

## FEATURES

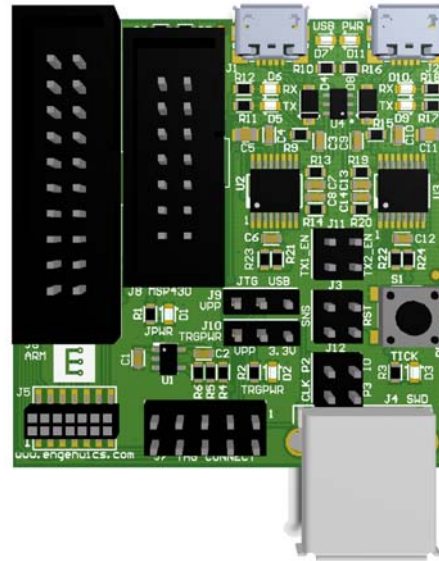
- J-Link (ARM) and MSP-FET (MSP430) programmer connection to three possible target device connectors: Engenuics open-source 14-pin JTAG/SWD/Debug connector, Tag-Connect TC-2050-IDC, and SWD using USB connector
- Dual UART debugging channels via two separate FTDI USB-to-serial chips for complete configuration and isolation of channels
- Onboard power regulation with USB or JTAG input to 3.3V LDO
- Optional target power 5V, 3.3V or none via jumper selection
- Onboard device Reset button with optional jumper connection to target
- Board power target LEDs showing USB1, USB2 and/or JTAG power
- Target power LED indicating supplied power
- Supplied Altium Schematic and PCB library with target board connectors

## APPLICATIONS

- JTAG programming and debugging for development boards or production devices
- UART to RS-232 converter to monitor or control serial interfaces

## OVERVIEW

The JTAG/debug adapter for ARM/MSP430 is a feature-rich multi-mode communications adapter for embedded systems. The device offers three options to connect ARM or MSP430 JTAG or SWD programmers without requiring expensive and/or large headers on the target device.



The Engenuics JTAG-14 connection uses a 0.050" pitch 2X7 SMT connector. All JTAG/SWD signals are available along with two UART Tx/Rx pairs and a system tick input. Dual FTDI USB-to-Serial converters connect through to the target to access UART debugging with or without JTAG.

A Tag-Connect 10-pin header enables the same TC-2050-IDC cable to connect to ARM or MSP430 targets. Two unused lines are used to bring out one UART Tx/Rx pair for serial debugging.

For ARM devices supporting two-line SWD programming, the adapter has a USB A connector with re-purposed D- and D+ lines to connect to the target using a standard USB connector (often already in place and used for power/charging). This is not an active SWD-to-USB protocol converter – it simply makes use of a standard physical USB connector for SWD signals. A jumper attaches the adapter's onboard 3.3V Vcc back to the Vsns line on the JTAG programmer to emulate device power sense when this connection is used.

## LED INDICATORS

Status LEDs are used to quickly, visually provide board and target status (Figure 1).

