UG110: Ember® EM35x Development Kit User Guide

This document describes the Ember EM35x Development Kit and explains how to set up its hardware and use the Debug Adapter (ISA3). Descriptions of some of the software tools available along with some examples of their uses are also included. For information about developing applications, see the Quick Start Guide provided with your software stack, along with the help and documentation included with your development environment. For software installation instructions, see the stack's release notes.

KEY FEATURES

- Overview of the EM35x Development Kit
- Kit components
- Setting up the kit
- Using the Debug Adapter (ISA3)
- Debug adapter (ISA3) commands
- Additional software tools

1. About This Guide

1.1 Purpose

This document describes the Ember EM35x Development Kit and explains how to set up its hardware and use the Debug Adapter (ISA3).

1.2 Audience

This document is intended for embedded software and hardware engineers who are responsible for developing wireless applications with the Ember EM35x Development Kit. This document assumes that the reader has a solid understanding of embedded systems design and programming in the C language. Experience with networking and radio frequency systems is useful but not expected.

1.3 Documentation Conventions

Notation	Meaning	Example
Italics	Identifies on-screen software menu options.	*Connect*
UPPERCASE	Identifies a keyboard key.	ENTER
Right-angle bracket	Delimits a series of software program menu options to be clicked.	*Open* > *Save*

`Courier`	Identifies software code and, in body text, variables.	`void Main(String[] argv)`
		
		`the buffer variable`

`Courier Italics`	Identifies a variable name.	*`ipAddress`*

2. Introducing the EM35x Development Kit

2.1 Overview

The EM35x Development Kit is used for application design and development. The Development Kit contains a variety of hardware for quickly creating a hardware prototype, links to Silicon Labs stack software such as EmberZNet PRO and various tools that enable the development of your application software.

In general, Silicon Labs' stacks provide a common API (Application Programming Interface) that supports the following layers of the OSI model (Open System Interconnection Reference Model).

- **PHY:** radio control
- **MAC:** medium access
- **LINK:** route discovery
- **NETWORK:** routing, association
- **APPLICATION:** Application profile support for reliable message delivery

For example, the EmberZNet PRO stack is used to build ZigBee PRO-based applications. Applications that are built on this stack benefit from the following features:

- PHY and MAC layers comply with the IEEE 802.15.4-2003 standard
- LINK and NETWORK layers comply with the latest ZigBee PRO specification
- The APS layer provides the interface to the application for data transfer and management, including reliable transport and binding.

The Development Kit includes a development environment, such as Simplicity Studio, which facilitates application development and debugging. A compiler, such as IAR-EWARM, is also one of the kit's software components. Debug Adapters (ISA3s) incorporate Power-over-Ethernet (PoE) capability, which can simplify node deployment in the test environment. Breakout Boards provide a direct connection for debugging customer-designed hardware. For more information, see document TS6, the *EM35x Breakout Board Technical Specification*.

2.2 Support

Once you receive your development kit, register to download development software on Silicon Labs' technical support portal, https://www.silabs.com/support. Use the support portal to contact Customer Support for any questions you might have during the development process.

2.3 Documentation

QSG101: EM35x Development Kit Quick Start Guide, is shipped with the EM35x Development Kit. The stack installer provides a documentation index (in documentation/index.htm and also linked from a Start Menu entry) that contains links to documentation locations and brief descriptions of each document's purpose. Documents are also available through the support portal as Adobe PDF files.

2.4 Hardware Requirements

To use the EM35x Development Kit you will need:

- PC with Ethernet connectivity
- Network hub with DHCP server

2.5 Before You Begin

The EM35x Development Kit is designed only for the operating conditions and interfaces specified in documents TS7, the *Debug Adapter (ISA3) Technical Specification*, TS6, the *EM35x Breakout Board Technical Specification*, and TS8, the *EM3x Module Technical Specification*. Any modifications or alterations to the hardware are liable to cause irreparable damage to the EM35x Development Kit, and shall render its warranty null and void.

If you wish to use the EM35x Development Kit in a non-standard fashion, consult with Silicon Labs Customer Support or Sales before starting custom development. This is especially true if you are embarking on an aggressive development cycle, plan to use custom hardware, or wish to use alternate software configuration files, images, or hardware configurations. Contact us and describe your plan, so we can help you minimize the risk of delays in your development cycle.

3. Development Kit Hardware Components

3.1 Overview

The following figure shows the components in the EM35x Series Development Kit.

Figure 3.1. EM35x Series Development Kit

The inventory of development kit components is included in the development kit's Quick Start Guide (QSG101). This section describes the use for each of the major components.

The EM35x Development Kit development board set has three major hardware components:

- EM35x Breakout Board
- EM35x Module
- Debug Adapter (ISA3)

The EM35x Development Kit also includes the following components:

- US-to-Multinational AC Plug Power Adapter Kit
- Power-Over-Ethernet (PoE) Switch
- USB Power Adapters
- Miscellaneous Cables (USB, DEI, Packet Trace Port, and RF Coax)

3.2 EM35x Breakout Board

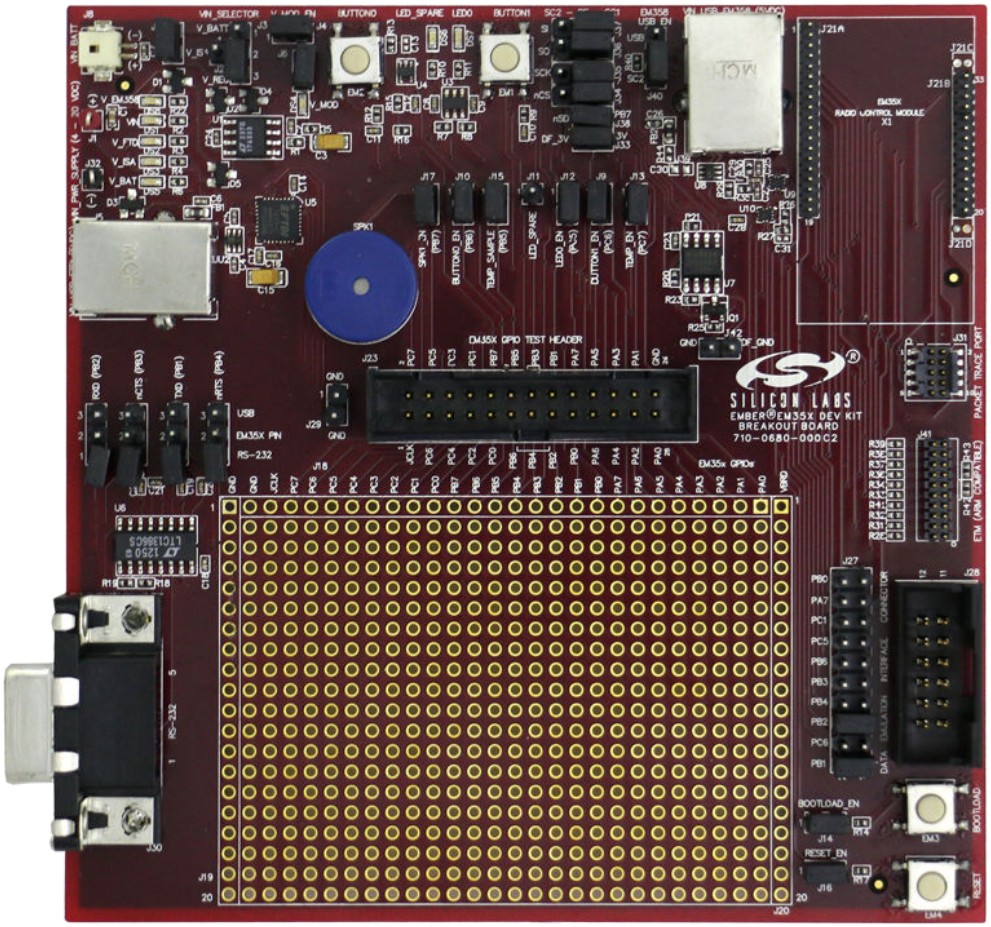


Figure 3.2. EM35x Breakout Board

The **Breakout Board** (shown in the figure above) serves as test beds for network hardware and applications. Each Breakout Board has an associated EM35x Module, which can be deployed as a node within a network application. Each Breakout Board connects with a Debug Adapter (ISA3) through two communication links: the Packet Trace Port and the DEI Port. This allows the Breakout Board's EM35x Module to interface with the development environment through the Debug Adapter (ISA3)'s Packet Trace Port and its wired Ethernet connection. The Breakout Board also has a prototype breadboard area for application-specific hardware development.

The Breakout Board has the following components:

- External power supply connectors
- One DB-9 serial port connector for RS-232 serial communication
- One USB connector for EM35x SC1 virtual COM port serial communication
- One USB connector for EM358x USB virtual COM port serial communication
- One header with TTL-compliant UART signals for EM35x SC1 SPI serial communication
- A buzzer, two buttons, two LEDs, and a temperature sensor for application development purposes
- External serial flash for application bootloader purposes (via either EM35x SC1 or SC2)
- Hardware reset buttons for the EM35x module
- Prototype or bread-boarding area (28 x 20, 0.1" pitch array) for application-specific hardware development
- One data emulation interface connector

For detailed information about the Breakout Board, see document TS6, the *EM35x Breakout Board Technical Specification*.

3.3 EM35x Module

The EM35x Module (see figure below) contains the Ember EM35x System-on-Chip (SoC) solution providing a complete radio and microcontroller solution. All modules are pin-compatible, and they can be directly attached to a Breakout Board. The kit includes both EM357 and EM3588 module variants.

