ECHELON®

2.0

FT 5000 EVB
Hardware Guide

078-0390-01B

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Preface

The FT 5000 EVB is a development board for evaluating the LONWORKS 2.0 platform and creating LONWORKS devices. The FT 5000 EVB is a complete Series 5000 LONWORKS device that uses an FT 5000 Smart Transceiver. It includes a variety of I/O devices that you can use to develop prototype and production devices.

Welcome

The FT 5000 EVB is a complete Series 5000 LONWORKS device that you can use to evaluate the LONWORKS 2.0 platform and create LONWORKS devices. The FT 5000 EVB includes a FT 5000 Smart Transceiver with an external 10 MHz crystal (you can adjust the system's internal clock speed from 5MHz to 80MHz), an FT-X3 communication transformer, 64KB external serial EEPROM and flash memory devices, and a 3.3V power source. The FT 5000 EVB features a compact design that includes the following I/O devices that you can use to develop prototype and production devices and test the FT 5000 EVB example applications:

- 4 x 20 character LCD
- 4-way joystick with center push button
- 2 push-button inputs
- 2 LED outputs
- Light-level sensor
- Temperature sensor

The FT 5000 EVB also includes EIA-232/TIA-232 (formerly RS-232) and USB interfaces that you can use to connect the board to your development computer and perform application-level testing and diagnostics. You can also use the EIA-232 interface for development with the ShortStack® Developer's Kit. Note that you can only use one of the EIA-232 and USB interfaces at a time.

Each FT 5000 EVB also features support for the in-circuit programming of the external serial non-volatile EEPROM and flash memory devices on the board using the serial peripheral interface bus (SPI) and Inter-Integrated Circuit (I^2C) interface.

Purpose

This document describes how to connect the FT 5000 EVB boards, and it describes the Neuron core, I/O devices, service pin and reset buttons and LEDs, and jumper settings on the FT 5000 EVB hardware.

Audience

This guide is intended for device and system designers with an understanding of control networks.

Box Contents

The FT 5000 EVB hardware ships with the following material:

- FT 5000 EVB Evaluation Boards. The FT 5000 EVB hardware includes two FT 5000 EVBs that you can connect to a LONWORKS TP/FT-10 channel.
- Development Tool CD. The FT 5000 EVB hardware is shipped with either the NodeBuilder FX Development Tool CD or the Mini FX Application CD. You can use these development tools to build Neuron C applications and download them to the FT 5000 EVB.
- LonMaker® Integration Tool CD (with NodeBuilder FX Development Tool only). The LonMaker tool lets you install, bind, monitor and control, and test the FT 5000 EVBs in a managed LONWORKS network.
- LonScanner™ Protocol Analyzer LNS Turbo Edition CD. The LonScanner Protocol Analyzer lets you observe, analyze, and diagnose the behavior of the TP/FT-10 channel to which the FT 5000 EVBs are connected.

- Quick Start Guide. The FT 5000 EVB hardware is shipped with either a NodeBuilder FX or Mini FX Quick Start Guide. This document describes how to install the software included with your FT 5000 EVB; connect the FT 5000 EVBs and your development computer to a LONWORKS FT-10 channel; and create a simple LONWORKS network using the Neuron C example application pre-loaded on the FT 5000 EVB.
- Power supplies (90–240VAC 50/60Hz) with power cords (US/Japan and Continental European).
- U10 USB Network Interface and USB Extension Cable. The U10 USB Network Interface lets you directly connect the development tool running on your computer to your FT 5000 EVB over a TP/FT-10 Free Topology Twisted Pair (ISO/IEC 14908-2) LONWORKS channel.
- Network cable and terminator. The network cable lets you interconnect your FT 5000 EVBs, and it lets you connect the boards to other devices and to the U10 USB Network Interface over a LONWORKS FT-10 channel.
- FT 5000 sample chips with FT-X3 transformers (not included in NodeBuilder FX/FT Development Tool Classroom Edition).
- License Return Envelope

Content

This guide includes the following content:

- *Connecting the FT 5000 EVB Hardware*. Describes how to power your FT 5000 EVB and connect it to a LONWORKS FT-10 channel and to your development computer.
- *FT 5000 EVB Hardware Details*. Describes the Neuron core, service pin and reset buttons and LEDs, I/O devices, and jumper settings on the FT 5000 EVB hardware.

Related Manuals

The documentation related to the NodeBuilder tool and Mini FX Application is provided as Adobe Acrobat PDF files and online help files. The PDF files for the NodeBuilder tool are installed in the **Echelon NodeBuilder** program folder when you install the NodeBuilder tool. The PDF files for the Mini FX Application are installed in the **Echelon Mini** program folder when you install the Mini FX application. You can download the latest NodeBuilder and Mini FX documentation, including the latest version of this guide, from Echelon's website at *www.echelon.com/docs*.

EIA-232C Serial Interfacing with the Neuron® Chip	Describes a simple level conversion circuit to allow the Neuron Chip to communicate with EIA-232C devices. Also includes Neuron C software to drive an RS232C CRT terminal.
FT 5000 EVB Examples Guide	Describes how to run the Neuron C example applications included with the NodeBuilder FX Development Tool and Mini FX Development Kit on an FT 5000 EVB.
I/O Model Reference for Neuron® Chips and Smart Transceivers	Describes the I/O objects that are available for use with the Neuron Chips and Smart Transceivers.
Introduction to the LONWORKS® Platform	Provides a high-level introduction to LONWORKS networks and the tools and components that are used for developing, installing, operating, and maintaining them.
LonWorks® USB Network Interface User's Guide	Describes how to install and use the U10 USB Network Interface, which is included with the NodeBuilder FX/FT Development Tool and the Mini FX/FT Evaluation Kit.

Mini FX User's Guide	Describes how to use the Mini FX Application to develop a prototype or production control system that requires networking, particularly in the rapidly growing, price-sensitive mass markets of smart light switches, thermostats, and other simple devices and sensors.
Neuron® C Reference Guide	Provides reference information for writing programs using the Neuron C language.
NodeBuilder® FX User's Guide	Describes how to use the NodeBuilder tool to develop LONWORKS device applications and build and test prototype and production LONWORKS devices
Series 5000 Chip Data Book	Provides specifications and user instructions for engineers who develop applications and devices that use FT 5000 Smart Transceivers or Neuron 5000 Processors, and for users of network interfaces based on the FT Smart Transceivers or Neuron Chips.
ShortStack® User's Guide Release 2.1	Describes how to develop an application for a LONWORKS device using Echelon's ShortStack 2.1 Micro Server. It describes the architecture of a ShortStack device and how to develop a ShortStack device.

For More Information and Technical Support

The **NodeBuilder ReadMe** and **Mini FX ReadMe** documents provide descriptions of known problems, if any, and their workarounds for the NodeBuilder tool and Mini kit, respectively. To view these ReadMe documents, click **Start**, point to **Programs**, point to **Echelon NodeBuilder** or **Echelon Mini**, and then select **NodeBuilder ReadMe First** or **Mini FX ReadMe First**. For additional information about the NodeBuilder tool and Mini kit, you can go to the NodeBuilder and Mini kit Web pages at *www.echelon.com/nodebuilder* and *www.echelon.com/mini*.

If you have technical questions that are not answered by this document, the NodeBuilder tool or Mini kit online help, or the NodeBuilder tool or Mini kit ReadMe files, you can contact technical support. Free e-mail support is available, or you can purchase phone support from Echelon or an Echelon support partner. See *www.echelon.com/support* for more information on Echelon support and training services.

You can also view free online training or enroll in training classes at Echelon or an Echelon training center to learn more about developing devices. You can find additional information about device development training at *www.echelon.com/training*.

You can obtain technical support via phone, fax, or e-mail from your closest Echelon support center. The contact information is as follows:

Region	**Languages Supported**	**Contact Information**
The Americas	English Japanese	Echelon Corporation Attn. Customer Support 550 Meridian Avenue San Jose, CA 95126 Phone (toll-free): 1-800-258-4LON (258-4566) Phone: +1-408-938-5200 Fax: +1-408-790-3801 *lonsupport@echelon.com*

Region	Languages Supported	Contact Information
Europe	English German French Italian	Echelon Europe Ltd. Suite 12 Building 6 Croxley Green Business Park Hatters Lane Watford Hertfordshire WD18 8YH United Kingdom Phone: +44 (0)1923 430200 Fax: +44 (0)1923 430300 *lonsupport@echelon.co.uk*
Japan	Japanese	Echelon Japan Holland Hills Mori Tower, 18F 5-11-2 Toranomon, Minato-ku Tokyo 105-0001 Japan Phone: +81-3-5733-3320 Fax: +81-3-5733-3321 *lonsupport@echelon.co.jp*
China	Chinese English	Echelon Greater China Rm. 1007-1008, IBM Tower Pacific Century Place 2A Gong Ti Bei Lu Chaoyang District Beijing 100027, China Phone: +86-10-6539-3750 Fax: +86-10-6539-3754 *lonsupport@echelon.com.cn*
Other Regions	English Japanese	Phone: +1-408-938-5200 Fax: +1-408-328-3801 *lonsupport@echelon.com*

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Connecting the FT 5000 EVB Hardware

This chapter describes how to power your FT 5000 EVB and connect it to a LONWORKS FT-10 channel and to your development computer.

Connection Instructions

To connect the FT 5000 EVB boards, follow these steps:

1. Unpack the equipment from the shipping carton.

   Note: The FT 5000 EVB boards are shipped in protective anti-static packaging. When assembling the FT 5000 EVB boards, the boards must not be subjected to high electrostatic potentials. Avoid touching the component pins, or any other metallic equipment on the evaluation boards.

2. Verify that all of the following hardware and software items are present.

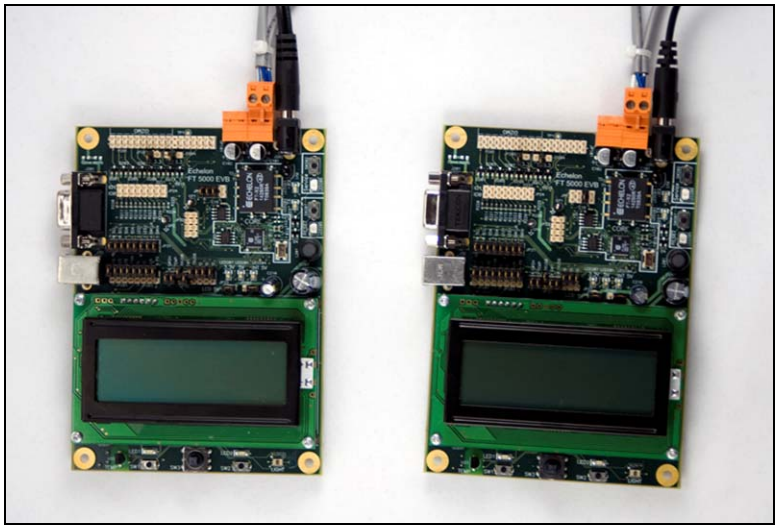
Item	Qty
FT 5000 EVB	2
Power supply (90–240VAC 50/60Hz) and power cords (US/Japan and Continental European)	2
Network cable and terminator	1
U10 USB Network Interface	1
USB Extension Cable	1
Development tool CD (NodeBuilder FX CD or Mini FX CD)	1
LonMaker CD (with NodeBuilder FX Development Tool only)	1
LonScanner CD (LNS Turbo Edition CD with NodeBuilder FX Development Tool; Trial Edition CD with Mini FX Evaluation Kit)	1

3. Install the software included with your development kit on your computer.

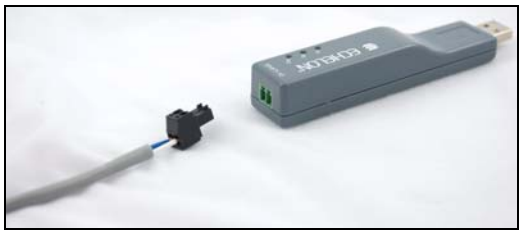
   - The NodeBuilder FX Development tool includes the NodeBuilder FX Development Tool CD, LonMaker Integration Tool CD, and the LonScanner Protocol Analyzer LNS Turbo Edition CD. See the *NodeBuilder FX User's Guide* for more information on installing the NodeBuilder software.
   - The Mini FX Evaluation Kit includes the Mini FX CD and LonScanner Protocol Analyzer Trial Edition CD. See the *Mini FX User's Guide* for more information on installing the Mini kit software.