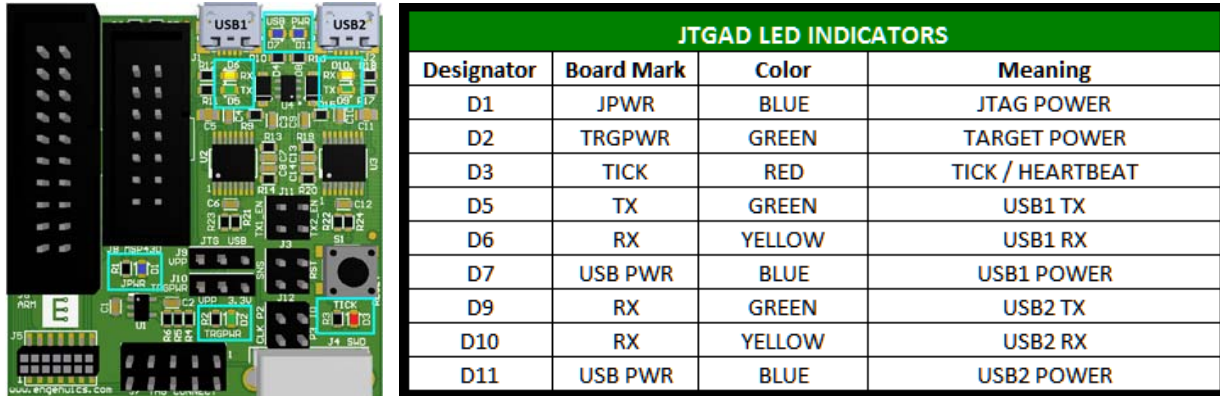


Figure 1: Status LED locations and function table

## JUMPER CONFIGURATION

Jumper blocks allow customization of adapter board connections to the target. There are eight jumpers on the adapter board summarized in Figure 2.

JTGAD JUMPERS			
Jumper	POSITION 1	POSITION 2	Off Function
VPP (J9)	POSITION JTG: VPP (highest of 5V USB or JTAG power, less diode drop) to TRGPWR	POSITION USB: VPP provided to TRGPWR from highest USB voltage (5V USB less diode drop)	No power to TRGPWR
TRGPWR (J10)	POSITION VPP: VPP provided to target	POSITION 3.3V: regulated 3.3V provided to target	No power to target board.
SNS (J3)	3.3V to JTAG VSNS	N/A	3.3V not on VSNS (target Vcc to VSNS)
RST (J3)	Target reset line pulled up; reset button active	N/A	Target reset line not terminated
TX1_EN (J11)	USB1 Tx driver and pull-up attached to target	N/A	UTX1 to target floating
TX2_EN (J11)	USB2 Tx driver and pull-up attached to target	N/A	UTX2 to target floating
CLK (J12)	CLK-P2: SWDCLK connected to pin two of repurposed USB (J4)	CLK-P3: SWDCLK connected to pin three of repurposed USB (J4)	Not valid if J4 is used
IO (J12)	IO-P3: SWDIO connected to pin three of repurposed USB (J4)	IO-P2: SWDIO connected to pin two of repurposed USB (J4)	Not valid if J4 is used

Figure 2: Adapter board jumper configuration.

**CONNECTOR SPECIFICATIONS: JTAG PROGRAMMER/DEBUGGER PODS**

ARM JTAG (typically Segger J-Link modules) and MSP430 MSP-FET JTAG programmers have standard output pins using 20-pin and 14-pin 0.100" box connectors, respectively. The connectors and pin outs are shown in Figure 3.

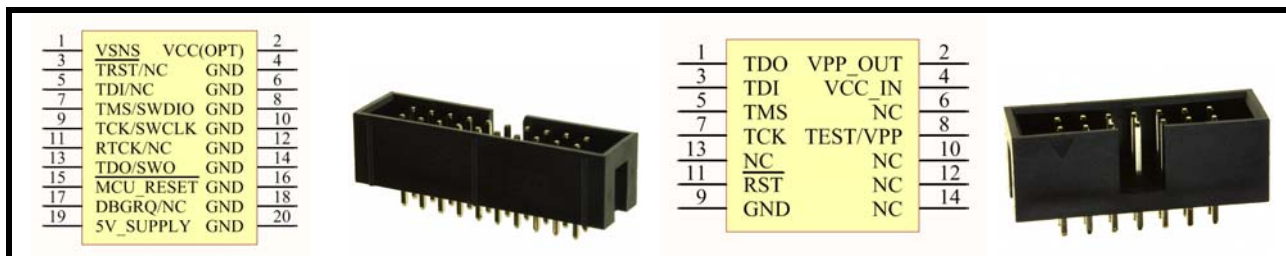


Figure 3: ARM J-LINK JTAG/SWD (left) and MSP-FET (right) pin outs  
 Connector photos from www.digikey.ca

**CONNECTOR SPECIFICATIONS: ENGENUICS PROGRAMMING / DEBUGGING HEADER**

Standard JTAG programmer connectors are robust and excellent for development boards but are often not a viable solution for form-factor prototype or production devices. Engenuics uses a low-cost, 14-pin 0.050" pitch connector that connects the required JTAG or SWD lines and also provides two target UART connections and a system tick output. Symbols are defined explicitly for male and female versions to help ensure proper physical connection when planning production or debug systems (Figure 4).

