

Interfacing MSP430 Flash Emulation Tools to the CubeSat Kit™

Introduction

The programming and debugging interface to TI's MSP430 family of ultralow-power microcontrollers is via a low-cost Flash Emulation Tool (FET).

This Application Note Explains how to interface various programming and debugging interface with Pumpkin's CubeSat Kit.

The MSP430 in the CubeSat Kit is present on both the Development Board (in a socket on a daughterboard) and on the FM430 Flight Module (soldered to the PCB). It normally operates at +3.3V via an on-board regulator.

MSP430 JTAG Connector Pinouts

As used with the 64-pin MSP430 variants used in the CubeSat Kit, the 2x7 0.100" spacing JTAG connector used for programming and debugging the MSP430 can be pinned out in one of two ways.

Internal Power

The pinout for use with *internal power* connects the MSP430's VCC pins to pin 2 of the 14-pin JTAG connector, with pin 4 disconnected:

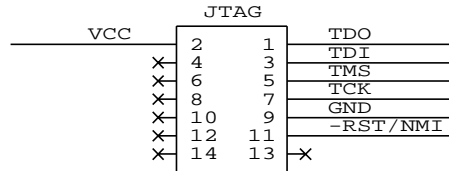


Figure 1: JTAG Pinout for Internal Power

The term *internal power* reflects the fact that power to the MSP430 comes *from the FET itself*.

The TI MSP-TS430PM64 target board that is used in the CubeSat Kit and is part of TI's FET kits for the 64-pin MSP430s is configured for internal power.¹

External Power

The pinout for use with *external power* connects the MSP430's VCC pins to pin 4 of the 14-pin JTAG connector, with pin 2 disconnected:

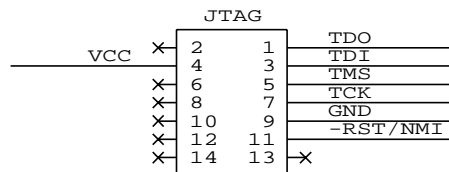


Figure 2: JTAG Pinout for External Power

The term *external power* reflects the fact that power to the MSP430 comes from a source of power *external to the FET itself*.

CubeSat Kit JTAG Connector Implementations

Development Board

The CubeSat Kit's Development Board has an on-board +3.3V regulator to supply power to the MSP430. The Development Board uses TI's MSP-TS430PM64 target board (with its 64-pin ZIF socket) as the daughterboard for the MSP430.

The CubeSat Kit + TI MSP-TS430PM64 combination results in an internal power JTAG connector (V_{CC} on pin 2, with pin 4 disconnected) that has external power (from the CubeSat Kit) *also* connected to the JTAG connector's pin 2.

FM430 Flight Module

The CubeSat Kit's FM430 Flight Module uses an FPC (Flexible Printed Circuit) connector² due to space and mass considerations. A JFPC adapter from Softbaugh, Inc.³ is used to convert the FPC connector to the standard 2x7 JTAG MSP430 header.

The JFPC adapter is pinned out as an *internal power* adapter. The FM430 Flight Module + JFPC adapter combination results in an internal power JTAG connector (V_{CC} on pin 2, with pin 4 disconnected) that has external power (from the CubeSat Kit) *also* connected to the JTAG connector's pin 2.

FET Compatibility

TI Parallel-port MSP430 Flash Emulation Tool MSP-FETP430IF

The TI parallel-port based Flash Emulation Tool is plug-and-play compatible with the CubeSat Kit, regardless of the voltage at which the Flight MCU operates. This is due to the internal design of the MSP-FETP430IF, which combines four separate power sources (two from the parallel port, one from an external power header and one from pin 4 of the JTAG connector) inside the FET and operates at the highest voltage level present on those sources.

| Target | JTAG Connector | Compatibility |
|---------------------------|--------------------------------|---------------|
| Development Board (all) | on MSP-TS430PM64 daughterboard | plug-and-play |
| FM430 Flight Module (all) | via JFPC adapter | plug-and-play |

Figure 3: MSP-FETP430IF (Parallel FET) Compatibility

TI USB-based MSP430 Flash Emulation Tool MSP-FET430UIF

The USB-based MSP-FET430UIF has features not found in the parallel-port MSP-FETP430IF, like adjustable target V_{CC} (1.8V-5.0V) and the ability to supply up to 100mA to the target.

The USB-based MSP-FET430UIF is designed to operate with JTAG connectors pinned out for V_{CC} on pin 2 (internal power, pin 4 disconnected) or V_{CC} on pin 4 (external power, pin 2 disconnected).

In order to use the MSP-FET430UIF on a Rev C or earlier CubeSat Kit Development Board and on all FM430 Flight Modules, it is necessary to set the MSP-FET430UIF's V_{CC} to +3.3V. This is because external voltage is present on the daughterboard's JTAG connector (pin 2). A mismatch between the internal (FET) and external (Development Board) voltages is likely to lead to incorrect operation of the FET.⁴

| Target | JTAG Connector | Compatibility |
|---------------------------------------|--------------------------------|-------------------------------------|
| Development Board (Rev C and earlier) | on MSP-TS430PM64 daughterboard | set MSP-FET430UIF V_{CC} to +3.3V |
| FM430 Flight Module (all) | via JFPC adapter | set MSP-FET430UIF V_{CC} to +3.3V |

Figure 4: MSP-FET430UIF (USB FET) Compatibility

Configuring the MSP-FET430UIF for +3.3V Operation

Support for TI's MSP-FET430UIF from third parties is relatively new and may not yet be present in your MSP430 tools. However, it is possible to use the IAR KickStart MSP430 tools that are supplied free with each MSP-FET430UIF in order to configure your MSP-FET430UIF for $V_{CC} = +3.3V$ operation. Once configured, the MSP-FET430UIF will retain its V_{CC} setting and can be used with any toolset when connected to CubeSat Kit hardware.