4. Connect the barrel connectors of the included power supplies into the barrel jacks on the FT 5000 EVBs, connect the power supplies to the included power cords that are appropriate for you region (US/Japan or Continental European), and then plug the power cords into a power outlet. The power LEDs on the boards will activate when they are powered on.

5. Connect one of the orange network connectors on each FT 5000 EVB to the included network cable. Each board contains two orange network connectors (JP101, JP102) that are connected together. You can use these network connectors to daisy-chain multiple devices.



6. Use the included U10 USB Network Interface to attach your development computer to the TP/FT-10 channel. To do this, connect the black network connector on the network cable to the U10 USB Network Interface, and then plug the U10 USB Network Interface into an available USB port on your computer. You can use the included USB extension cable to help connect the USB 10 Network Interface to your development computer.



If this is the only LONWORKS interface installed on your computer, it will automatically use the default name **LON1**, and you can proceed directly to your software application and begin using the interface as **LON1**.

If you have another network interface installed on your computer, you can check the name used by the U10 USB Network Interface in the LONWORKS Interfaces application. You can also use this application to configure the buffer sizes and counts used by the U10 USB Network Interface. To open the LONWORKS Interfaces application, and check the name of the U10 USB Network Interface and configure it, click **Start** on the taskbar, click **Control Panel**, double-click **LonWorks Interfaces**, and then click the **USB** tab.

For more information on installing and using the U10 USB Network Interface, see the *LonWorks USB Network Interface User's Guide*.

Note: You can use a different network interface such as a PCC-10, PCLTA-20, or PCLTA-21; SLTA-10; remote network interface (*i*.LON SmartServer, *i*.LON 100 Internet Server, *i*.LON 600 LONWORKS-IP Server, or *i*.LON 10 Ethernet Adapter); or an IP-852 interface (*i*.LON SmartServer with IP-852 routing, *i*.LON 100 Internet Server with IP-852 routing, or *i*.LON 600 LONWORKS-IP Server).

To use a PCC-10, a PCLTA-20, or a PCLTA-21 as the network interface, you first need to configure it as a layer-2 or layer-5 network interface using the LONWORKS Plug 'n Play application (layer 2 or 5 if you are using the NodeBuilder tool [use layer 2 for best performance], or layer 5 if you are using the Mini kit). To do this, click **Start** on the taskbar, click **Control Panel**, and then double-click **LonWorks Plug 'n Play**. In the **Device Selected** box, select your network interface. In the **NI application** box, select **PCC10NSI** if you are using a PCC-10, or select **NSIPCLTA** if you are using a PCLTA-20 or a PCLTA-21. Click **OK** to save your changes and close the LonWorks Plug 'n Play application.

7. If you are using the NodeBuilder tool, complete the quick-start exercise in Chapter 3 of the *NodeBuilder FX User's Guide*. In the quick-start exercise, you will develop a device with one sensor and one actuator. The sensor is a simple sensor that monitors a push button on the FT 5000 EVB and toggles a network variable output each time the button is pressed. The actuator drives the state of an LED on the FT 5000 EVB based on the state of a network variable input.

   This quick-start guides you through all the steps of creating a device with the NodeBuilder tool, including creating the NodeBuilder project, the device template, the device interface, and the Neuron C code that implements your device interface; implementing device functionality in the Neuron C code; building and downloading the device application; testing the device in a LONWORKS network; and debugging the device application.

8. Run the Neuron C example applications included with the NodeBuilder FX tool or Mini FX Application on your FT 5000 EVBs. The NodeBuilder tool and Mini kit include three Neuron C example applications (*NcSimpleExample*, *NcSimpleIsiExample*, and *NcMultiSensorExample*) that you can use to test the I/O devices on the FT 5000 EVBs, and create simple managed and self-installed LONWORKS networks.

   The *NcMultiSensorExample* application is pre-loaded on the FT 5000 EVBs and runs in Interoperable Self-installation (ISI) mode by default. You install and connect this example application and the other examples using the LonMaker tool or using the ISI protocol. See the *FT 5000 EVB Examples Guide* for more information on using these example applications.

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FT 5000 EVB Hardware Details

This chapter describes the Neuron core, service pin and reset buttons and LEDs, I/O devices, and jumper settings on the FT 5000 EVB hardware.

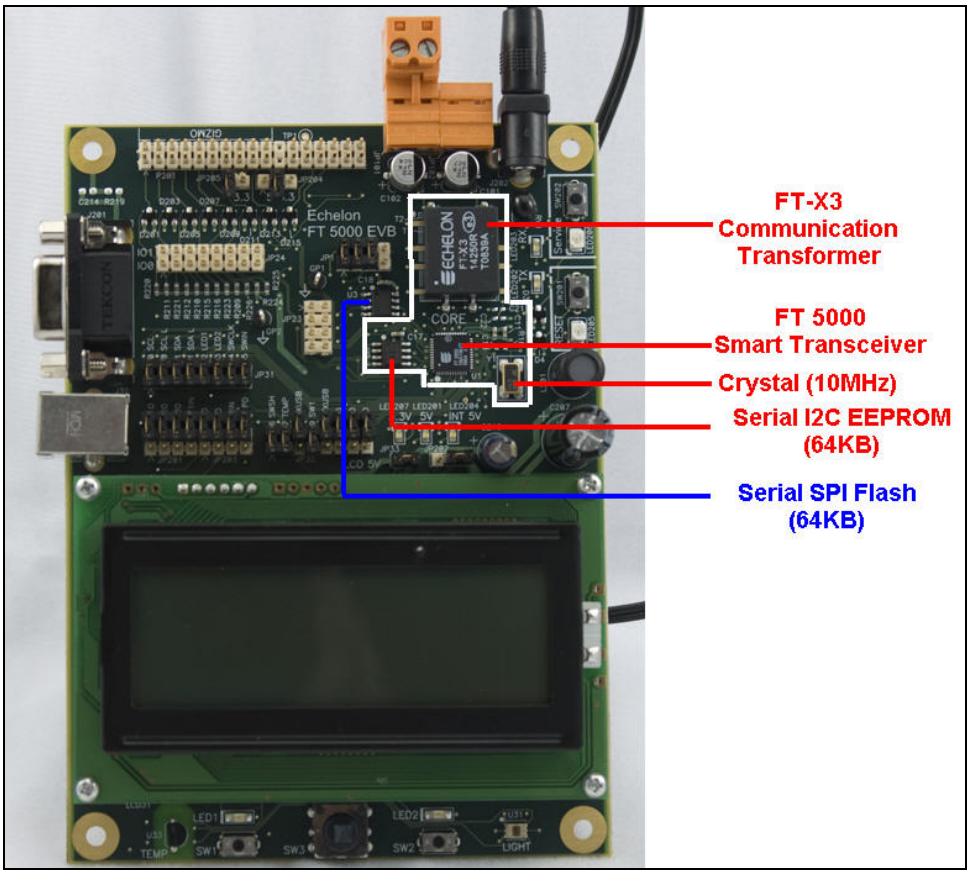
Introduction to FT 5000 EVB Hardware Details

The following sections provide additional details on the FT 5000 EVB hardware, including descriptions of the core circuit, I/O devices, service and reset buttons and LEDs, and jumper settings.

You can view schematics for the peripheral circuitry of the FT 5000 EVB. The peripheral circuitry is the section of the evaluation board external to the core circuit that is labeled **CORE**. To view the FT 5000 EVB schematics, click **Start**, point to **Programs**, point to **Echelon NodeBuilder** or **Echelon Mini**, point to **Documentation**, and then click **FT 5000 EVB Schematics**.

Neuron Core

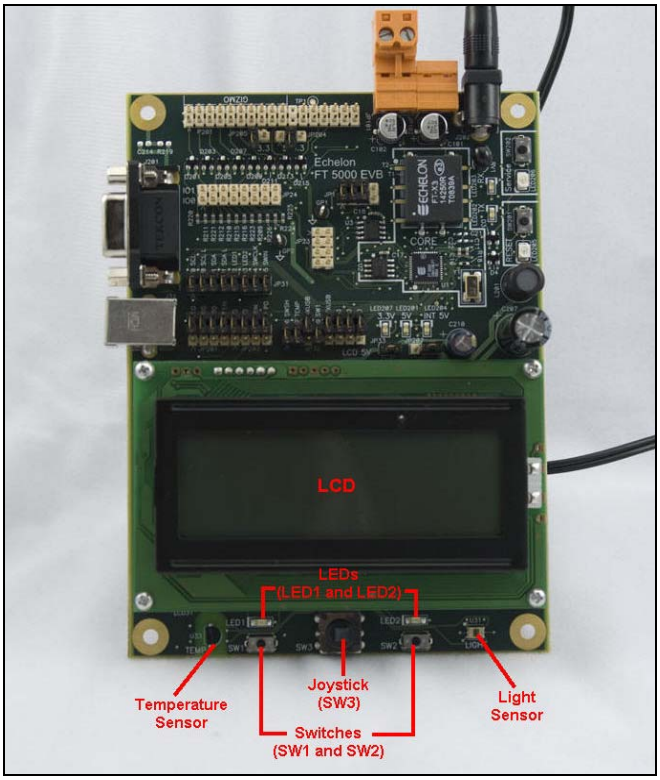
The Neuron core of the FT 5000 EVB includes a FT 5000 Smart Transceiver with an external 10 MHz crystal (you can adjust the system's internal clock speed from 5MHz to 80MHz), an FT-X3 communication transformer, and a 64KB external serial EEPROM non-volatile memory device. For details on the FT 5000 core, see the *Series 5000 Chip Data Book*.