The EM35x module is used together with the Development Kit Breakout Board to prototype customer hardware, and to develop and debug application software. Its low-power design represents a good starting point for your own product design.

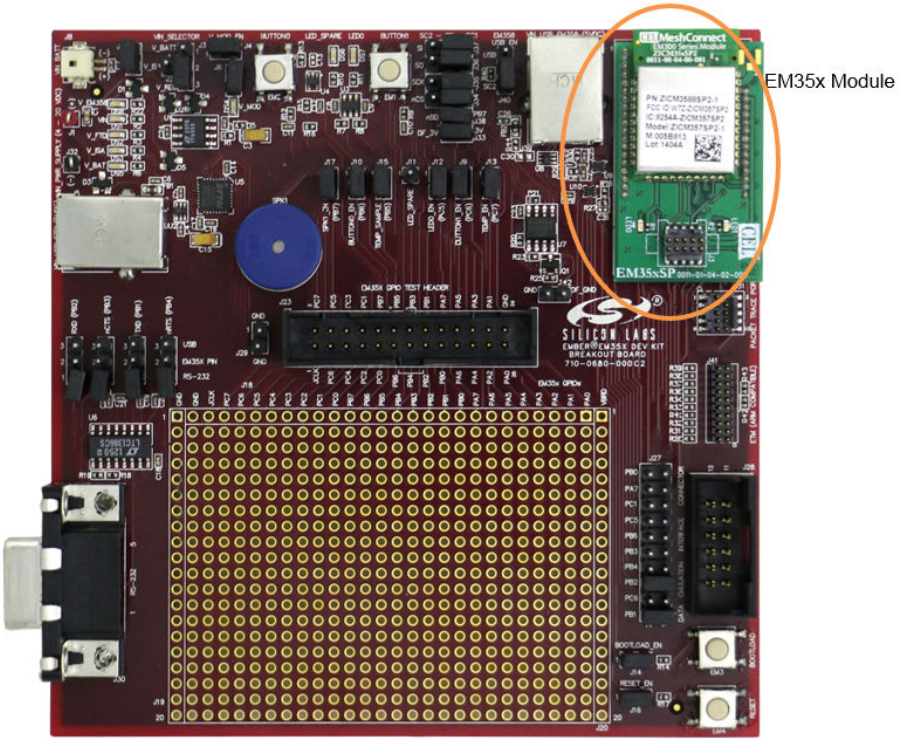


Figure 3.3. EM35x Breakout Board with EM35x Module Installed

The EM35x Module includes these components:

- The Ember EM35x SoC (IEEE 802.15.4-compliant, 2.4 GHz radio transceiver with ARM® Cortex™-M3 microcontroller).
- All off-chip components required for optimum SoC performance
- Two LEDs
- Packet Trace Port connector

For detailed information about the modules, see document TS8, the *EM3x Module Technical Specification*.

Once you move away from the EM35x Module and toward application-specific hardware, refer to the extensive reference design library available through the Silicon Labs support portal. Each reference design provides a schematic, Bill of Materials (BOM), characterization data, and layout files. They are designed and delivered in a manner that reduces both time to market and hardware implementation risk. For assistance in locating the best design for your needs, contact Customer Support.

3.4 Debug Adapter (ISA3)

A **Debug Adapter (ISA3)** connects a Breakout Board to the Ethernet. Each adapter transmits network data collected through its Packet Trace Port and conveys it over its Ethernet connection to the development environment. It also picks up any messages or new software that is addressed to this Breakout Board. The ISA3 functions as a source-level debugger for EM3x devices, providing single-stepping and breakpoint support via IAR EWARM.

The Debug Adapter (ISA3) provides an efficient and configurable debug interface to the EM35x Development Kit Breakout Board for processing emulation and debug commands. It also provides an interface to the development environment for monitoring and managing network data.

The Debug Adapter (ISA3) has the following components:

- Debug Port interface to the Breakout Board's Extended Debug Interface Connector
- Packet Trace Port interface to the radio communication module, providing programming and debugging services
- TCP/IP 10/100 Ethernet interface with Power-over-Ethernet functionality
- USB Interface

The Packet Trace Port is a cabled communication link between the Debug Adapter (ISA3) and the EM35x Module mounted on the Breakout Board.

3.5 Other Kit Components

- **Packet Trace Port Cables** connect each Debug Adapter (ISA3) to a Breakout Board.
- **AAA Battery Pack** attaches to a Breakout Board and enables deployment of battery-operated nodes.
- **USB Power Supply with Adapters** power Breakout Boards and / or Debug Adapters (ISA3s) from wall sockets.
- **Ethernet Cables** connect Debug Adapters (ISA3s) to an Ethernet subnet and the PoE Switch to your PC or network.
- **Data Emulation Interface (DEI) cables** provide a peripheral interface connection between the Debug Adapter (ISA3) and Breakout Board. The DEI cable supports UART functionality.

4. Acceptable Power Sources for Normal Operation

The following table lists all of the components and the acceptable combinations of power sources that yield normal operation. Potential power sources include the following:

- Power-Over-Ethernet (PoE) Switch
- AAA battery pack (3 VDC)
- USB cable
  - Connected to PC
  - Connected to USB Power Supply with Adapters
- Power over Packet Trace Port on Debug Adapter (ISA3) (the target power select switch on the front panel must be set to *Int* (Internal)).
- From RCM dedicated power
- External DC adapter (not supplied with the Development Kit)

Table 4.1. Safe Combination of Operating Power

	PoE	External DC	AAA Battery Pack	Packet Trace Port	USB	Breakout Board
Debug Adapter (ISA3)	X	N/A	N/A	N/A	X	N/A
EM35x Module	N/A	N/A	N/A	X[1]	N/A	X
EM35x Breakout Board	N/A	X[2]	X	X[3]	X	N/A

Note:

1. Power is sourced from the Debug Adapter (ISA3) to the RCM module using the Packet Trace Port cable connected to the Debug Adapter (ISA3) with its target power select switch set to *Int* (Internal).
2. External dc power between 4 V and 20 V can be connected to clip leads J1 (+) and J32 (-) on the EM35xx Breakout Board.
3. Power is sourced from the Debug Adapter (ISA3) to the EM35x Breakout Board using the Packet Trace Port cable connected to the Debug Adapter (ISA3) with its target power select switch set to *Int* (Internal).

4.1 Power-Over-Ethernet (PoE) Switch

The EM35x Development Kit contains a NETGEAR 8-port Power-over-Ethernet (PoE) switch that supplies power to a Debug Adapter (ISA3) over a standard TIA/EIA-568 category 5 cable. The Debug Adapter (ISA3) can, in turn, supply power to an EM35x Breakout Board and the Module that is mounted on it. Thus, you can place Breakout Boards wherever an Ethernet cable connection is available.

The dc operating power for data terminal units is fed through unused pairs 7/8 and 4/5. For more information about the NETGEAR switch, see its online technical specifications.

The NETGEAR PoE Switch that is supplied in the EM35x Development Kit is certified by Silicon Labs. If you wish to use a different PoE switch, consult Customer Support.

The US-to-Multinational AC Plug Power Adapter Kit, shown in the following figure, is a set of three power adapters for use with the NETGEAR PoE Switch. These three interchangeable plugs are provided with various port configurations suitable for North America, Europe, the United Kingdom, and Australia.

Figure 4.1. US-to-Multinational AC Plug Power Adapter Kit

4.2 USB Power Supply with Adapters

The USB power adapter is a linear regulated wall plug power supply with 5 V DC at 1 A regulated output. It has a USB type-B connector for connecting power via a USB cable to the USB port of the Debug Adapter (ISA3) or Breakout Board. Five interchangeable snap-in input plugs are provided with various port configurations suitable for North America, Europe, the United Kingdom, Australia, and China.

5. Setting up Hardware Components

5.1 Overview

This chapter contains the following sections:

- EM35x Radio Communications Module (RCM)
- Hardware Connections
- Connecting the Breakout Board and RCM
- Breakout Board Power Configurations
- Breakout Board Serial Configurations
- Common Hardware Configurations
- Connecting the RF Cable to the RCM

5.2 EM35x Radio Communications Module (RCM)

The EM35x Development Kit contains various types of EM35x RCMs designed by Silicon Labs' partner, California Eastern Laboratories (CEL). These modules contain either the EM357 or EM3588 IC and are configured to use either the PCB antenna or the on-board RF connector (U.FL). Some module variants also include a power amplifier. These configuration options are noted in the Module Product Label, shown in the following example label. This label can be found on the bottom of the module. The top line contains the Silicon Labs Part Number, while the bottom line contains the Module Serial Number. The Module Serial Number is also listed in the Hardware Identification List attached to the QSG101, *EM35x Development Kit Quick Start Guide*. You can determine the EUI-64 of each module based on this list.

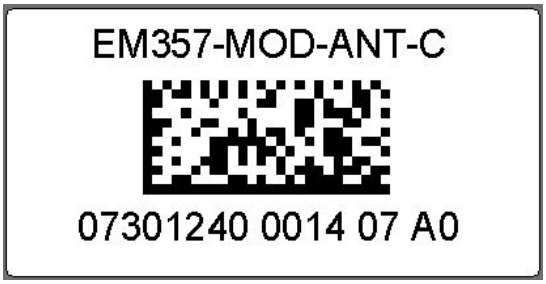


Figure 5.1. Module Product Serial Number Label

The modules shipped already installed on Breakout Boards are module variant EM3588-M-AN-C. Other module variants are contained in the Module Variety Pack. Refer to the following table for configuration comparisons of the modules included in your development kit.

