{CKH}, T_{CKL}$	$T_{CLK}$ pulse width	20ns	1.1ms
$T_{CD}$	$T_{CLK}$ to TMS, TDI	0	15ns
$T_{SU}$	TDO Setup time	19ns	
$T_{HD}$	TDO Hold time	0	

Table 1. Common frequencies.

## Design Notes

The HS1 is designed to drive JTAG/SPI signals on target boards that have less than 100ohms of series resistance. Higher resistance may result in degraded operation.

## Supported Target Devices

The JTAG-HS1 is capable of targeting the following Xilinx devices:

1. Ordered List Item Xilinx FPGAs
2. Xilinx Zynq-7000
3. Xilinx CoolRunner™/CoolRunner-II CPLDs
4. Xilinx Platform Flash ISP configuration PROMs
5. Select third-party SPI PROMs
6. Select third-party BPI PROMs

The following devices cannot be targeted by the JTAG-HS1:

1. Ordered List Item Xilinx 9500/9500XL CPLDs
2. Xilinx 1700 and 18V00 ISP configuration PROMs
3. Xilinx FPGA eFUSE programming

Remote device configuration is not supported for the JTAG-HS1 when used with Xilinx's iMPACT software. Note: Please see the "Introduction to Indirect Programming – SPI or BPI Flash Memory" help topic in iMPACT for a list of supported FPGA/PROM combinations. Note: Please see the "Configuration Memory Support" section of Xilinx UG908 for a list of the FPGA/PROM combinations that Vivado supports.