In addition to the 64KB external serial EEPROM device in the Neuron core, the FT 5000 EVB includes a 64KB external serial flash device. These serial EEPROM and flash memory devices are used to store your application code, configuration data, and an upgradable system firmware image (the Series 5000 chips have no user-accessible on-chip non-volatile memory). The external serial EEPROM and flash memory devices communicate with the FT 5000 Smart Transceiver via the SPI or I^2C interfaces. The EEPROM device on the FT 5000 EVB uses the I^2C interface; the flash device uses the SPI interface. When a device is reset, the application code and configuration data are copied from the external non-volatile memory into the 64 KB internal on-chip RAM, and the device application is then executed.

I/O Devices

This section briefly describes the I/O devices included on the FT 5000 EVB, which consists of two push buttons, two LEDs, a temperature sensor, a light sensor, an LCD, and a joystick.



Push Button Switches

The FT 5000 EVB includes two push-button switches. The switches are labeled **SW1** and **SW2**. The **SW1** push button is connected to the **IO9** pin on the FT 5000 Smart Transceiver. The **SW2** push button is connected to a 74HC165 8-bit parallel-in/serial-out shift register, and data is shifted on the FT 5000 Smart Transceiver **IO4** (clock) and **IO5** (data) pins, with a latch strobe on **IO6** (active low to capture). The button readings must be debounced under application control.

LEDs

The FT 5000 EVB includes two blue LEDs that are labeled **LED1** and **LED2**. **LED1** is connected to the FT 5000 Smart Transceiver **IO2** pin when jumper pins 9-10 on JP31 are connected. **LED2** is connected to the **IO3** pin when jumper pins 11-12 on JP31 are connected.

Temperature Sensor

The FT 5000 EVB includes a temperature sensor based on a 1-Wire® Maxim Integrated Products digital thermometer (Part No. DS18S20). The thermometer uses the Touch I/O interface and is connected to the FT 5000 Smart Transceiver **IO7** pin. For more information about this temperature sensor, see its data book at *datasheets.maxim-ic.com/en/ds/DS18S20.pdf*.

Light-Level Sensor

The FT 5000 EVB includes a light-level sensor based on a Texas Advanced Optoelectronic Solutions® Light-To-Digital Converter (Part No. TSL2561). The light sensor is connected to the FT 5000 Smart Transceiver **IO0** and **IO1** pins (via the I^2C interface). The I^2C address for the light level sensor is 0x39. For more information about this light sensor, see its data book at *www.taosinc.com/getfile.aspx?type=press&file=tsl2560-e58.pdf*.

LCD

The FT 5000 EVB includes a 4 x 20 character LCD with a yellow-green backlight from Newhaven Display International Inc (Part No. NHD-0420D3Z-FL-GBW). The LCD is connected to the FT 5000 Smart Transceiver **IO0** and **IO1** pins (via the I^2C interface). For more information about this LCD, see its data book at *www.newhavendisplay.com/specs/NHD-0420D3Z-FL-GBW.pdf*.

Joystick

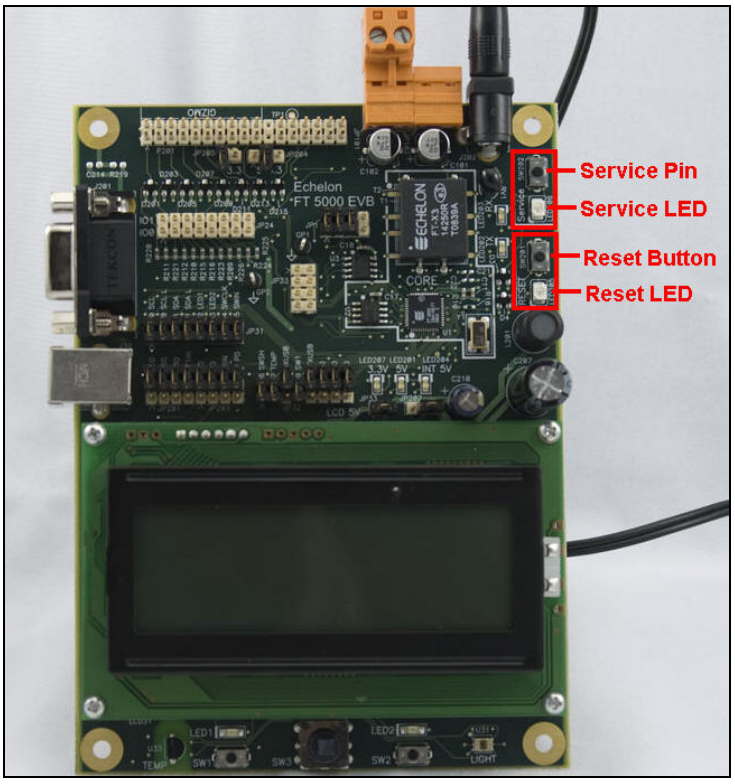
The FT 5000 EVB includes a 4-way joystick with center push button from ALPS® Electric Co (Part No. SKQUCAA010). The joystick is connected to a 74HC165 8-bit parallel-in/serial-out shift register, and data is shifted on the FT 5000 Smart Transceiver **IO4** (clock) and **IO5** (data) pins, with a latch strobe on **IO6** (active low to capture). For more information about this joystick, go to the ALPS Web site at *www3.alps.com/WebObjects/catalog.woa/E/HTML/Switch/Tact/SKQU/SKQUAAA010.html*.

Service Pin and Reset Buttons and LEDs

The FT 5000 EVB includes a Service button and a Reset button that have corresponding LEDs.

You can use the Service Pin button to send a service pin message from an evaluation board. You will use the Service Pin button when you install the device with the LonMaker tool or Mini kit, as described in the *FT 5000 EVB Examples Guide*. You can use the Service LED to identify the device state (applicationless, unconfigured, configured), and you can also use it to provide additional application-specific information.

You can use the Reset button to reset the FT 5000 EVB when an application running on the board appears to have failed, or to test the reset behavior of an application loaded on the board. The Reset LED illuminates when you press the Reset button, or the FT 5000 Smart Transceiver is reset.



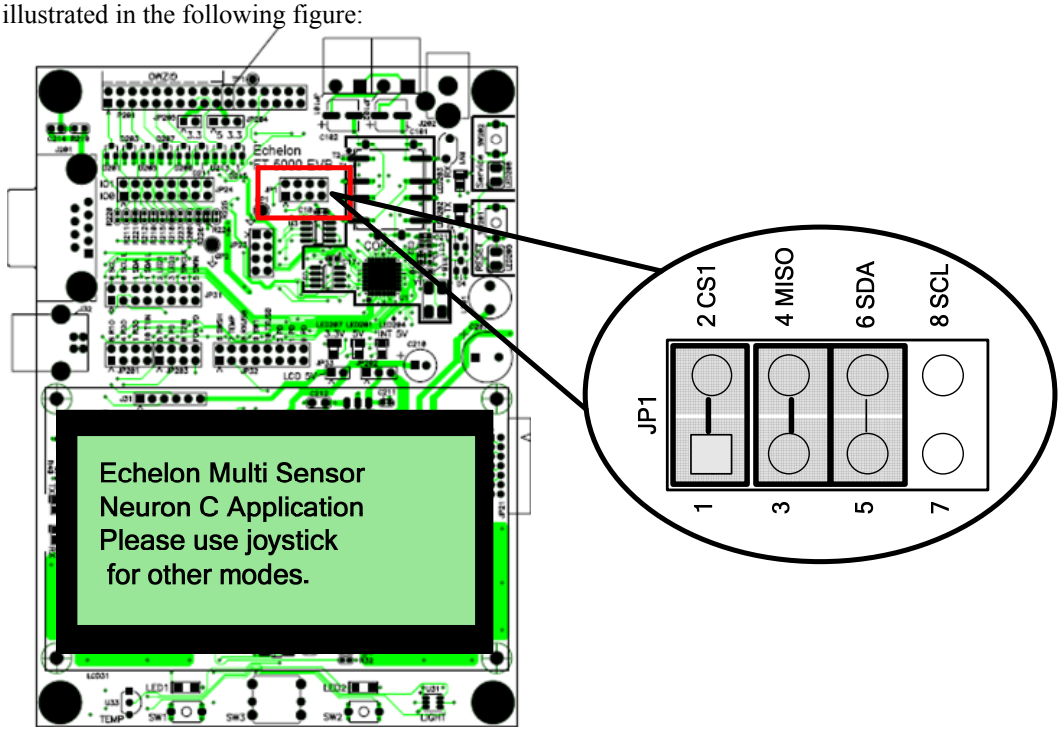
Jumper Settings

The FT 5000 EVB contains multiple sets of jumpers that you can use to configure the board. The following sections display the locations of the jumpers on the FT 5000 EVB, show the default settings of the jumpers, and describe how to use the jumpers to enable and disable various connections on the board.

External Serial Non-Volatile Memory Device Connection (JP1)

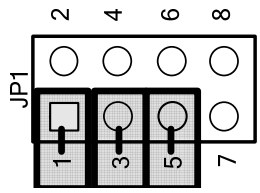
This set of jumpers is used to connect an external serial non-volatile memory device (EEPROM or flash) to the FT 5000 Smart Transceiver on the FT 5000 EVB. The FT 5000 Smart Transceiver uses external serial memory (EEPROM or flash) to store your application code, configuration data, and an upgradable system firmware image (the FT 5000 Smart Transceiver has no user-accessible on-chip non-volatile memory). When a device is reset, the application code and configuration data are copied from the external non-volatile memory into the internal on-chip RAM, and the device application is then executed.

The external serial non-volatile memory connection on the FT 5000 EVB is enabled by default, as illustrated in the following figure:

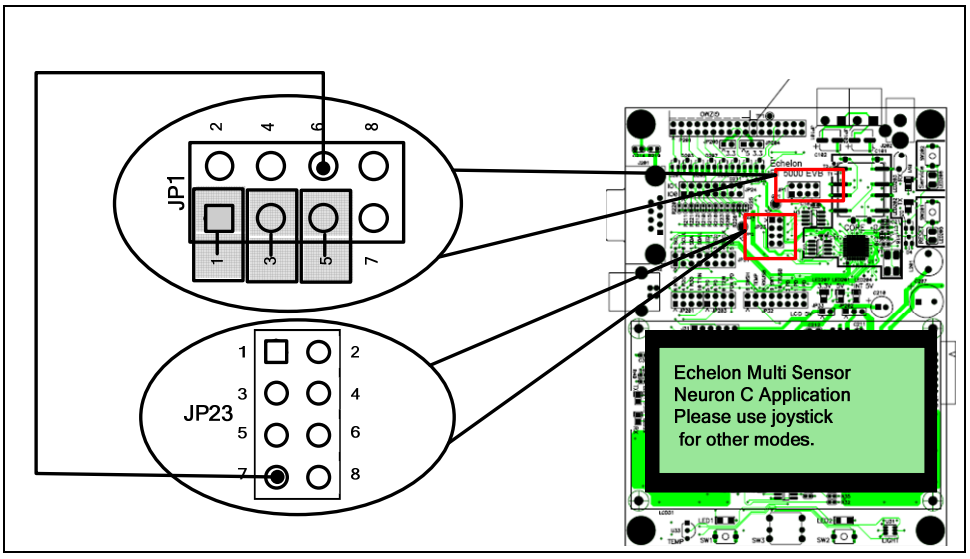


If you need to recover the device running on the FT 5000 EVB because it has failed, you can disconnect the external serial non-volatile memory from the FT 5000 EVB and then reload the application image file. To do this, follow these steps:

1. Remove jumpers 1-2, 3-4, and 5-6 to disconnect the external serial non-volatile memory from the FT 5000 EVB.



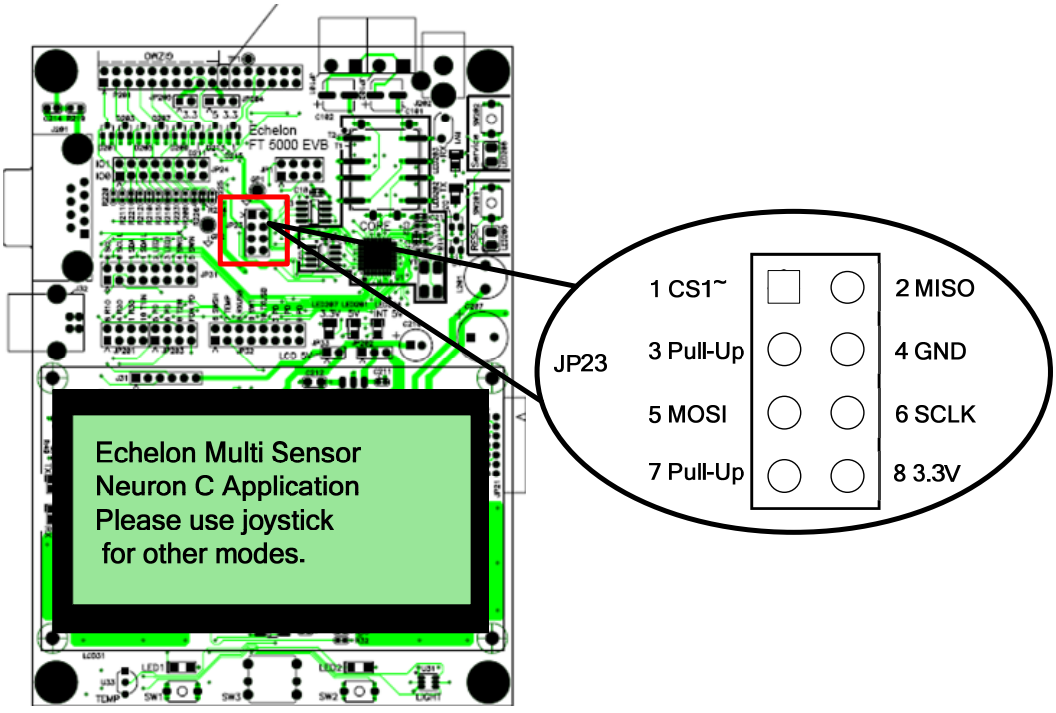
2. Ground pin 6 on JP1. To do this, connect pin 6 on JP1 to pin 7 on JP23.



3. Press the Reset button.
4. Re-connect the jumpers.
5. Reload the rebuilt application image file for the device running on the FT 5000 EVB.

Flash ICE Connection (JP23)

This header can be used to connect a SPI interface flash ICE, which you can use instead of the external serial non-volatile memory flash device on the FT 5000 EVB. When you use a flash ICE on JP23, you must disconnect the serial flash device on the FT 5000 EVB by disconnecting jumpers 1-2 and 3-4 on JP1 [see *External Serial Non-Volatile Memory Device Connection (JP1)*) for more information]. By default, this header is open as illustrated in the following figure:



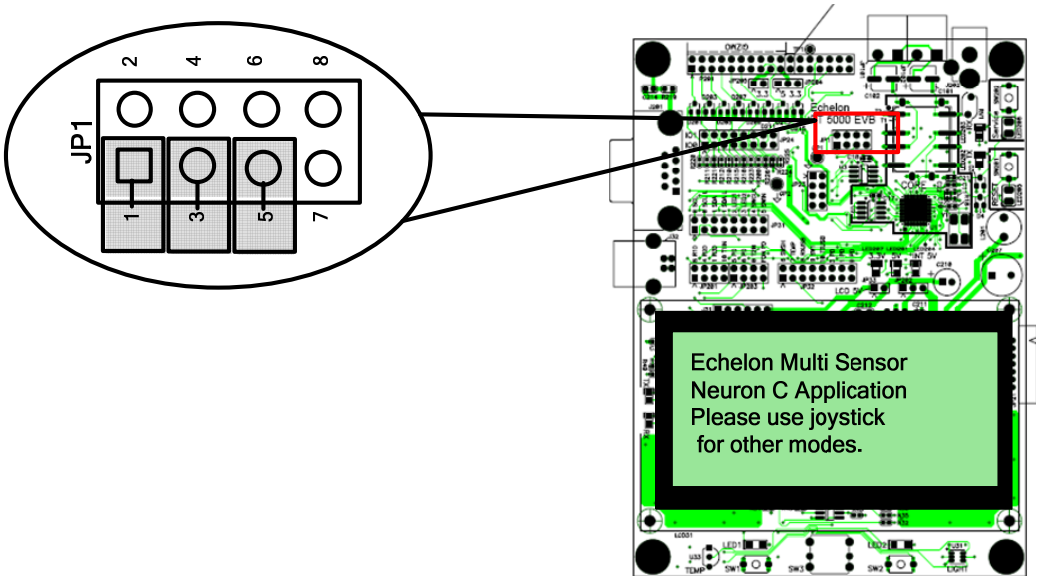
Performing In-Circuit Programming of External Serial Memory Devices

The JP23 header along with the jumpers on JP1 provides support for third-party in-circuit device programmers, which you can use to update the data in the external serial EEPROM and flash devices used by the FT 5000 Smart Transceiver on the FT 5000 EVB. This provides an alternative to loading application images into these external serial memory devices over the TP/FT-10 network. Note that the NodeBuilder tool and Mini kit only support downloading application images over a LONWORKS network; they do not directly support loading application images through third-party device programmers or memory ICE. Echelon has tested a third-party in-circuit programmer, the Aardvark™ I2C/SPI USB Host Adapter from TotalPhase™, as described later in this section.

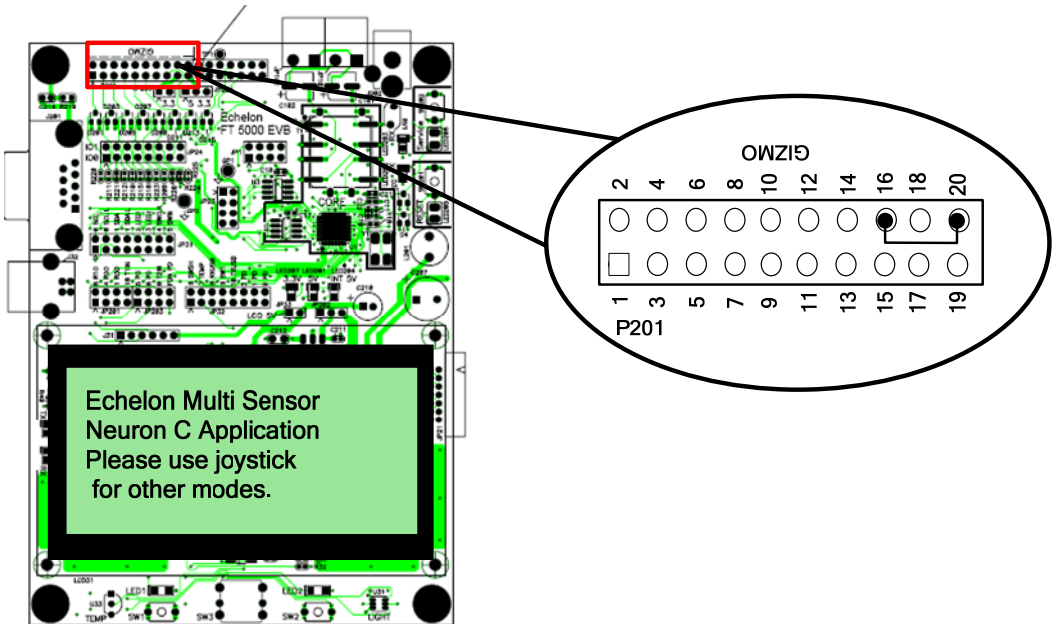
To perform in-circuit programming of the external serial EEPROM and flash memory devices on the FT 5000 EVB, you use the devices' I2C and SPI interfaces. You must use the I^2C interface to program the EEPROM device on the FT 5000 EVB, and you use the SPI interface to program flash device on the FT 5000 EVB.

To perform in-circuit programming of the external serial EEPROM and flash memory devices on the FT 5000 EVB, follow these steps:

1. Power off the FT 5000 EVB.
2. Remove jumpers 1-2, 3-4, and 5-6 from JP1 to disconnect the external serial non-volatile memory from the FT 5000 EVB.



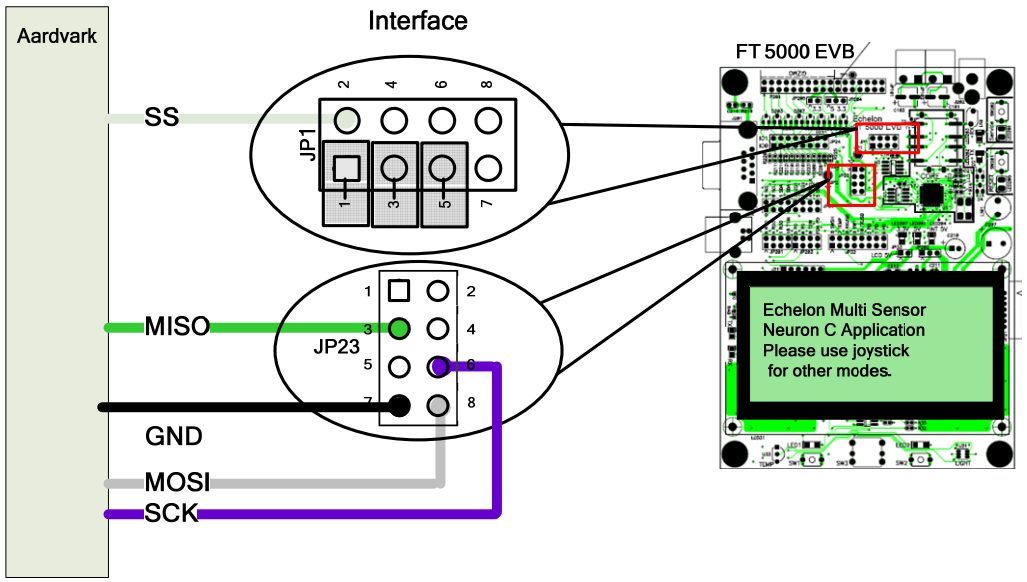
   - If you are programming the serial flash device on the FT 5000 EVB, hang the shunt off pin 1 because you will need to use pin 2.
   - If you are programming the serial EEPROM device on the FT 5000 EVB, hang the shunt off pin 5 because you will need to use pin 6.
3. Power on the FT 5000 EVB.
4. Ground the Reset pin on the FT 5000 EVB. To do this, connect pins 16 and 20 on the Gizmo I/O Connector on the FT 5000 EVB. This holds the RST~ line low, places the I^2C and SPI interfaces into a high-impedance state, and idles the Neuron chip. This eliminates the possibility of the Aardvark programmer conflicting with the Neuron chip when the Aardvark is accessing the I^2C and SPI interfaces.