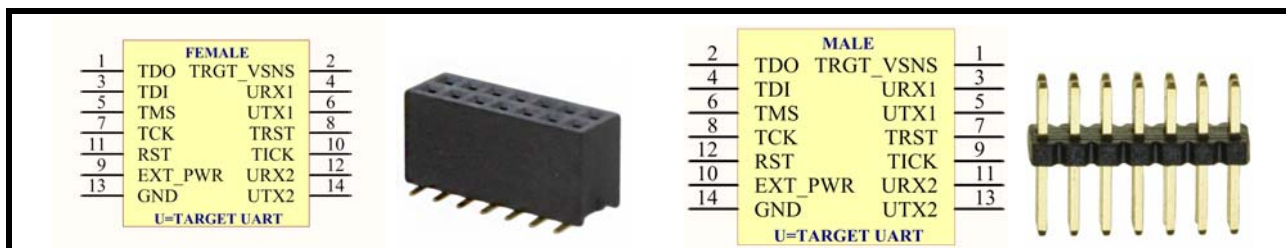


Figure 4: Engenuics 14-pin programming / debug header female (left) and male (right)  
 Connector photos from www.digikey.ca

**CONNECTOR SPECIFICATIONS: TAG-CONNECT PLUG-OF-NAILS**

High volume production devices and any cost-sensitive designs can use a Tag-Connect (www.tag-connect.com) connector-less PCB land pattern with a Tag-Connect cable. Tag Connect 10-pin (TC2050-IDC) cables use a 2x5 0.100" box connector on the programmer end that terminates in the plug-of-nails PCB contacts. Standard JTAG/SWD signaling is assigned to these pins. Engenuics added one pair of UART Tx/Rx communication lines to unused pins on the 10-pin target land pattern for the TC2050-IDC cable (Figure 5).



Figure 5: Engenuics/Tag Connect pin out, Tag Connect Cable, Example PCB Land Pattern  
 Tag-Connect product photo from [www.tag-connect.com/TC2050-IDC-NL](http://www.tag-connect.com/TC2050-IDC-NL)

### CONNECTOR SPECIFICATIONS: SWD OVER REPURPOSED USB CONNECTOR

Small devices requiring external power and programming access present a unique challenge. Due to the ubiquity of USB Micro B chargers and associated connectors, using a USB Micro B connector as a power and data port makes sense. The D+ and D- terminations are re-purposed to support SWD mode for ARM microcontrollers.

USB A to Micro B cables are readily available and thus make the most sense to use in the application. Since only four signal lines are available with USB A, the required target voltage sense for JTAG devices is not present and is thus emulated on the adapter. This is enabled by shorting the VSNS jumper. Figure 6 shows the adapter side and target side connections used to support SWD programming using this technique.



Figure 6: Programming adapter USB A (left) and target USB Micro B connector (right)  
 Connector photos from [www.digikey.ca](http://www.digikey.ca)

Note that the target Micro B connector has a VSNS connection to target VCC if designers choose to implement their own programming adapters and bring back target power through a 5-line Micro B to Micro A/B cable. Unfortunately these cables are hard to find or at least quite expensive. Note that a USB OTG cable will not function correctly since pin 4 is pulled low internally on the cable.

Altium Designer schematic symbols and PCB land patterns for all of the above are available at [engenuics.com/software/engenuics\\_adapter\\_library.zip](http://engenuics.com/software/engenuics_adapter_library.zip)

## USB SERIAL PORTS

Two built-in FTDI USB-to-Serial converters allow easy UART connection from target to a PC through the adapter board. FTDI drivers support Windows, Mac and Linux operating systems. The FTDI drivers are typically functionally excellent, though occasionally take several minutes to first enumerate and then assign the serial port to the hardware in Windows. Figure 7 shows the enumeration process in Windows 7. Please use the latest drivers found here:

<http://www.ftdichip.com/Drivers/VCP.htm>

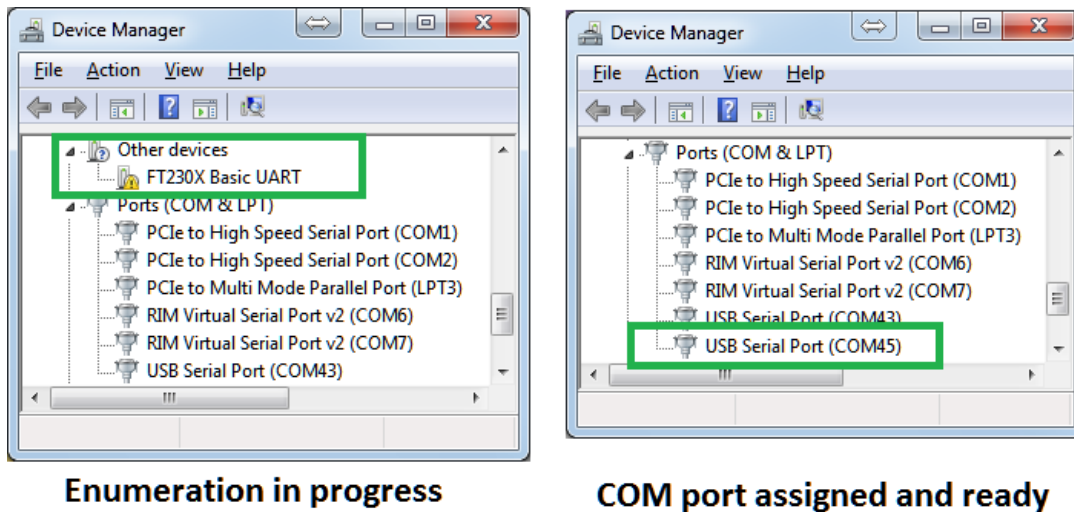


Figure 7: FTDI enumeration in Windows 7

The same serial port on the adapter board should enumerate to the same COM port in the operating system if the same physical PC USB port is used. However, this is not guaranteed and depends on many factors so be sure to use a device manager application to view which COM port is assigned. It is recommended to plug in USB1 first (connector J1) and note which COM port is assigned. Then plug in USB2 and note its COM port.

USB1 and USB2 map to specific pins on the target connectors. J1 supports both USB1 and USB 2; J2 supports only USB1. J3 does not support any serial pairs. In all cases, the adapter-to-target transmit line can be disconnected from the FTDI driver chip using a jumper. Figure 8 shows the relevant hardware.

JTAG/USB TO SERIAL CONNECTIONS			
Connector	Board Reference	Tx Driver Jumper	Target Board Connections
J1	USB1	TX1_EN	J5 Pin 4 (Tx board to Rx target)
			J5 Pin 6 (Rx board from Tx target)
			J7 Pin 7 (Tx board to Rx target)
			J7 Pin 9 (Rx board from Tx target)
J2	USB2	TX2_EN	J5 Pin 12 (Tx board to Rx target)
			J5 Pin 14 (Rx board from Tx target)

Figure 8: USB to Serial hardware connections

With the Tx jumper removed, the MCU Tx line is not loaded by the FTDI Tx driver on the adapter board. The communication stream from the module to the MCU can still be monitored through the FTDI Rx connection without loading the signal. If direct connection to the module on the target is required, the MCU UART Tx line can be set to high impedance in firmware (or disconnected if the target has an onboard jumper for this purpose) so the PC can talk directly to the module via the debug adapter (Figure 9).