Table 5.1. Module Product Variant Matrix

Silicon Labs Part Number	CEL Part Number	Silicon Labs Product Number	IC	Antenna or Connector	PA or non-PA	Qty Included in Kit
EM357-MOD-ANT-C	ZICM357SP0-1-SL	0730	EM357	Antenna	Non-PA	1
EM357-MOD-RF-C	ZICM357SP0-1C-SL	0731	EM357	Connector	Non-PA	1
EM357-MOD-LR-RF-C	ZICM357SP2-1C-SL	0732	EM357	Connector	PA	1
EM357-MOD-LR-ANT-C	ZICM357SP2-1-SL	0733	EM357	Antenna	PA	1
EM3588-M-AN-C	ZICM3588SP0-1-SL	0734	EM3588	Antenna	Non-PA	3
EM3588-M-RF-C	ZICM3588SP0-1C-SL	0735	EM3588	Connector	Non-PA	1
EM3588-MLR-RF-C	ZICM3588SP2-1C-SL	0736	EM3588	Connector	PA	1
EM3588-MLR-AN-C	ZICM3588SP2-1-SL	0737	EM3588	Antenna	PA	0

5.3 Connecting the Breakout Board and RCM

Refer to document *QSG101: EM35x Development Kit Quick Start Guide,* included in the development kit, for detailed step-by-step instructions for setting up your hardware.

Two hardware modules attach to the EM35x Breakout Board:

- Radio Communication Module (RCM)
- Debug Adapter (ISA3)

CAUTION: Observe electrostatic discharge (ESD) precautions when removing, handling, or replacing RF communication modules.

To attach the radio communication module:

Align the radio communication module to its footprint outline on the Breakout Board, and then press it into place. To avoid communication problems, verify that each RCM is firmly seated in its Breakout Board connector, and its Packet Trace Port cable is properly seated.

To remove the radio communication module:

Carefully pull the RCM away from the Breakout Board.

To attach the Debug Adapter (ISA3):

1. Plug the Packet Trace Port cable into the Debug Adapter (ISA3).
2. Plug one end of the Packet Trace Port cable into the 10-pin Packet Trace Port (J31) on the Breakout Board, and the other end into the Debug Adapter (ISA3). If desired, the Packet Trace Port cable may be connected directly to the RCM instead of the Breakout Board, but the Breakout Board connector allows for straight cable paths and more convenient swapping of modules.
3. Verify that the Debug Adapter (ISA3)'s Target Power Select switch is set to Int (Internal).

To remove the Debug Adapter (ISA3):

1. Unplug the Packet Trace Port cable from the Breakout Board (or RCM).
2. Unplug the Packet Trace Port cable from the Debug Adapter (ISA3).

5.4 Breakout Board Power Configurations

The Breakout Board may be powered in one of five ways:

- Breakout Board Power Supplied by Debug Adapter (ISA3) (shown below): The default configuration is to supply power via the Debug Adapter (ISA3) and Packet Trace Port cable. Ensure the power switch on the Debug Adapter (ISA3) is in the INT (Internal) position. The power supply of the Debug Adapter (ISA3) is also controlled via the admin interface. You may need to connect to the admin port of the Debug Adapter (ISA3) and issue the “power on” command. No external power supply should be connected to the Breakout Board when supplying power from the Debug Adapter (ISA3). The power supply jumper on the Breakout Board should be in the horizontal position, connecting V_ISA to the center pin. The V_ISA LED (DS3) will illuminate when power is applied.

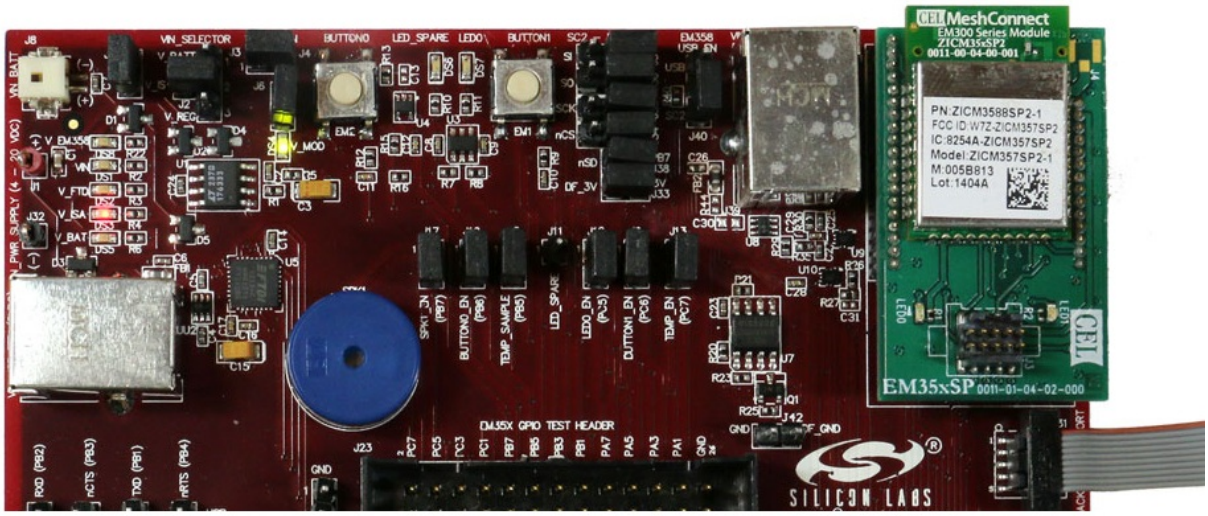


Figure 5.2. Breakout Board Power Supplied by Debug Adapter (ISA3)

- Breakout Board Power Supplied by USB (shown below): The Breakout Board may also be powered through the USB connector (J5), either using a USB cable plugged in to the USB power adapter included in the development kit, or by connecting it to your PC. The power supply jumper on the Breakout Board should be in the lower vertical position, connecting V_REG to the center pin. The V_FTDI LED (DS2) will illuminate when power is applied. When powering the Breakout Board in this way, ensure the power switch on the Debug Adapter (ISA3) is in the EXT (External) position.

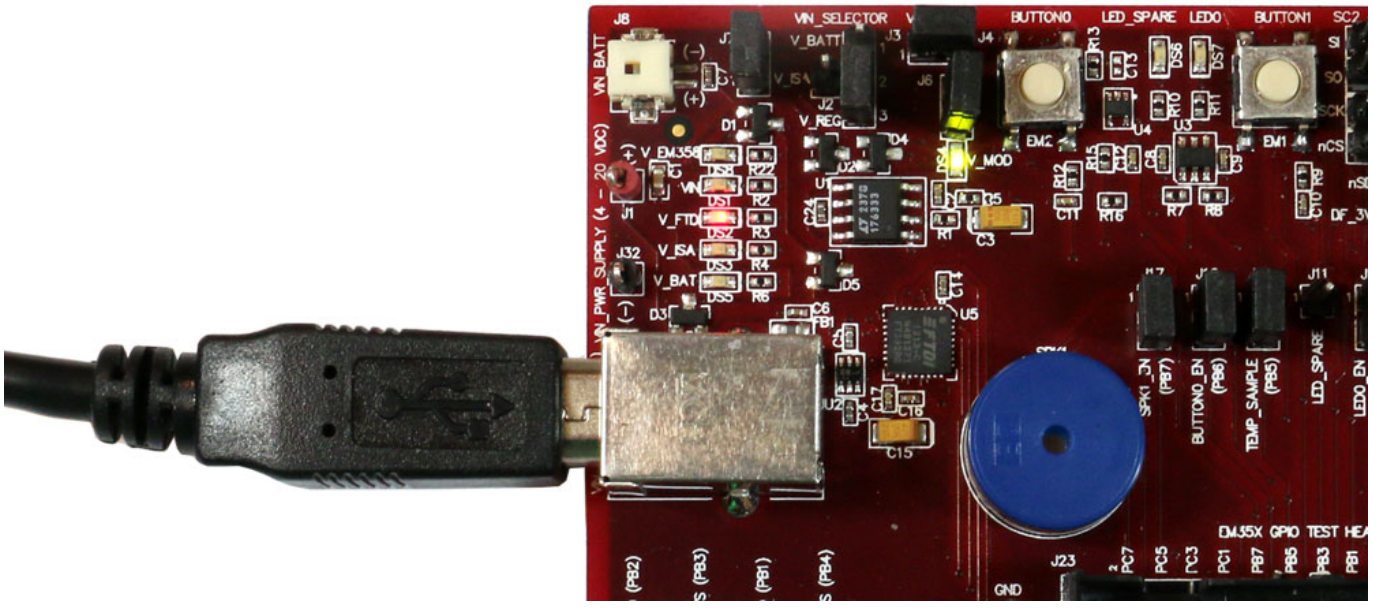


Figure 5.3. Breakout Board Power Supplied by USB (J5)

- Breakout Board Power Supplied by DC Jumpers (shown below): The Breakout Board may also be powered by an external power source that provides 4-20 V dc. The power supply should be connected to jumpers J1 (+ supply) and J32 (ground). The power supply jumper on the Breakout Board should be in the lower vertical position, connecting V_REG to the center pin. The VIN LED (DS1) will illuminate when power is applied. When powering the Breakout Board in this way, ensure the power switch on the Debug Adapter (ISA3) is in the EXT (External) position.