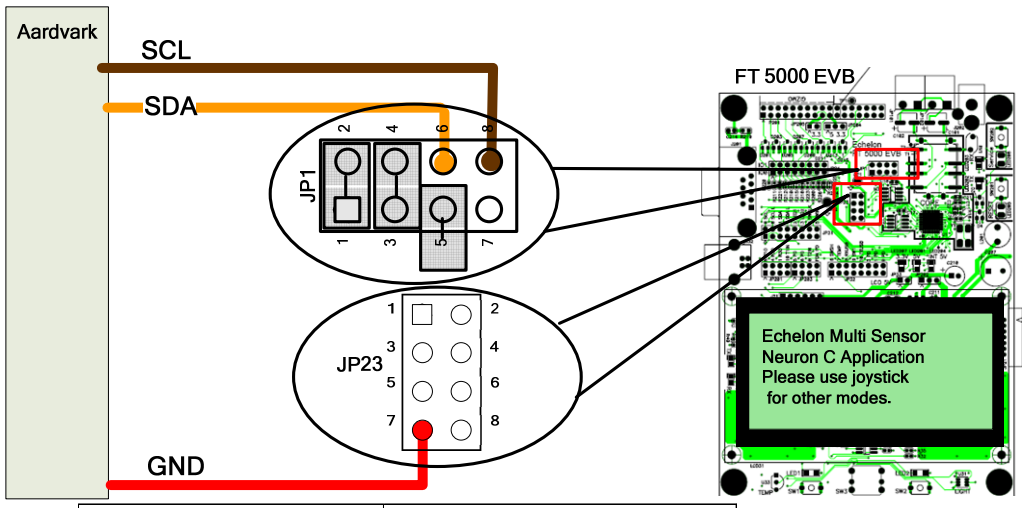
5. Connect your external serial EEPROM or flash memory device to a compatible device programmer. Echelon has tested the Aardvark™ I2C/SPI USB Host Adapter from TotalPhase™ (Part No. TP240141), with the 10-pin split cable from TotalPhase (Part No. TP240212), as one method for creating this connection (for more information on this adapter, go to the TotalPhase Web site at *www.totalphase.com/products/aardvark_i2cspi/*). The Aardvark has six signal lines: two for the I^2C interface (SDA and SCL), and four for the SPI interface (MOSI, MISO, SCL, and SS).

   The I^2C/SPI interface used by the FT 5000 Smart Transceiver has some pins that are multifunctional; therefore you must disconnect the external serial memory device using JP1 [see *External Serial Non-Volatile Memory Device Connection (JP1)* for more information] and program each memory device individually. After you disconnect the external serial memory device, you can use flying leads provided by the 10-pin split cable to connect the Aardvark programmer to the external serial EEPROM or flash device.

   The following figures display the connections you need to make between the Aardvark programmer and the external memory devices on the FT 5000 EVB for the in-circuit programming over the SPI and I^2C interfaces.



Aardvark Programmer Lead Connector	FT 5000 EVB SPI Interface (Serial Flash)
SS (White)	JP1, pin 2
MISO (Green)	JP23, pin 3
SCK (Purple)	JP23, pin 6
GND (Black)	JP23, pin 7
MOSI (Grey)	JP23, pin 8



Aardvark Programmer Lead Connector	FT 5000 EVB I²C Interface (Serial EEPROM)
SCL (Brown)	JP1, pin 8
SDA (Orange)	JP1, pin 6
GND (Red)	JP23, pin 7

6. Program your external serial EEPROM or flash memory device using an application such as the Flash Center Memory Programmer from TotalPhase. You can download the Flash Center Memory Programmer for free from the TotalPhase Web site at *www.totalphase.com/products/flash_center/#downloads*.

   If you use the Flash Center Memory Programmer software, you also need to change the extension of the **.NME** and **.NMF** application image files generated by the NodeBuilder tool to **.HEX**. This is because the Flash Center Memory Programmer requires hex files that have **.HEX** extensions. Also note that if you are programming the external serial flash device on the FT 5000 EVB, you must also program the external serial EEPROM device on the board with the configuration data in the **.NME** file.

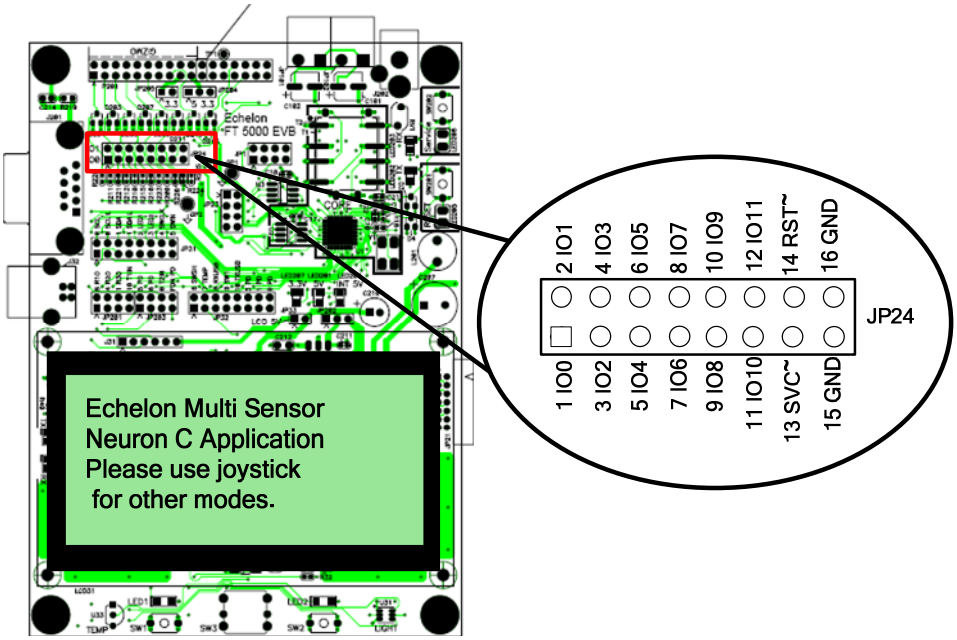
7. Remove the connection from the in-circuit device programmer.
8. Power off the FT 5000 EVB.
9. Re-connect the pins on JP1.
10. Remove ground from the Reset pin by removing the connection between pins 16 and 20 on the Gizmo I/O Connector (see step 4).
11. Power on the FT 5000 EVB.

For more information on performing in-circuit programming of Series 5000 chips, see Chapter 8 of the *NodeBuilder FX User's Guide*.

I/O Line Access (JP24)

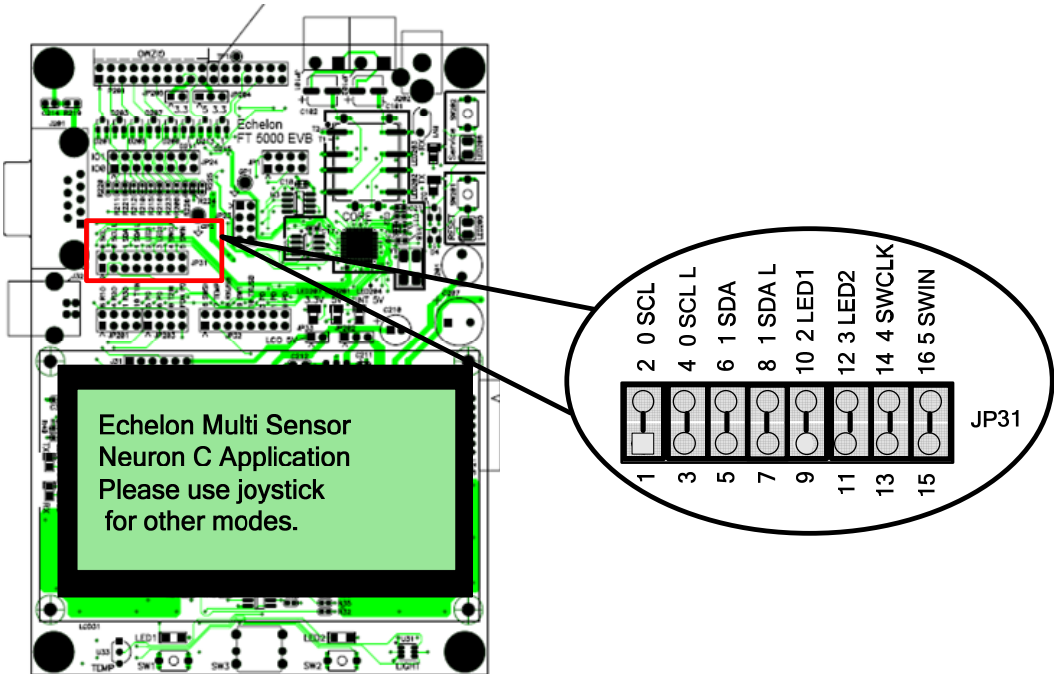
This header provides access to the 12 I/O, service, and reset lines of the FT 5000 Smart Transceiver on the FT 5000 EVB, and it provides a ground reference for instrumentation with a scope or logic analyzer. Although JP24 can be used to wire other I/O devices, you should use the Gizmo Header (P201) to do this because it can also provide power for other devices (see *I/O Connector* later in this

chapter for more information about the Gizmo header). By default, this header is open as illustrated in the following figure:



LCD, Light Sensor, LEDs, Switch, and Joystick Connections (JP31)

This set of jumpers is used to connect the LCD, Light Sensor, LEDs, and the shift register for the SW2 push button (lines 1 and 2 of three) and joystick (SW3) on the FT 5000 EVB. The 13-14 and 15-16 pins on JP31 are used with the 1-2 pins on JP32 for bitshift I/O with the SW2 push button and the Joystick. By default, all the jumpers are connected, as illustrated in the figure below. You can use an I/O line for other I/O functions by disconnecting the jumper that connects the I/O line to an I/O device on the FT 5000 EVB.