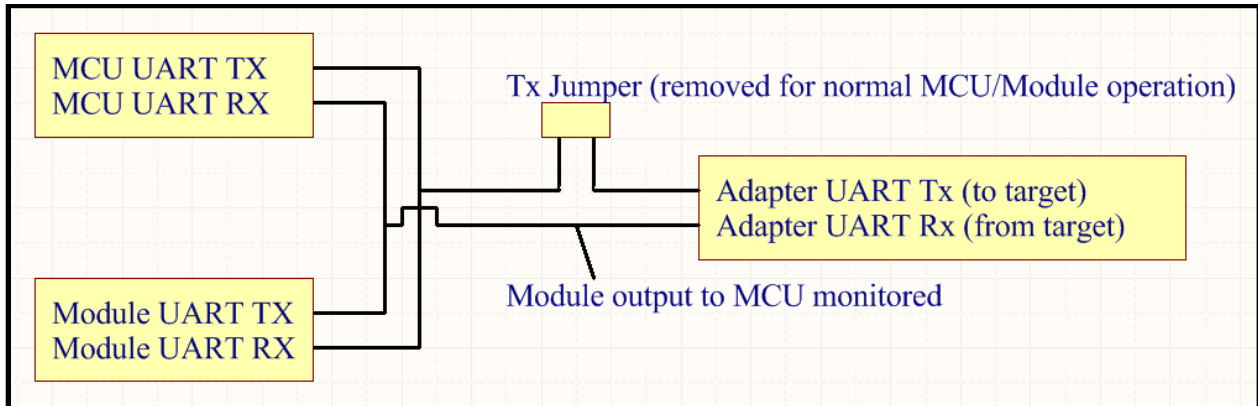


Figure 9: Example connection of monitoring a target UART bus with an option to override the MCU UART Tx

Both channels also have built-in weak pull-up resistors on the Tx lines (after the jumpers on the target side) and Rx lines from the target to avoid garbage data on high-impedance, floating or otherwise unused lines. If the target can tolerate the pull-ups, these jumper locations can also be repurposed for other digital IO access to specific targets.

**ORDERING INFORMATION AND RELATED PRODUCTS**

ENGENUICS PART NUMBER	VERSION	NOTES
200059	JTGAD-EHDW-04	JTAG adapter with two USB A to USB Micro B cables
200003	J-LINK EDU	ARM JTAG/SWD programmer debugger (educational use only).
N/A	MSP-FET	Texas Instrument MSP-430 flash emulation tool (programmer / debugger). Please visit <a href="http://www.ti.com/tool/MSP-FET">http://www.ti.com/tool/MSP-FET</a>
N/A	TC2050-IDC	Tag-Connect "plug of nails" cables. Please visit <a href="http://www.tag-connect.com/TC2050-IDC">http://www.tag-connect.com/TC2050-IDC</a>

**ELECTRICAL SPECIFICATIONS**

PARAMETER	MIN	NOM	MAX	UNITS
Supply voltage	3.3	5	5.5	V
LDO output voltage to target	3.25	3.3	3.35	V
LDO supply current to target			300	mA
UART 1 maximum data rate			115200	bps
UART 2 maximum data rate			115200	bps
UART transmit line pull-up resistance	99	100	101	kOhm
UART receive line pull-up resistance	99	100	101	kOhm

**DATASHEET REVISION HISTORY**

DATE	VERSION	RELEASE NOTES
January 20, 2015	1.0	First release
May 24, 2015	1.1	Minor editing
June 17, 2015	2.0	Update for JTGAD-EHDW-04 hardware
August 27, 2015	2.1	Update LED drawings and USB1/USB2 hardware descriptions
November 17, 2015	2.2	Correct MALE 14-pin connector schematic; add note about repurposing TX UART lines.

Further information can be accessed online at the product page for this device [www.engenuics.com/products](http://www.engenuics.com/products) or via email at [support@engenuics.com](mailto:support@engenuics.com)

**LIABILITY DISCLAIMER**

Engenuics Technologies Incorporated (“Engenuics”) reserves the right to make changes without further notice to the product to improve reliability, function or design. Engenuics does not assume any liability arising out of the application or use of any product or circuits described herein.

**FCC WARNING**

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by Engenuics to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his/her own expense will be required to take whatever measures may be necessary to correct this interference.

**CONTACT**

Engenuics Technologies Incorporated  
6680A Mirah Road  
Saanichton, BC V8M 1Z4 Canada  
+1-778-351-0153  
+1-888-912-3451 (North America toll-free)  
[support@engenuics.com](mailto:support@engenuics.com)