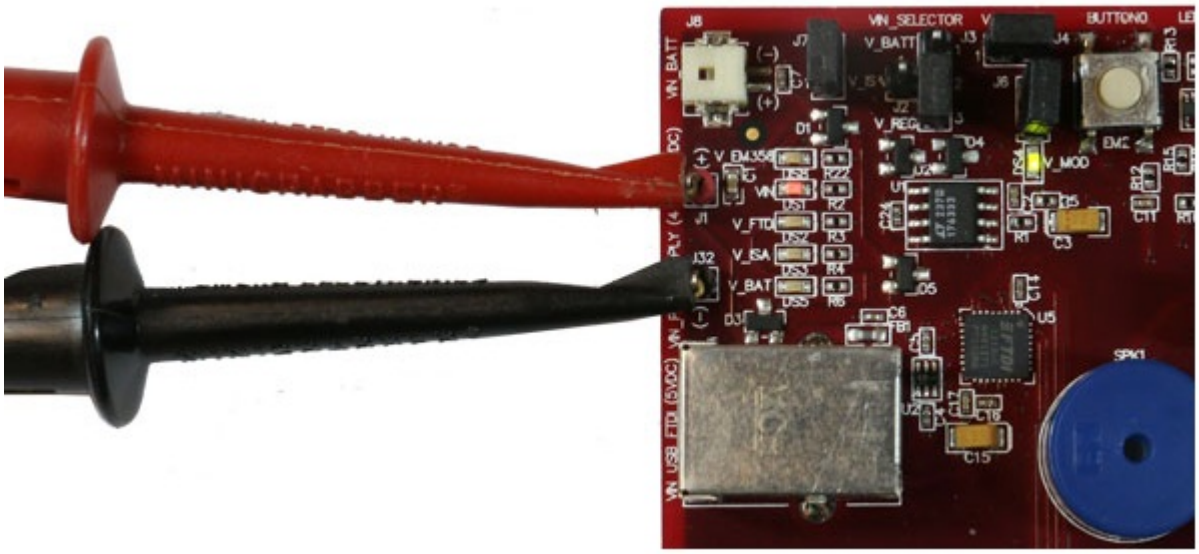


Figure 5.4. Breakout Board Power Supplied by DC Jumpers

- Breakout Board Power Supplied by Battery Connector (shown below): The Breakout Board may also be powered via the battery connector (J8), using the supplied battery pack and 2x AAA batteries. The power supply jumper should be in the upper vertical position, connecting V_BATT to the center pin. The V_BAT LED (DS5) will illuminate when power is applied. When powering the Breakout Board in this way, ensure the power switch on the Debug Adapter (ISA3) is in the EXT (External) position.

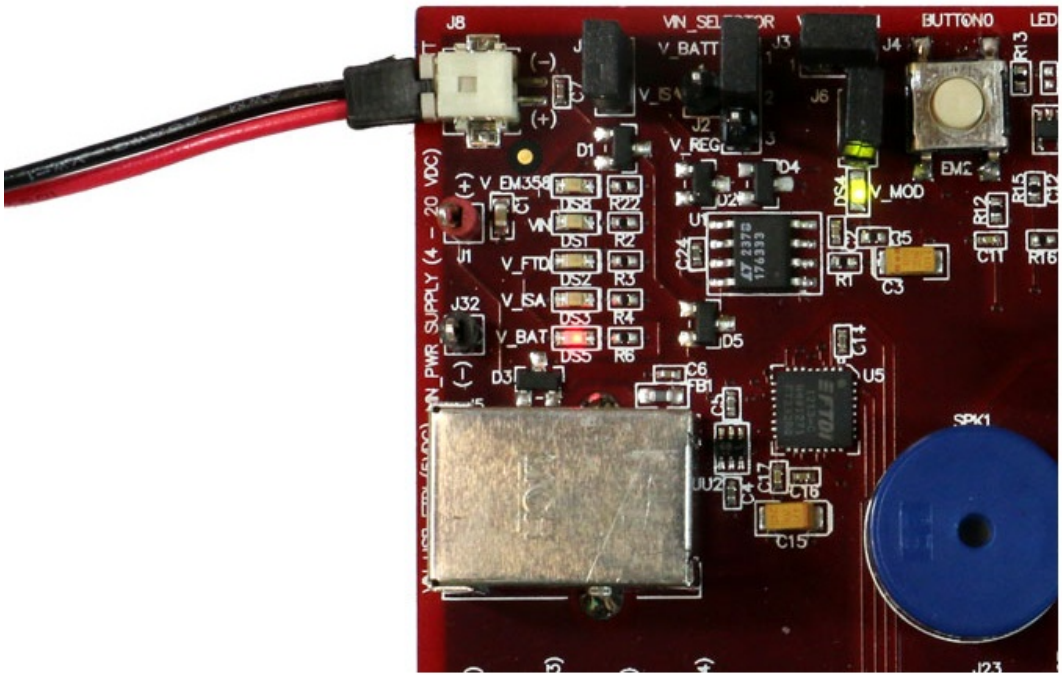


Figure 5.5. Breakout Board Power Supplied by Battery Connector

- Breakout Board Power Supplied by EM3588 USB (J39) (shown below): Finally, the Breakout Board may also be powered through the EM3588 USB connector (J39), either using a USB cable plugged in to the USB power adapter included in the development kit, or by connecting it to your PC. The power supply jumper on the Breakout Board should be in the lower vertical position, connecting V_REG to the center pin. The V_EM358 LED (DS8) will illuminate when power is applied. When powering the Breakout Board in this way, ensure the power switch on the Debug Adapter (ISA3) is in the EXT (External) position.

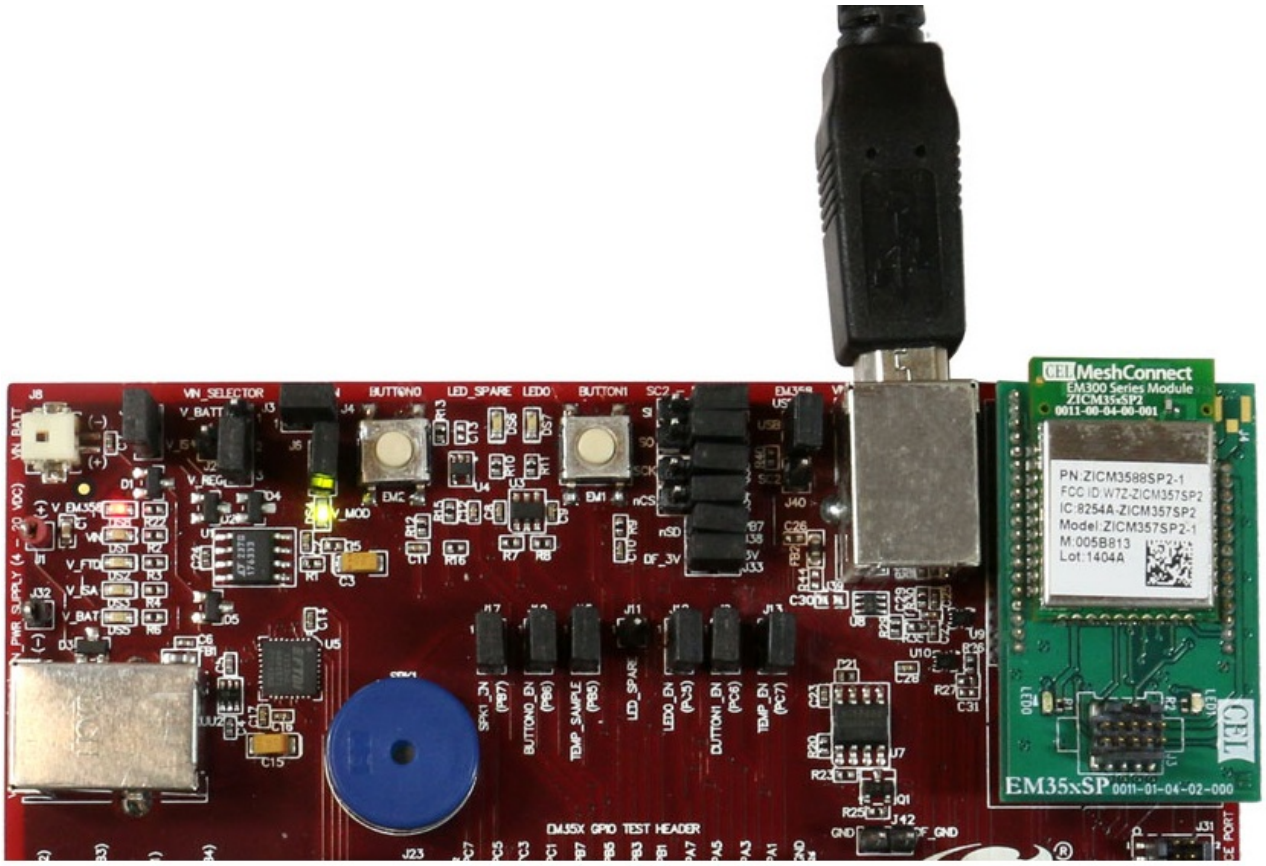


Figure 5.6. Breakout Board Power Supplied by EM3588 USB (J39)

The V_MOD LED (DS4) on the Breakout Board will also illuminate to indicate that power is properly applied to the board and the RCM.

5.5 Breakout Board Serial Configurations

Serial connectivity to the Breakout Board can be made in a number of ways. The default configuration of your development kit will match your expected usage scenario.