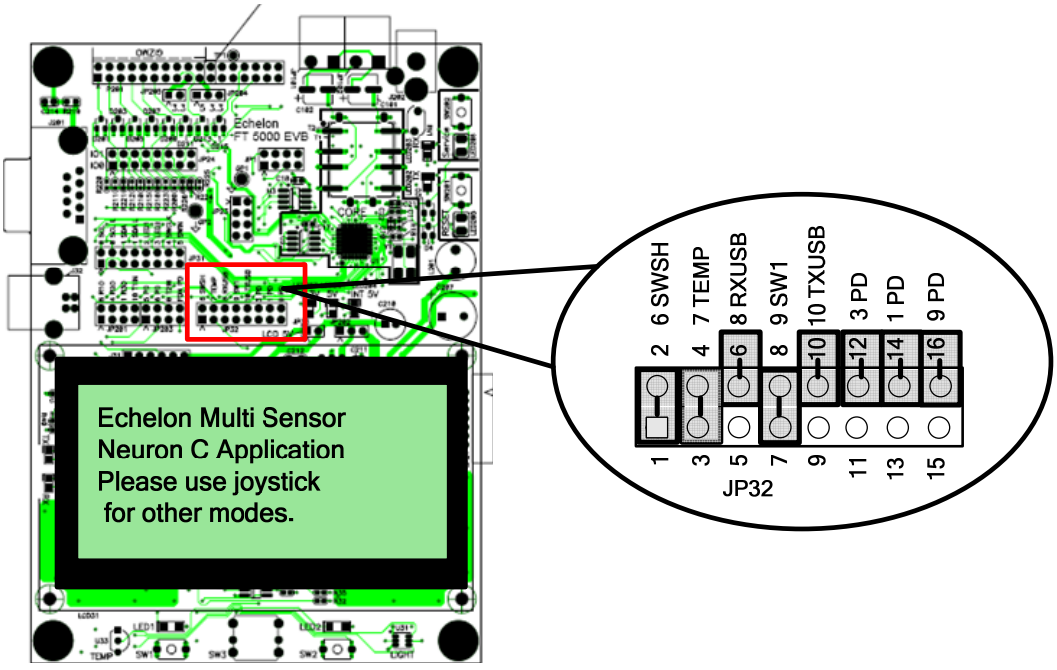


The following table lists the I/O pins and I/O devices associated with the jumpers on JP31.

Jumper	I/O Pin	I/O Device/Functionality on FT 5000 EVB
1-2	IO0	SCL LCD
3-4	IO0	SCL L Light sensor
5-6	IO1	SDA LCD
7-8	IO1	SDA L Light sensor
9-10	IO2	LED1
11-12	IO3	LED2
13-14	IO4	SWCLK (Shift register clock for SW2 and Joystick)
15-16	IO5	SWIN (Shift register data in for SW2 and Joystick)

Switch, Joystick, Temperature Sensor, and USB Connections (JP32)

This set of jumpers is used to connect the shift register for the SW2 push button (line 3 of three) and joystick (SW3), temperature sensor, USB interface, SW1 push button, and I/O pull-downs on the FT 5000 EVB. The 1-2 pins on JP32 are used with the 13-14 and 15-16 pins on JP31 for bitshift I/O with the SW2 push button and the Joystick. By default, the switch and temperature sensor jumpers are connected, and the USB interface jumpers are disconnected as illustrated in the figure below. You can use an I/O line for other I/O functions by disconnecting the jumper that connects the I/O line to an I/O device on the FT 5000 EVB.



The following table lists the IO pins and IO devices associated with the jumpers on JP32.

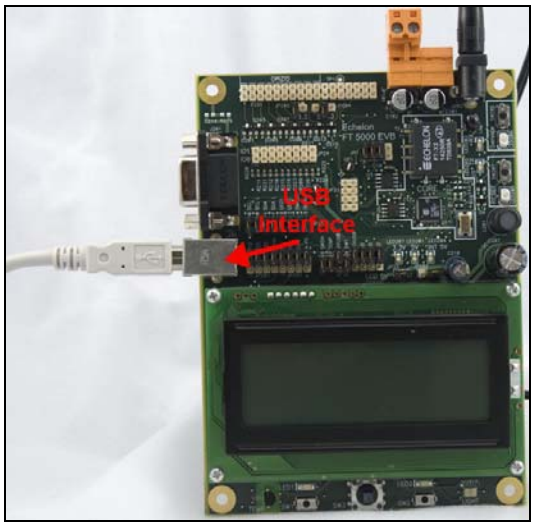
Jumper	I/O Pin	IO Device/Functionality on FT 5000 EVB
1-2	IO6	SWSH (Shift register latch strobe for SW2 and Joystick)
3-4	IO7	TEMP (temperature sensor)
5-6	IO8	RXUSB (USB receive)
7-8	IO9	SW1
9-10	IO10	TXUSB (USB transmit)
11-12	IO3	PD (connects a 499 Ω pull-down resistor to IO3)
13-14	IO1	PD (connects a 499 Ω pull-down resistor to IO1)
15-16	IO9	PD (connects a 499 Ω pull-down resistor to IO9)

Connecting the USB Interface

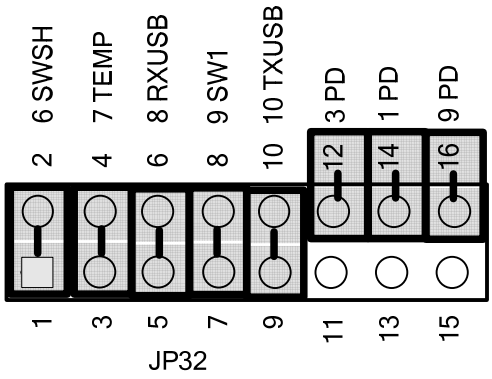
You can enable serial communication without handshake lines and then connect your FT 5000 EVB to your development computer via a USB interface. This lets you perform application-level debugging, tests, or diagnosis. Once you create this USB connection, you can output debugging and tracing information from the device application running on your FT 5000 EVB to a terminal emulation program on your computer such as Windows HyperTerminal.

To create the USB connection for performing application-level debugging, follow these steps:

1. Connect the type A connector on a USB Type A to Type B Cable to an available USB port on your computer, and then connect the type B connector to the USB interface on the left side of the FT 5000 EVB.



2. Connect jumpers 5-6 (IO8 RXUSB) and 9-10 (IO10 TXUSB) on JP32. This connects the **IO8** and **IO10** pins on the FT 5000 Smart Transceiver to the USB communications interface on the board. **IO10** is connected to pin 5 RXD as a serial data output to the USB interface, and **IO8** is connected to pin 1 TXD as a serial data input from the USB interface.



3. Run Windows HyperTerminal or another terminal emulation program on your computer to monitor the serial output. Configure your terminal emulation program for direct connection to your serial port using the serial parameters specified in the device application. See the next section, *Configuring a Device Application for Serial Debugging*, for how to configure your device application for application-level debugging.

   Note: You can use only one of the EIA-232 or USB interfaces on the FT 5000 EVB at a time.

For information on implementing serial I/O, see the *EIA-232C Serial Interfacing with the Neuron Chip* engineering bulletin (005-0008-01D).

Configuring a Device Application for Serial Debugging

If you are connecting the USB or EIA-232 interface to perform application-level debugging, you must declare an SCI I/O object in your device application that specifies the communication parameters to be used by Windows HyperTerminal or another terminal emulation program on your computer to monitor the serial output. In addition, you must specify code in your device application that outputs data to the interface.

For example, the example applications included with the FT 5000 EVB include the following code that declares an SCI I/O object in the **FT5000EvalBoard.h** file specifying a baud rate of 9600 bps (see the *SCI (UART) Input/Output* section in Chapter 4 of the *I/O Model Reference* for more information on creating SCI I/O objects):

```
#ifdef FT5000EVALBOARD_USE_SERIALDEBUG
#include <io_types.h>
#pragma specify_io_clock "10 MHz"
IO_8 sci baud(SCI_9600) ioSerialDebug;
void EvalBoardPrintDebug(char* string);
#endif // FT5000EVALBOARD_USE_SERIALDEBUG
```

The **FT5000EvalBoard.nc** file in the example applications includes a `EvalBoardPrintDebug()` function. This function calls the built-in **io_out_request ( )** function, which establishes and initiates the output operation over the serial interface [see the *Neuron C Reference Guide* for more information on the **io_out_request ( )** function]. The declaration of the `EvalBoardPrintDebug()` function is as follows:

```
#ifdef FT5000EVALBOARD_USE_SERIALDEBUG

void EvalBoardPrintDebug(char *string)
{
      io_out_request(ioSerialDebug, string, (unsigned int) strlen(string));
      while (!io_out_ready(ioSerialDebug));
}

#endif // FT5000EVALBOARD_USE_SERIALDEBUG
```

The **Switch.nc** and **LED.nc** files in the example device applications store various values in strings and then call the `EvalBoardPrintDebug()` function to output the strings to the serial interface.

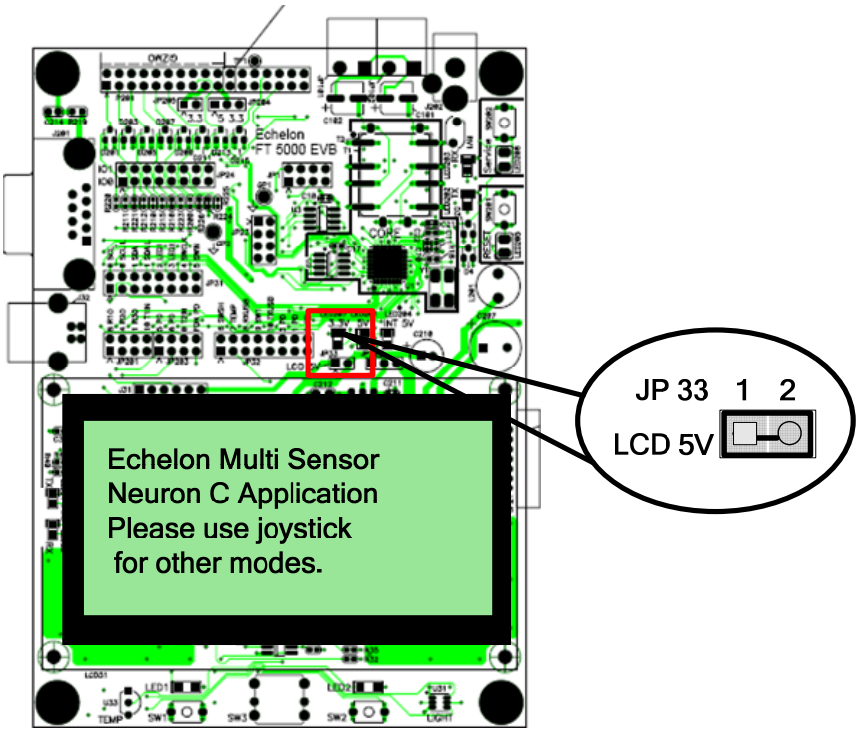
```
if (bOn) {
        // Toggle the state of the switch
        nvoSwitch[0].state ^= 1;
        nvoSwitch[0].value = nvoSwitch[0].state ? 200u : 0;

        // Copy to feedback NV
        nviSwitchFb[0] = nvoSwitch[0];
         (void)strcpy(string, "Switch 1 pressed\r\n");
        EvalBoardPrintDebug(string);
    }
    else {
        (void)strcpy(string, "Switch 1 released\r\n");
        EvalBoardPrintDebug(string);
    }
```

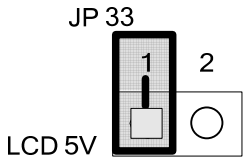
You can view the source code for the FT 5000 EVB example device applications by clicking **Start**, pointing to **Programs**, pointing to **Echelon NodeBuilder** or **Echelon Mini**, pointing to **Examples,** pointing to **FT5000 EVB**, clicking the desired **Example Source Code** folder, and then clicking the Source folder. See the *FT 5000 EVB Examples Guide* for more information on the example device applications you can run on your FT 5000 EVB.