IAR Embedded Workbench KickStart for MSP430 V3

Install the KickStart package using the CD-ROM that is supplied with the MSP-FET430UIF, or download it from IAR's (<http://www.iar.com/>) and/or TI's (<http://www.ti.com/>) web sites. Follow the instructions for installing the drivers for the MSP-FET430UIF in order to ensure proper operation – see TI document slau138c.pdf.⁵

Open the IAR tutorial projects by selecting File → Open Workspace → Install Directory\tutor\tutorials.eww. Select project1 and right-click to Set as Active if it's not already selected. Then choose Project → Rebuild All. The project should build with no warnings and no errors.

Next, select Project → Options. Under Category: Debugger, select Setup → Driver → FET Debugger:

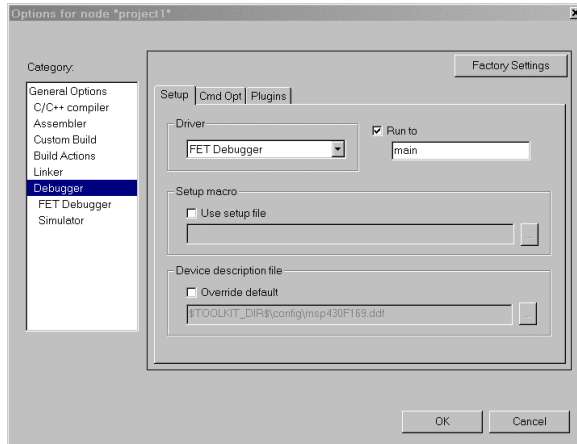


Figure 5: Selecting the FET Debugger as the Debugger

Under Category: FET Debugger, select Setup → Connection → TI USB FET and enter 3.3 for Target VCC (in Volt):

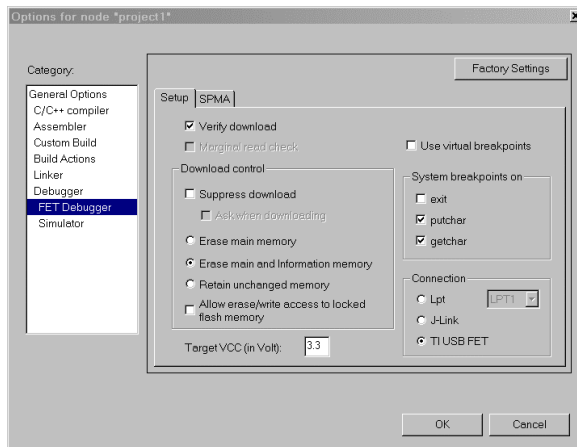


Figure 6: Setting the FET Debugger Properties

Click on OK. Select Project → Debug. If you receive some messages about the firmware of the FET being out-of-date, allow the firmware upgrade to proceed. Upon success, you can verify in the Debug Log window that the V_{CC} voltage of the FET has been set to 3.3V:

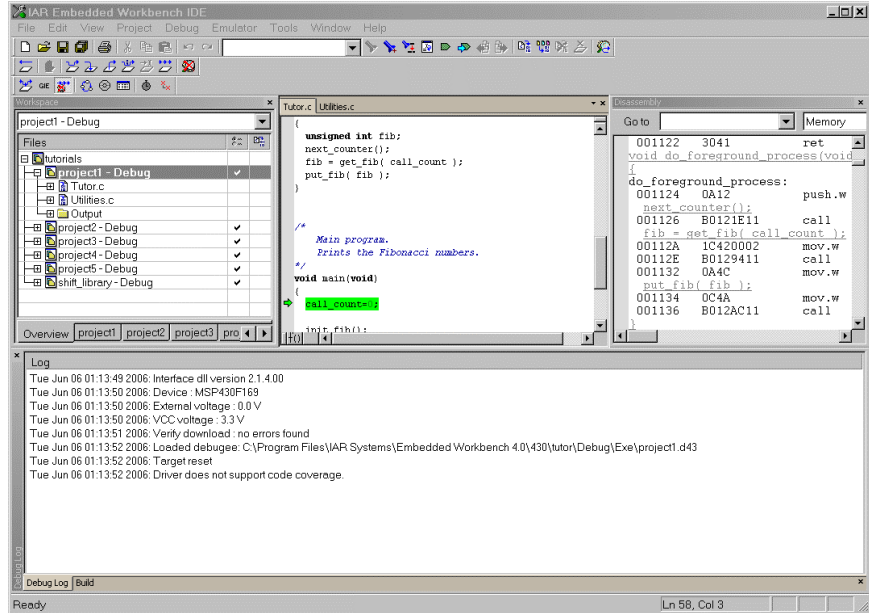


Figure 7: Successful Configuration of MSP-FET430UIF for V_{CC}= 3.3V Operation using IAR's Embedded Workbench

References

1. *MSP-FET430 FLASH Emulation Tool (for use with IAR Version 3.x) User's Guide (Rev. C)*, Texas Instruments User's Guide slau138c.pdf, Texas Instruments, 2005.

¹ The MSP-TS430PM64 board can be (re-)configured for external power by removing resistor R8 (0Ω) and fitting resistor R9 (0Ω).
² Hirose P/N FH10A-8S-1SHB.
³ <http://www.softbaugh.com>.
⁴ E.g. the FET can program the MSP430 but not enter a debug state.
⁵ This document's name will change on the TI website as it is revised. Revision C is slau183c.pdf, revision D is slau138d.pdf, etc.