- **To use the pass-through UART feature of the Debug Adapter (ISA3):** Plug the larger 12-pin DEI cable into the DEI header on the Breakout Board and the connector on the Debug Adapter (ISA3). Ensure that jumpers are installed across the 8th (PB2) and 10th (PB1) rows of headers next to the DEI port on the Breakout Board to pass the UART RX and TX signals through. The serial port selection jumpers between the USB and DB-9 connectors should be removed, or placed on their center pins. Connection to the UART pass-through port can then be made using either of the two options below:
  - Connect to the Debug Adapter (ISA3) using the development environment. Launch the console. Choose the Serial 1 tab.
  - Run a terminal application (for example, Microsoft Telnet Client, HyperTerminal, PuTTY). Connect to port 4901 on the Debug Adapter (ISA3).
- **To use the RS-232 interface:** Connect a serial cable to the DB-9 connector on the Breakout Board. Ensure the four jumpers above the DB-9 connector are positioned towards the DB-9 connector to send the UART signals to the RS-232 transceiver, and remove the jumpers from the row of headers next to the DEI port or make sure the DEI cable is disconnected.
- **To use the USB interface:** Install the FTDI USB drivers as described in the stack release notes, and connect a USB cable to J5 of the Breakout Board and to your PC. Ensure the four jumpers above the DB-9 connector are positioned towards the USB connector to send the UART signals to the FTDI chip, and remove the jumpers from the row of headers next to the DEI port or make sure the DEI cable is disconnected.
- **To use the EM358x USB interface:** Install the Silicon Labs USB drivers as described in the stack release notes, and connect a USB cable to J39 of the Breakout Board and to your PC. Ensure the USB_EN jumper J40 to the left of the J39 USB connector is positioned on the top 2 pins (USB position).

5.6 Common Hardware Configurations

Common configurations of the Breakout Board and Debug Adapter (ISA3) can be seen in the following five figures.

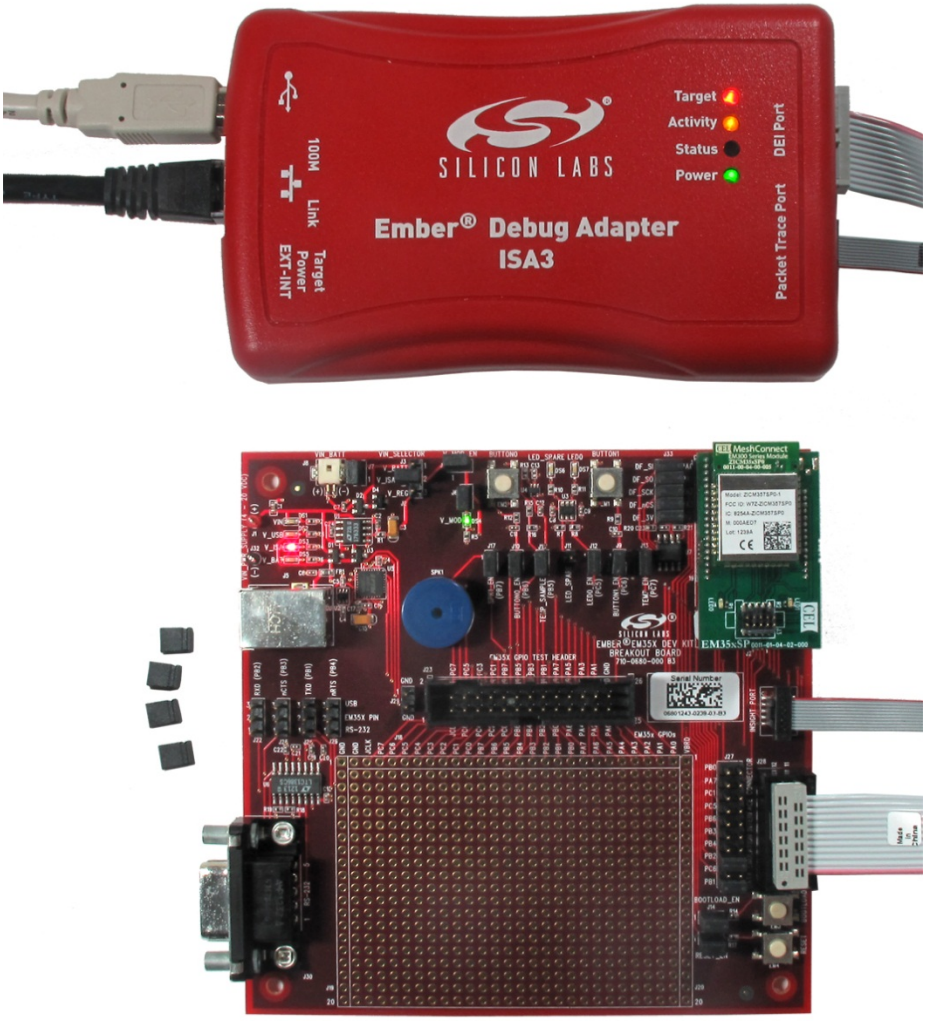


Figure 5.7. Debug Adapter (ISA3) Supplying Power; Pass-through UART Being Used for Serial Communication

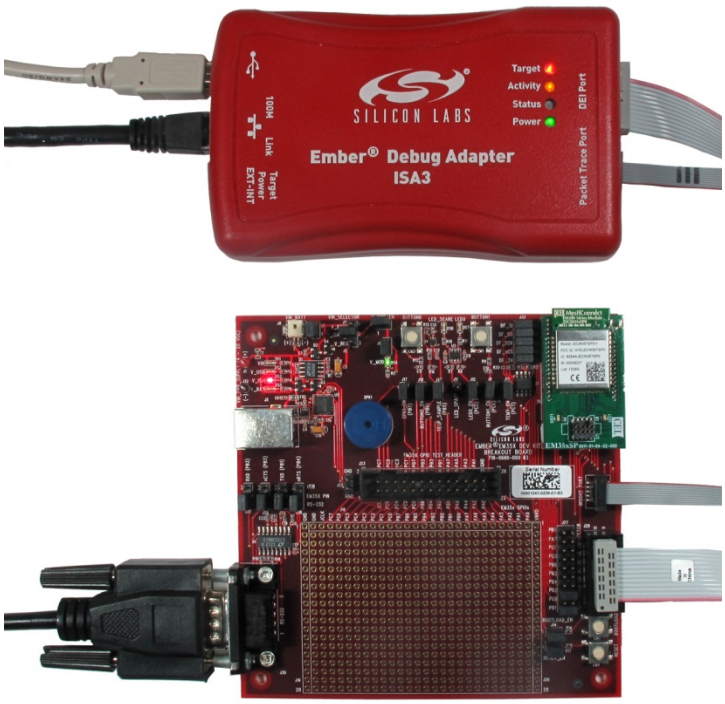


Figure 5.8. Debug Adapter (ISA3) Supplying Power; RS-232 Serial Communication

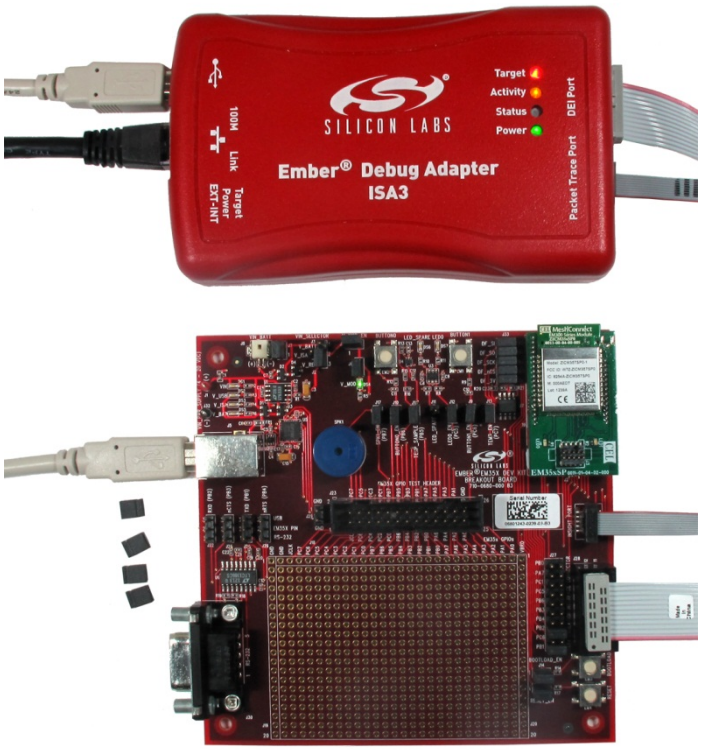


Figure 5.9. Power Supplied Via USB Connector; Pass-through UART Being Used for Communication