LCD 5V Power (JP33)

This jumper provides 5V power for the LCD on the FT 5000 EVB. If you are using the FT 5000 EVB example applications or you are developing a device application that uses the LCD, leave this jumper connected as illustrated in the following figure:

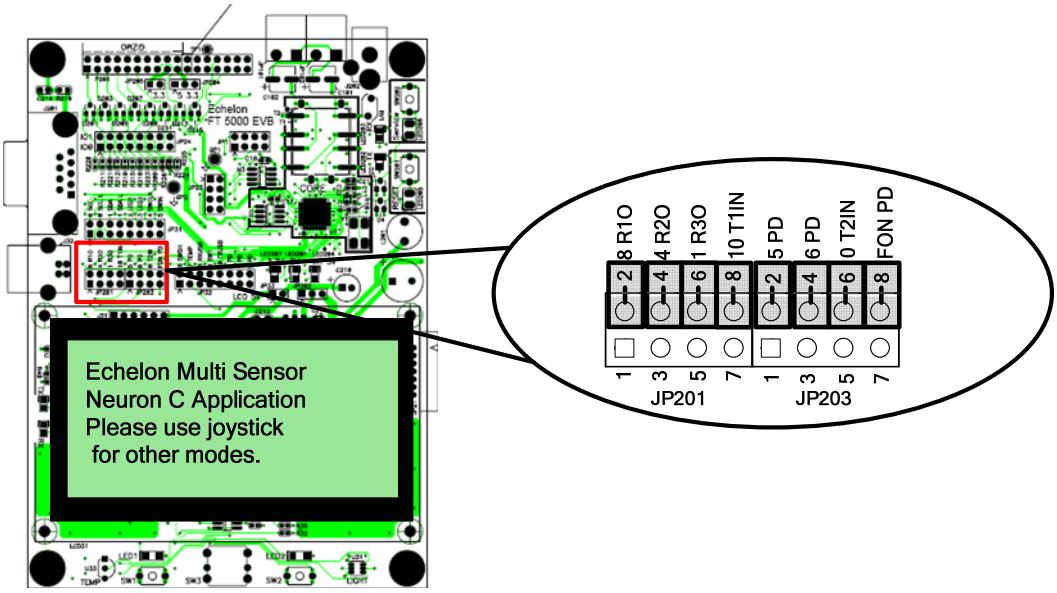


If you are not using the LCD and you want to reduce the power consumption of the FT 5000 EVB, you can disconnect the LCD's power as illustrated in the following figure (you can hang the shunt off pin 1 or pin 2):



EIA-232 Interface (JP201and JP203)

This set of jumpers enables the EIA-232 and ShortStack interfaces on the FT 5000 EVB. These jumpers are disconnected by default (these interface are disabled) as illustrated in the following figure:



You can enable the EIA-232 interface without and with handshake lines. You can enable the EIA-232 interface without handshake lines to connect your FT 5000 EVB to your development computer for performing application-level debugging. You can enable the EIA-232 interface with handshake lines to connect your FT 5000 EVB to a development computer for performing application-level debugging or to connect it to other microcontrollers.

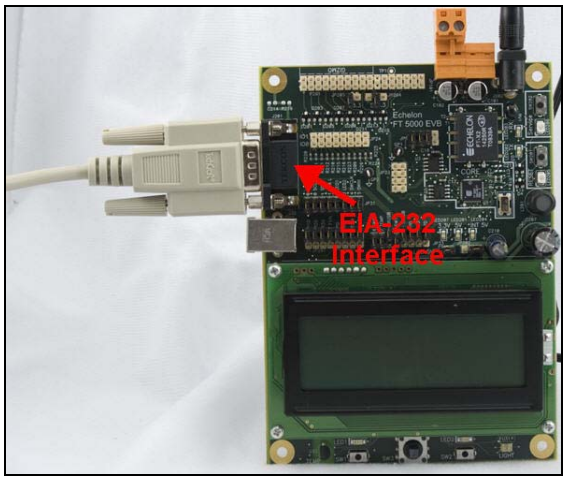
Note: When you connect the EIA-232 interface, you need to disconnect the same I/O signals from the on-board I/O devices on jumpers JP31 and JP32.

The following sections describe how to enable the EIA-232 interface without and with handshake lines.

Connecting the EIA-232 Interface (without handshake lines)

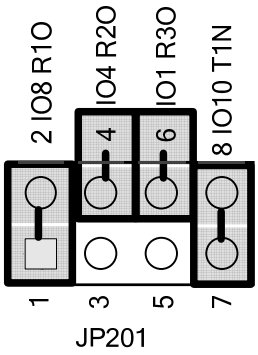
To create the EIA-232 connection without handshake lines, follow these steps:

1. Connect the male end of a DB9 Male-Female Serial Extension Cable to the DB9 socket on the upper left-hand side of the FT 5000 EVB, and then connect the female end to one of the COM ports (typically COM1 or COM2) on your computer.



2. Verify that jumpers 5-6 (RXUSB) and 9-10 (TXUSB) on JP32 for the USB interface are disconnected. This is because you can only use one of the EIA-232 and USB interfaces on the FT 5000 EVB at a time. See *Switch, Temperature Sensor, Joystick, and USB Connections (JP32)* earlier in this chapter for more information.

3. Connect jumpers 1-2 (IO8 R10) and 7-8 (IO10 T1IN) on JP201. This connects the **IO8** and **IO10** pins on the FT 5000 Smart Transceiver to the EIA-232 communications interface on the board. **IO10** is connected to pin 12 as a serial data output (TX) on the EIA-232 interface, and **IO8** is connected to pin 14 as a serial data input (RX).



4. Run Windows HyperTerminal or another terminal emulation program on your computer to monitor the serial output. Configure your terminal emulation program for direct connection to your serial port using the serial parameters specified in the device application. See *Configuring a Device Application for Serial Debugging* earlier in this chapter for more information on configuring your device application for application-level debugging.

   Note: You can use only one of the EIA-232 or USB interfaces on the FT 5000 EVB at a time.

For information on implementing serial I/O, see the *EIA-232C Serial Interfacing with the Neuron Chip* engineering bulletin (005-0008-01D).

Connecting the EIA-232 Interface (with handshake lines)

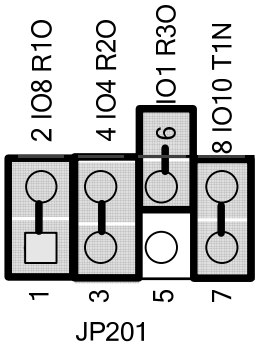
You can enable the EIA-232 interface with handshake lines to connect your FT 5000 EVB to a development computer for performing application-level debugging or to connect it to other microcontrollers.

To create the EIA-232 connection with handshake lines, follow these steps:

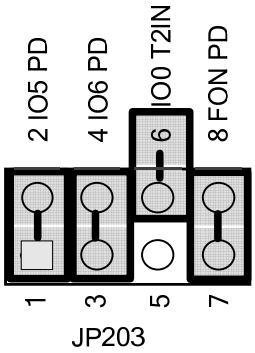
1. If you are connecting your FT 5000 EVB to a development computer for performing application-level debugging, follow step 1 in the previous section.

2. Verify that jumpers 5-6 (RXUSB) and 9-10 (TXUSB) on JP32 for the USB interface are disconnected. This is because you can only use one of the EIA-232 and USB interfaces on the FT 5000 EVB at a time. See *Switch, Temperature Sensor, Joystick, and USB Connections (JP32)* earlier in this chapter for more information.

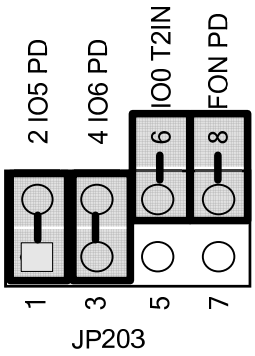
3. Connect jumpers 1-2 (IO8 R10), 3-4 (IO4 R20), and 7-8 (IO10 T1IN) on JP201. This connects the **IO4**, **IO8**, and **IO10** pins on the FT 5000 Smart Transceiver to the EIA-232 communications interface on the board. **IO10** is connected to pin 12 on the EIA-232 connector as a serial data output (TX), **IO8** is connected to pin 14 as a serial data input (RX), and **IO4** is connected to pin 7 as a request to send input (RTS).



4. Connect jumpers 5-6 (IO0 T2IN) on JP203 to route the IO0 signal through the EIA-232 interface level shifter. This signal is connected to the CTS~ signal on the EIA-232 interface.
You can connect the RTS~ signal from the EIA-232 interface to the IO4 input on the FT 5000 Smart Transceiver using jumper 3-4 on JP201.



5. In addition, you can connect jumpers 7-8 (FON PD) on JP 203 to prevent the EIA-232 level shifter from entering sleep mode during idle periods. See *Connecting the ShortStack Interface* later in this chapter for the locations of these jumpers.



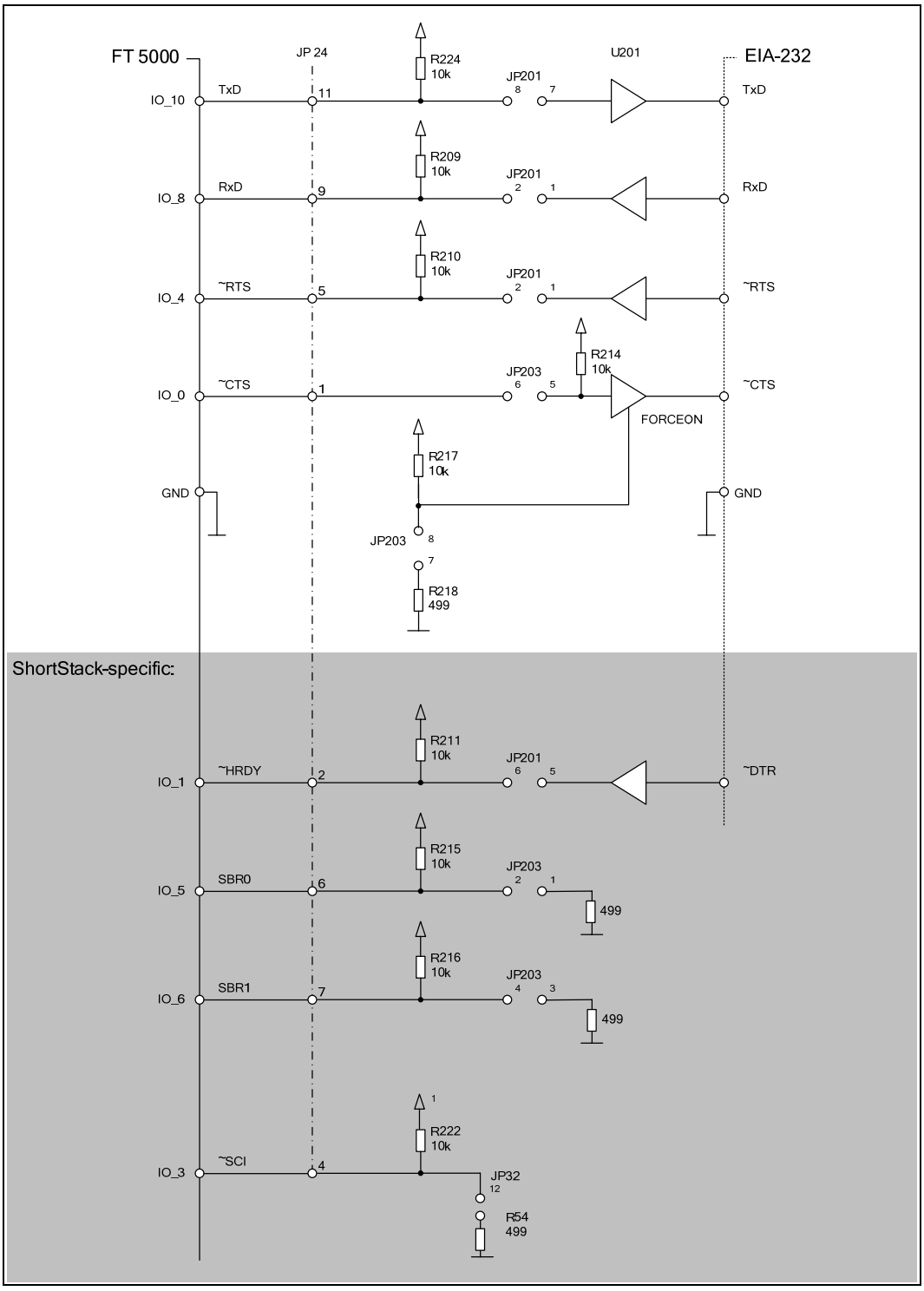
6. If you are using the EIA-232 interface to connect your FT 5000 EVB to ShortStack host processor, or if you planning to connect a microcontroller via an SCI connection but without the EIA-232 level shifter, see *Connecting the ShortStack Interface* for more information on how to do this.