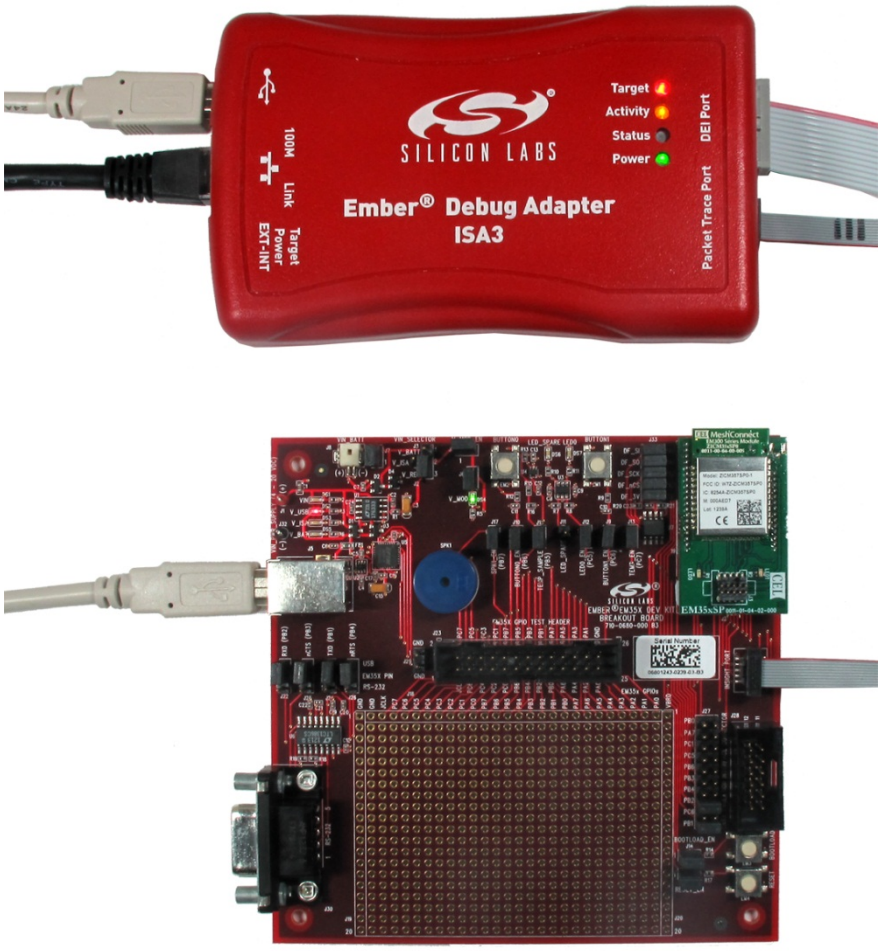


Figure 5.10. Debug Adapter (ISA3) Supplying Power; FTDI Serial <-> USB Converter Used for Communication

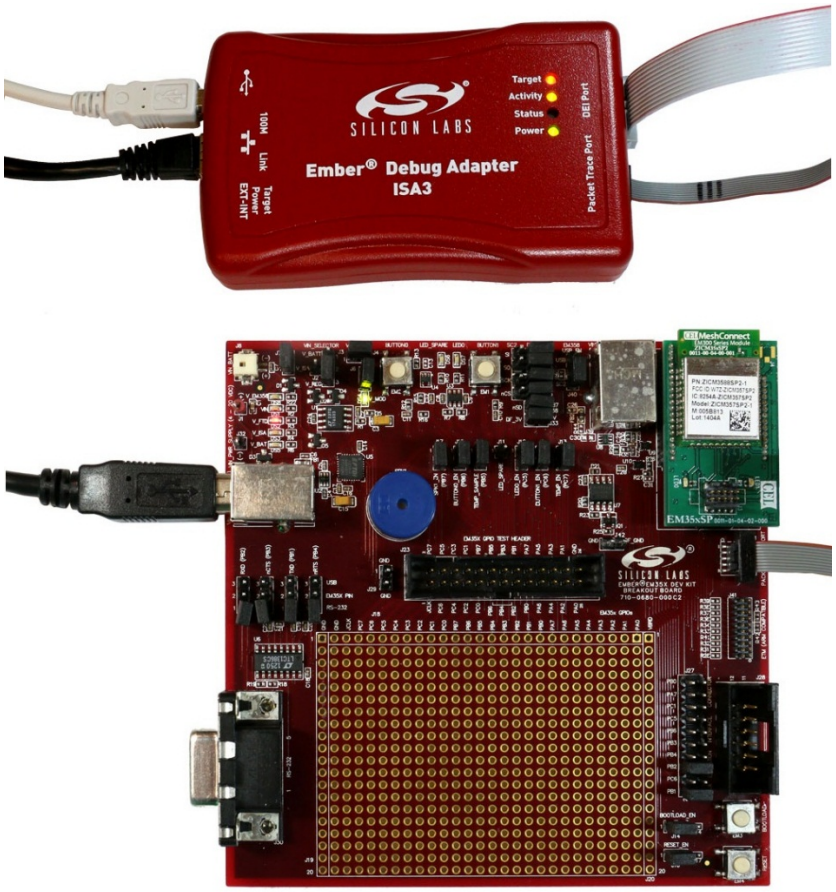


Figure 5.11. Debug Adapter (ISA3) Supplying Power; EM358x USB Used for Communication

5.7 Connecting the RF Cable to the RCM

As detailed in Table 5.1 Module Product Variant Matrix on page 10, depending on the configuration of the module, some RCMs include a PCB antenna while others include an RF connector (type U.FL) where an external antenna can be connected via an RF adapter cable. The following figure shows an example of a module with a PCB antenna.

Figure 5.12. Module with PCB Antenna

The RF connector may also be used as a connection to test equipment. The development kit contains an RF adapter cable (type U.FL) that plugs into the RF Connector on these modules. The following figure shows an example of a module with this RF connector.

Figure 5.13. Module with U.FL RF Connector

6. Using the Debug Adapter (ISA3)

6.1 Overview

The Debug Adapter (ISA3) provides an Ethernet connection to EM35x devices. You can use the Debug Adapter (ISA3) to perform the following tasks:

- Program and debug using Serial Wire or JTAG.
- Monitor packets sent and received by the radio.
- Send and receive serial port data.
- Send and receive debugging data.
- Turn power on and off.
- Control reset, bootloader and GPIO signals.

6.2 Connectivity and Power

All the features of the Debug Adapter (ISA3) are available via the Ethernet connection. The Debug Adapter (ISA3) can also be connected to a PC via USB to change the Ethernet settings.

When connected via USB, the Debug Adapter (ISA3) will also be powered via USB. It should be connected to a powered USB hub, or port on your PC that is capable of supplying full power to connected devices.

When connected via Ethernet, the Debug Adapter (ISA3) may be powered in one of two ways:

1. Using an Ethernet switch that supplies Power Over Ethernet (PoE).
2. Using a USB power supply.

The Debug Adapter (ISA3) will also supply power to the connected EM35x device when the power switch is in the INT (Internal) position. If the connected EM35x device has its own power supply, ensure the power switch is kept in the EXT (External) position.

You can connect via Ethernet to the ports listed in the following table using either the Silicon Labs development environment or a terminal application (for example, Microsoft Telnet Client, HyperTerminal, or PuTTY).

Table 6.1. Debug Adapter (ISA3) Ports

Port	Use
4900	Virtual serial port on EM35x via Packet Trace Port cable.
4901	Physical serial port on EM35x via Data Emulation Interface cable.
4902 or 23	Admin interface.

6.3 Ethernet Settings

By default, Debug Adapters (ISA3)s are configured to get an IP address via DHCP. They are assigned hostnames of EM-ISA3-00, EM-ISA3-01, etc. You can use the development environment to discover the Debug Adapters (ISA3) on the network and see their IP addresses.

If you are unable to use DHCP, the ISA3 Ethernet configuration may be changed using the admin interface over USB as described in section 6.4 Using the Admin Interface over USB. The following example changes the settings to a static IP address of 192.168.1.100 with a netmask of 255.255.255.0 and a gateway of 192.168.1.1.

```
>em3xx_isa.exe --admin "ip static 192.168.1.100 255.255.255.0 192.168.1.1"
em3xx_isa version 1.0.9
DLL version 1.0.13, compiled Aug 19 2009 19:42:00

Success: ip: (after reboot) static 192.168.1.100 255.255.255.0

>em3xx_isa.exe --admin "ip dhcp off"
em3xx_isa version 1.0.9
DLL version 1.0.13, compiled Aug 19 2009 19:42:00

Success: ip: (after reboot) DHCP off
```

You must reset the ISA3 after this configuration change either by power cycling the device or with the `reset` command.

You can change the hostname to make it more descriptive or to avoid conflicts if Debug Adapters (ISA3)s from multiple development kits are connected to the same network. To change the hostname, use the admin command `hostname set <hostname>`.

6.4 Using the Admin Interface over USB

1. Connect the Debug Adapter (ISA3) to the PC using USB. Only connect one Debug Adapter (ISA3) at a time by USB.
2. Run em3xx_isa.exe with the --admin option.
3. Configure the Debug Adapter (ISA3) using the commands described in section 7. Debug Adapter (ISA3) Commands.

6.5 Using the Admin Interface over Ethernet

1. Connect the Debug Adapter (ISA3) to the network using Ethernet.
2. Connect to the admin port on the Debug Adapter (ISA3) using either Simplicity Studio or a terminal application:
   - Connect to the Debug Adapter (ISA3) using Simplicity Studio. Launch the console. Choose the Admin tab

     OR
   - Run a terminal application (e.g., Microsoft Telnet Client, HyperTerminal, PuTTY). Connect to port 4902 or 23 on the Debug Adapter (ISA3).
3. Configure the Debug Adapter (ISA3) using the commands described in section 7. Debug Adapter (ISA3) Commands.

6.6 Using the Serial Ports

Connect to port 4900 or 4901 on the Debug Adapter (ISA3) using either Simplicity Studio or a terminal application.

Port 4900 connects to the virtual serial port on the EM35x via the Packet Trace Port cable. The virtual serial port has no baud rate or other settings.

Port 4901 connects to the physical serial port on the EM35x via the Data Emulation Interface (DEI) cable. The default settings are 115200 baud, 8-n-1 (8 data bits, no parity bit, 1 stop bit). To change the default settings, use the port admin command. For example, for 19200 baud, 8-n-1, use the command port 1 19200 8-n-1.

6.7 Updating the Firmware

Periodically, Silicon Labs provides updated firmware for the Debug Adapter (ISA3). You can perform the update using em3xx_isa.exe or em3xx_load.exe. Both utilities automatically update the firmware to the latest version each time they run.