Connecting the ShortStack Interface

You can use JP201, JP203, JP24 and JP32 jumpers to control connections to a micro controller, such as a ShortStack host processor, without or without the EIA-232 level shifter. Jumpers and signal routing options are provided to support ShortStack Micro Servers on the FT 5000 EVB. The ShortStack Micro Server provides a simple way to add LONWORKS networking to new or existing smart devices. For more information on the ShortStack Micro Server, see the *ShortStack User's Guide*. The ShortStack Micro Server and user's guide is available as a free download from *www.echelon.com/shortstack*.

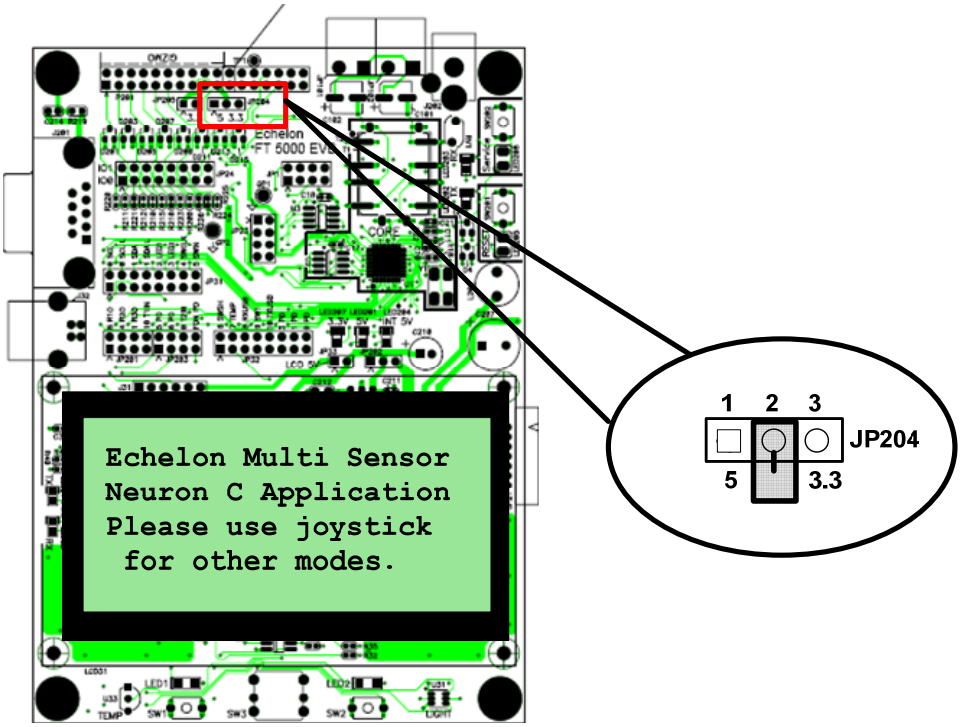
Note: You must use the ShortStack FX Developer's Kit to develop ShortStack applications for the FT 5000 EVB. Earlier versions of the kit do not support the FT 5000 EVB.

The following simplified diagram illustrates the signal routing and configuration options for ShortStack link layer connections (or other plain SCI connections) provided with the FT 5000 EVB. Note that when you connect the EIA-232 interface, you need to disconnect the same I/O signals from the on-board I/O devices on jumpers JP31 and JP32.

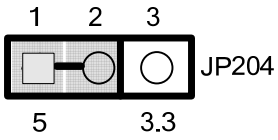

FT 5000
JP 24
U201
EIA-232
IO_10
TxD
11
R224
10k
JP201
8
7
TxD
IO_8
RxD
9
R209
10k
JP201
2
1
RxD
IO_4
~RTS
5
R210
10k
JP201
2
1
~RTS
R214
10k
IO_0
~CTS
1
JP203
6
5
~CTS
FORCEON
R217
10k
GND
GND
JP203
8
7
R218
499
ShortStack-specific:
IO_1
~HRDY
2
R211
10k
JP201
6
5
~DTR
IO_5
SBR0
6
R215
10k
JP203
2
1
499
IO_6
SBR1
7
R216
10k
JP203
4
3
499
1
R222
10k
IO_3
~SCI
4
JP32
12
R54
499

Gizmo 5V or 3.3V Power Select (JP204)

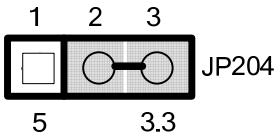
This jumper connects 5V or 3.3V power to the Gizmo connector (P201, pin 19) on the FT 5000 EVB. You can use the Gizmo connector for the external use of the 12 I/O pins of the FT 5000 Smart Transceiver and the power supply (5V or 3.3V). The 5V and 3.3V supplies are disconnected from JP201 by default as illustrated in the following figure (the shunt hangs off pin 2):



To connect 5V power to the Gizmo connector (P201, pin 19), connect the shunt between pins 1 and 2 as demonstrated in the following figure:

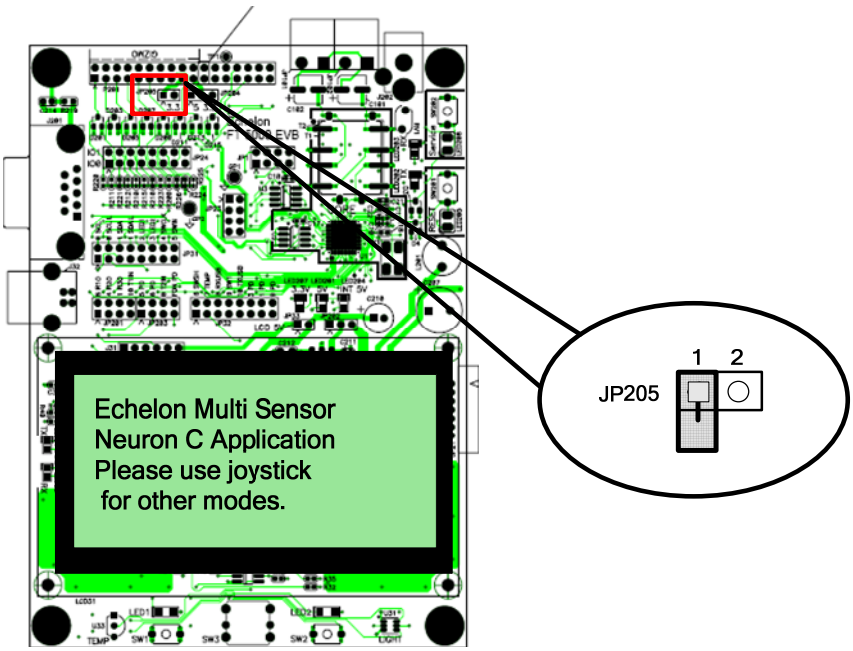


To connect 3.3V power to the Gizmo connector (P201, pin 19), connect the shunt between pins 2 and 3 as demonstrated in the following figure:

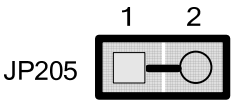


Gizmo 3.3V Power (JP205)

This jumper connects 3.3V power to the Gizmo connector (P201, pin 17) on the FT 5000 EVB. The 3.3V jumper is disconnected by default as illustrated in the following figure (the shunt hangs off pin 1):

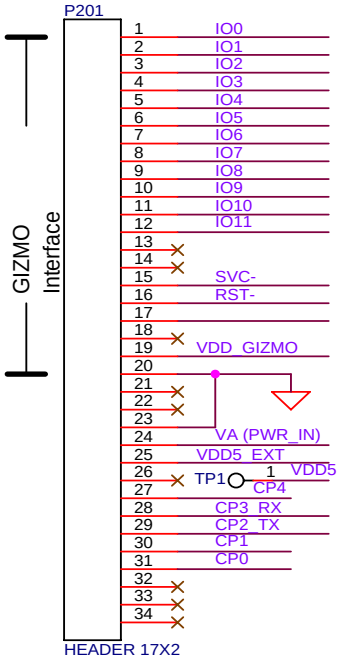


To connect 3.3V power to the 3V pin on the Gizmo connector (P201, pin 17), connect the shunt between pins 1 and 2 as demonstrated in the following figure:



I/O Connector

The following figure shows the I/O connector pinout for the FT 5000 EVB board. You can use this connector to attach custom I/O devices to an evaluation board.



Design and Test for Electromagnetic Compatibility

Echelon's free topology twisted pair technologies support the creation of products that meet a wide variety of regulatory requirements. Chapter 4 of the *FT 5000 Smart Transceiver Data Book* describes how to create products with Echelon's free topology twisted pair technology that meet electromagnetic compatibility regulations.

The FT 5000 EVB boards are designed to facilitate testing of Echelon's free topology twisted pair technologies. As such, they have no enclosure, providing open access to the IO connectors, buttons, LEDs, and other I/O components. They have been developed to allow consumer and commercial device OEM suppliers to evaluate the technology quickly, and have not been designed to be installed permanently in homes or commercial buildings. If you work with the FT 5000 EVB boards in a home environment, operation of other electronic equipment that is sensitive to RF radiated emissions, such as televisions or radios, might be temporarily impaired during the evaluation period.

The standards for RF emissions vary by geographic region. To determine which standards apply in your region, consult the appropriate regulatory agencies. In the European Union, CISPR 22 (or equivalently, EN 55022) applies. In the North American market, the FCC regulates emissions from unintentional radiators under 47CFR15.109, Subpart B, which allows for substitution of CISPR 22. The FT 5000 EVB boards comply with CISPR 22 Level A, but not Level B (which is required for deployment in home and commercial environments).

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