To update a Debug Adapter (ISA3) over USB, run em3xx_isa.exe with no options. For example:

```
>em3xx_isa.exe
em3xx_isa version 1.0.9
DLL version 1.0.13, compiled Aug 19 2009 19:42:00
Updating firmware: Ember InSight Adapter V1 compiled May 26 2009 13:47:00 V0.2b4
Replacing firmware: Ember InSight Adapter V1 compiled Feb 26 2009 21:54:00
... Firmware update successful. CRC=8DA7
Waiting for new firmware to boot
New firmware booted successfully
```

To update a Debug Adapter (ISA3) over Ethernet, run em3xx_isa.exe with the --ip option. For example:

```
>em3xx_isa.exe --ip 192.168.1.100
em3xx_isa version 1.0.9
DLL version 1.0.13, compiled Aug 19 2009 19:42:00
Connecting to IP address 192.168.1.100
Updating firmware: Ember InSight Adapter V1 compiled May 26 2009 13:47:00 V0.2b4
Replacing firmware: Ember InSight Adapter V1 compiled Feb 26 2009 21:54:00
... Firmware update successful. CRC=8DA7
Waiting for new firmware to boot
New firmware booted successfully
```

7. Debug Adapter (ISA3) Commands

7.1 Syntax Conventions

Element	Meaning	Example
`Literal`	A command or argument that is entered exactly as shown.	hostname read
Variable	An argument that is entered as the desired value for that variable.	hostname set hostname
`[ | ]`	An argument chosen from a list.	`[on|off]`

7.2 Entering Commands

- Commands can be entered over USB (see section 6.4 Using the Admin Interface over USB) or Ethernet (see section 6.5 Using the Admin Interface over Ethernet).
- Commands are not case sensitive.
- Arguments are separated with a single space.
- Backspace can be used to correct mistakes.

7.3 Command List

- button
- config
- connections
- debug
- help
- hostname
- ip
- port
- power
- reset
- usbaddr
- version

7.3.1 button

```
button [0|1] [press|release]
```

Description

Simulates button 0 or 1 on the Breakout Board being pressed or released.

The Data Emulation Interface cable must be connected.

Example

```
button 1 press
```

7.3.2 debug

```
debug [on|off|disable]
```

Description

Turns BackChannel Debug on (the default), off (for sleepy devices), or disable (for read-protected devices). With no arguments specified, it prints the current debug status.

Examples

```
debug
debug off
debug disable
```

7.3.3 config

```
config
```

Description

Displays the configuration of the Debug Adapter (ISA3):

- hostname and static IP settings
- IP mode (static or DHCP) and current IP settings
- serial port settings
- firmware version
- serial number and Ethernet MAC address
- type, EUI and board name of the attached EM35x device

You can also view the configuration using Simplicity Studio.

7.3.4 connections

```
connections
```

Description

Displays active and inactive TCP connections across the various Ethernet ports of the ISA3.

7.3.5 help

```
help
```

Description

Displays a list of all Debug Adapter (ISA3) commands.

7.3.6 hostname

```
hostname set hostname
hostname read
```

Description

Sets or displays the hostname of the Debug Adapter (ISA3).

The Debug Adapter (ISA3) must be reset for a change to take effect.

You can also view the hostname using Simplicity Studio.

Example

```
hostname set mydevice3
```

7.3.7 ip

```
ip static ipaddress netmask gateway
ip dhcp [on|off]
```

Description

Sets the static IP address, netmask and gateway. These are only used when DHCP is turned off.

Turns DHCP on or off.

The Debug Adapter (ISA3) must be reset for a change to take effect.

Examples

```
ip static 192.168.1.100 255.255.255.0 192.168.1.1
ip dhcp off
```

7.3.8 port

```
port 1
port 1 baud
port 1 baud [5|6|7|8]-[n|o|e]-[1|2]
```

Description

Displays the configuration of the serial port.

Sets the baud rate, data bits (5, 6, 7 or 8), parity (none, odd or even) and stop bits (1 or 2).

Examples

```
port 1
port 1 57600
port 1 115200 8-n-1
```

7.3.9 power

```
power [on|off|read]
```

Description

Turns the power to the attached EM35x device on or off. Displays the current power setting.

You can also turn the power on and off using Simplicity Studio.

Example

```
power on
```

7.3.10 reset

```
reset
reset adapter
reset host [hold]
```

Description

Resets the attached EM35x device if no arguments are specified

Resets the Debug Adapter (ISA3) when “adapter” argument is specified.

Resets the host MCU (if using the EM35x NCP Host Breakout Board and DEI cable is connected to ISA3), optionally holding the host MCU in reset state if “hold” is specified.

You can also reset the device using Simplicity Studio.

7.3.11 usbaddr

```
usbaddr read
usbaddr set [0|1|2|3|FF]
```

Description

Displays the USB address configuration of a specific Debug Adapter (ISA3).

Sets the USB address configuration, range is 0-3 or FF (default).

The Debug Adapter (ISA3) must be reset for a change to take effect. See document AN717, *Programming Options for the EM35xx Platform*, for step by step instructions on setting the address of a Debug Adapter (ISA3).

7.3.12 version

```
version
```

Description

Displays the firmware version of the Debug Adapter (ISA3).

You can also view the version using Simplicity Studio.

8. Software Tools Overview

This section describes some of the software tools you can use with your EM35x development kit. For instructions on how to get started comfiguring, compiling, and flashing applications using Simplicity Studio tools, see the Quick Start Guide included with your stack software.

8.1 Using the EM35x NodeTest Application

NodeTest is a pre-built application supplied by Silicon Labs for the purpose of performing RF functional testing and hardware validation on development boards or custom-designed hardware. It contains RF test functions pertinent to IEEE 802.15.4-based radio configurations. The NodeTest application supports a command parser and provides results in a consistent, easy-to-parse format. See *AN1019: Using the NodeTest Application*, for more information about using NodeTest and performing basic testing, such as a packet error test.

8.2 Testing Deep Sleep Current

- Deep sleep current can be easily measured using the NodeTest application running on a Breakout Board. Deep sleep current can only be measured when power is supplied to the board from a source other than the Debug Adapter (ISA3). The buffer logic on the Debug Adapter (ISA3) consumes extra current which will not allow for accurate measurements.
- If a Debug Adapter (ISA3) is connected to the Breakout Board, then the Debug Adapter (ISA3)'s Target Power Select Switch should be switched to EXT (External) so that the Debug Adapter (ISA3) is not supplying power.
- Supply power through the USB jack (J5), the dc jack, or the AAA Battery Pack. (The USB jack (J5) is recommended and reviewed in these test steps because it is the simplest.)
- Rotate the VIN_SELECTOR jumper (J2/J3) on the Breakout Board to the V_REG position (pins 2 and 3). If power is supplied properly and all four power/LED jumpers (J2/J3, J4, J6, and J7) in the upper left corner of the board are installed, then only the red V_USB LED and the green V_MOD LED will be illuminated.
- To properly measure current, remove the V_MOD jumper (J6) from the Breakout Board. This ensures that the green V_MOD LED is not being driven. If supplying voltage through the J8 battery connector, also remove J7 so the V_BATT LED DS5 is not driven.
- Remove the V_MOD_EN jumper (J4) from the Breakout Board to take current measurements. Then, connect an ammeter in place of the jumper.
- If using EM35x Breakout Board revision B0 or later, remove the DataFlash jumpers at J33-J38 to isolate the DataFlash IC from the rest of the circuit.
- If using EM35x Breakout Board revision C0 and later, confirm the USB enable (USB_EN) jumper at J40 is configured for SC2 (shorting jumper across bottom 2 pins) and not USB.

These jumper settings can be seen in the following figure.

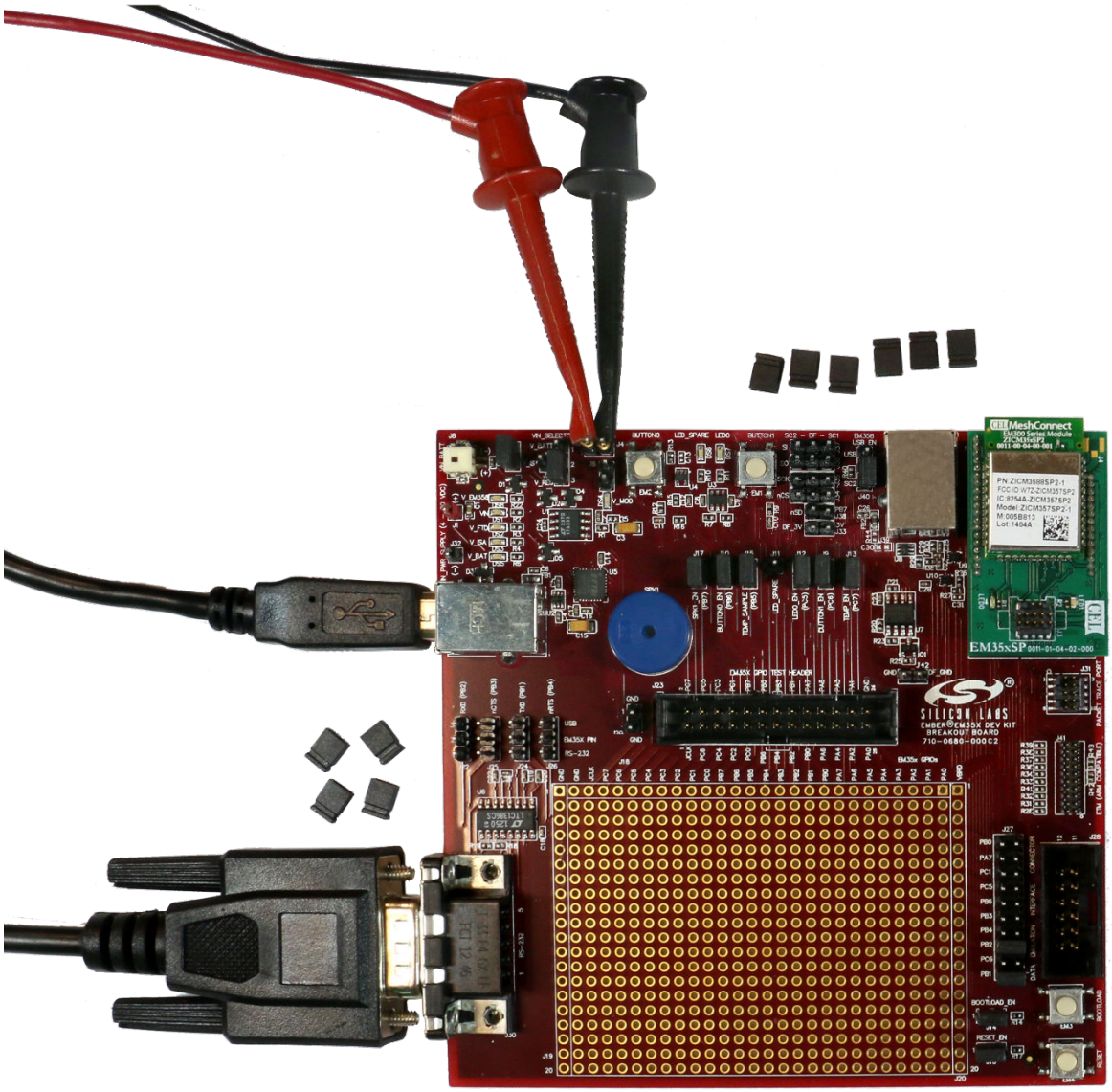


Figure 8.1. Jumper setting for Deep Sleep Current Testing

- Given an RCM programmed with NodeTest, execute the "shutdown" command:

```
> shutdown
Will wake from GPIO activity on the following port pins:
Port B, pin 6.
Port C, pin 6.
Entering SLEEPMODE_POWERDOWN via halSleep...
```

- Once the node is asleep, disconnect the Packet Trace Port cable, the DEI cable, the RS-232 cable, and remove all four UART jumpers (J22, J24, J25, and J26) from the Breakout Board between the USB and RS-232 connectors to obtain the lowest current settings. All other jumpers may remain installed.
- Waking up is accomplished via either activity on the SerialWire debugger or pressing BUTTON0 or BUTTON1.

To measure deep sleep while the Packet Trace Port cable is still attached, issue the "swjdisable 1" command in NodeTest to disable the SerialWire/JTAG port, and place the SWJ pins in a low current state. While the SWJ is disabled, the Packet Trace Port/debugger will not be functional until either the command "swjdisable 0" is issued or the chip resets.

8.3 Programming your Application on the EM35x

Programming EM35x flash is accomplished with the em3xx_load.exe utility, either via the Windows Command Prompt or via the Upload Application action in Simplicity Studio's Adapters view. The em3xx_load utility is included as part of the Debug Adapter (ISA3) Utilities Installer, in the "bin" subdirectory. For information on all the ISA3 utilities, see *UG107: ISA3 Utilities Guide*.

A complete summary of em3xx_load functionality with brief descriptions of each option can be found in em3xx_load's own help menu. Invoking "em3xx_load.exe" without options or invoking "em3xx_load.exe --help" will print this help menu. More information about using Simplicity Studio to upload applications can be found in the online help for Simplicity Studio.

The most common usage of em3xx_load is to simply program flash. em3xx_load takes the S37 specific version of Motorola S-record file formats, and these files use the .s37 extension. If you are using a bootloader, em3xx_load can also load a .ebl file, which is a proprietary, binary file format designed for applications that use an Ember Bootloader.

Given an S37 file called "file.s37", the most basic command for programming flash is simply:

```
em3xx_load.exe file.s37
```

Em3xx_load will then print out the versions it is using, the devices it is connected to, the steps it is performing, and programming progress. By default, the last step em3xx_load performs is to run the chip by toggling the nRESET pin.

By default, em3xx_load.exe assumes the Debug Adapter (ISA3) is connected via USB when no other options are given. If the Debug Adapter (ISA3) is connected via Ethernet, use the --ip option to specify the IP address or hostname of the Debug Adapter (ISA3) to be used. Given a Debug Adapter (ISA3) with an IP address of 123.123.123.123, programming can be accomplished with the command:

```
em3XX_load.exe --ip 123.123.123.123 file.s37
```

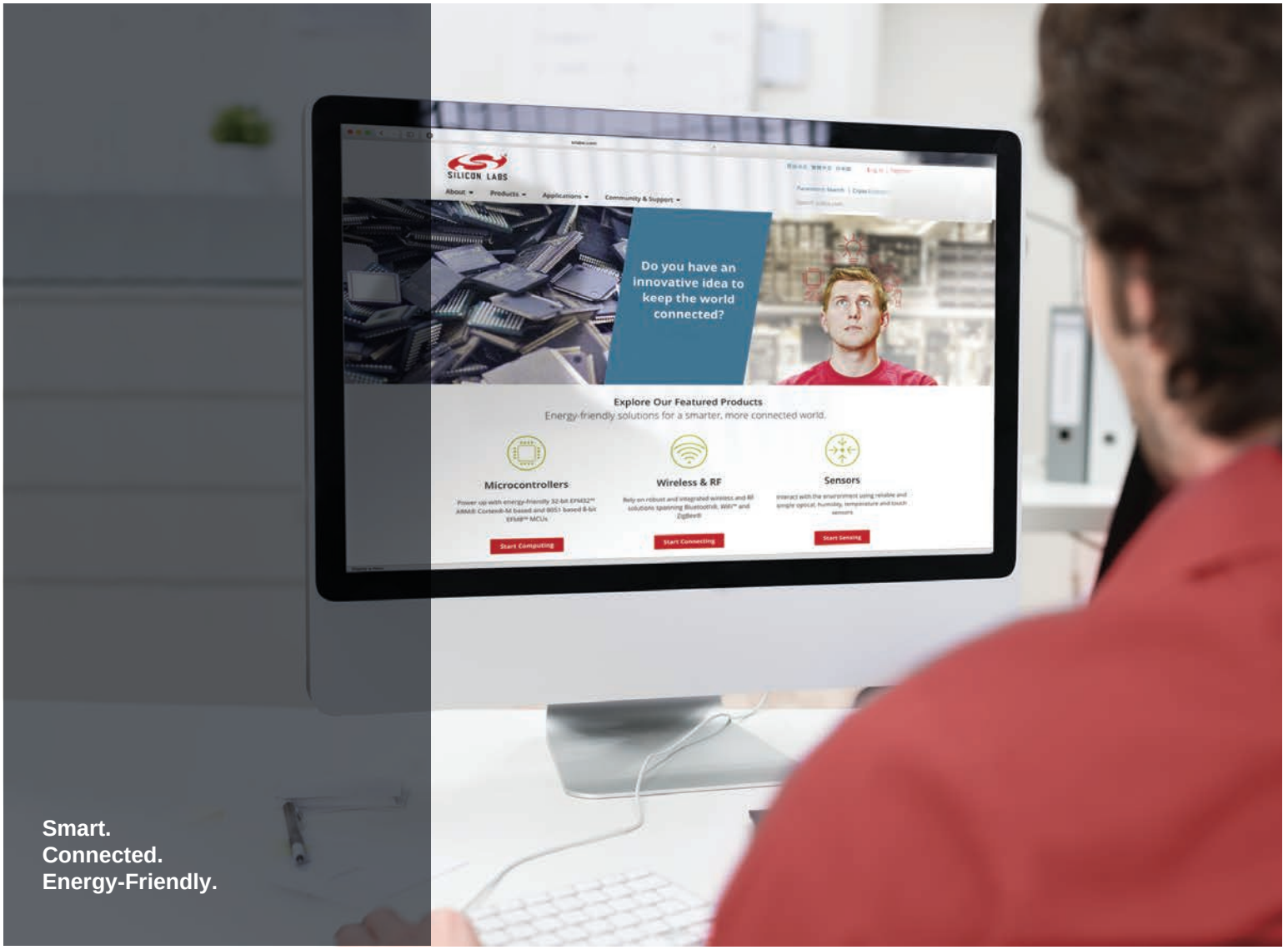
8.4 Programming Manufacturing Tokens

The em3xx_load utility has the ability to program manufacturing tokens much like the em2xx_patch tool did. In the case of the EM357, these tokens are contained in the Customer Information Block (CIB). For more information on using the em3xx_load utility, refer to document *UG107: ISA3 Utilities Guide*. For more information about CIB tokens and how to program them, refer to document *AN710: Bringing up Custom Devices for the Ember® EM35x SoC or NCP Platform.*

Certificates and installation codes can be programmed using the same em3xx_load tool that is used to program other tokens. There is a separate application note which describes the process in detail. For more information, see document *AN708: Setting Manufacturing Certificates and Installation Codes*.

8.5 Using the Debugger in IAR Embedded Workbench with a Debug Adapter (ISA3)

1. Start IAR Embedded Workbench. Open the workspace (*.eww).
2. Select Project > Options. Select the Debugger > J-Link/J-Trace category. Select the Connection tab.
3. Select TCP/IP Communication and enter the IP address of the Debug Adapter (ISA3). Click OK.
4. Embedded Workbench is not able to program the flash on the EM35x. Every time the project is re-built, you must manually load it onto the EM35x (using em3xx_load.exe) before starting a debug session.
5. Once the correct image has been loaded onto the EM35x, select Project > Debug without Downloading to start the debug session.



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