



March 10, 2013
TS1 Rev. 0.9



InSight Adapter Technical Specification

The Ember InSight Adapter is the hardware interface between the Ember EM2xx-based designs and the Ember InSight Desktop. This document describes InSight Adapter features and specifications.

New in this Revision

Document renumbering.

Contents

Overview	2
Features	2
Supplying Power to the InSight Adapter.....	4
Setting Up the InSight Adapter	5
Interfaces	6

Overview

The InSight Adapter provides the programming, debugging, and data emulation capability for EmberZNet PRO-based applications. It converts between the Ember SIF commands, Packet Trace Interface, TCP/IP, and UDP for an easy-to-deploy system over 10/100 Ethernet. It also contains power management logic to transform Power-over-Ethernet (PoE) into IC-friendly voltage planes. So, you can integrate the EM2xx-based debugging environment into an existing network infrastructure and remotely deploy hardware during the development phase without having to stay close to a wall outlet. However, a DC power jack is also available for applications that need it.

As part of the Ember Development Kit, the InSight Adapter connects to the EM250 RCM through two interfaces: the 10-pin InSight Port and the InSight Data Emulation Interface. These two interfaces provide access to all EM250 GPIO as well as the EM250 programming and debug I/O.

Six different services are available within the InSight Adapter over Ethernet. These include:

- Backchannel debug service
- Discovery service
- SIF service
- Time Sync service
- Packet Trace service
- Administration service

Therefore, the InSight Adapter contains the same functionality as the previous Ember product family. With InSight Desktop and the InSight Adapter, an EM2xx-based network integrates into an existing EM2420-based network.

For more information on the different services and IP ports supported by the InSight Adapter, refer to document UG108, the *EM250 Development Kit User Guide*. See document TS2, the *EM250 Radio Communication Module Technical Specification*, for more information on the RCM.

Features

The Ember InSight Adapter offers:

- Programming and debugging of the Ember EM2xx chip family
- Programming speed up to 25MHz over a 1-foot InSight Port cable
- Power-over-Ethernet conversion, no power supply needed
- One DC power jack, for applications not using PoE
- Support for 10/100 Ethernet protocols (TCP/IP and UDP) via an RJ-45 connector
 - Auto-Rate negotiation for either 10 or 100Mbps Ethernet
 - Auto-MDIX detection and switching (allowing use of both normal and crossed RJ-45 cables)

-
- Access to the EM250 UART (TTL-compatible) via the InSight Data Emulation Interface
 - InSight Port signals individually buffered for RCM operation down to 2.1V
 - USB-support for administration and configuration
 - InSight Adapter reset button
 - Fully enclosed to ease deployment
 - Cables included with InSight Adapter:
 - InSight Port cable
 - USB cable
 - InSight data emulation cables

InSight Adapter Enclosure

The InSight Adapter PCB enclosure is secured on the bottom by two screws. You can deploy the adapter in any convenient orientation on a benchtop or throughout the application environment. Do not open the enclosure. If you experience issues or problems with the adapter, contact Customer Support at www.silabs.com/zigbee-support.

Table 1 lists the interfaces and mechanical characteristics of the InSight Adapter.

Table 1. Mechanical characteristics of the InSight Adapter

Parameter	Description
Dimensions Enclosure Front panel Rear panel	5.2" x 5.1" x 1.5" (l x w x h) 4.7" x 1.3" 4.7" x 1.3"
Interfaces InSight Data Emulation Interface InSight Port RJ-45 for PoE and 10/100 USB 12V DC power jack InSight reset	26-pin dual-row, stress-release connector 10-pin, dual-row, 0.05" pitch 10-pin, 802.3af standard connector USB-B Type Connector for serial administration 2.1 x 5.5mm Center Pin Connector Push button (Normally Open)
Back panel LED Power indicator	Blue LED
Front panel LEDs (left to right: Green, Red, Yellow, Orange) ¹	

¹ On ISAs built before 4/30/2006, red and orange LEDs are reversed.

Supplying Power to the InSight Adapter

Warning: The Power-over-Ethernet circuitry within the InSight Adapter carrier board operates at a 48V DC potential. Before connecting Power-over-Ethernet, follow the basic electrical safety instructions provided in the *NetGear User Manual*.

As shown in Figure 1, you can power the InSight Adapter with either:

- 12V power input (DC power jack)
- RJ-45 connector using Power-over-Ethernet

IEEE standard 802.3af-2003 defines Power-over-Ethernet. This standard recommends that power and data be delivered to a device via a standard Ethernet (Cat5) cable, eliminating the need for an electrical cable in addition to a data cable. When a device is not drawing power from the Ethernet cable, the power-sourcing equipment turns off power to that device. You must have a power injector in order to power the board with the Ethernet cable. Silicon Labs recommends the power injector supplied in the Developer and Jump Start Kits (from NetGear), which Silicon Labs has tested and determined performs satisfactorily. If you plan to use a different PoE injector, contact Customer Support at www.silabs.com/zigbee-support before connecting.

Note: Power-over-Ethernet is disabled when the InSight Adapter is powered with the 12V DC power input. However, the Ethernet data is still available.

Table 2 describes the electrical characteristics of the InSight Adapter.

Table 2. DC electrical characteristics of the InSight Adapter

Parameter	Min.	Typ.	Max.	Unit
12V DC power jack Voltage supply Current draw (12V)	7	12 120	25	V mA
Power-over-Ethernet Power rating		1.44		W
InSight Port current source (to RCM or EM2xx-based design)		40	50	mA
Temperature range	- 40		85	C

Setting Up the InSight Adapter

The Ember Development Kit supports the InSight network, which runs over the Ethernet. Each Ember node is connected to the InSight network via its InSight adapter, which also takes node activity accessible to InSight Desktop. Together, InSight adapters and InSight Desktop provide an integrated development environment where you can perform a number of tasks, including:

- Debug hardware
- Monitor application or debug data
- Monitor radio data packets

Note: The Ember Development Kit is configured to support DHCP. If your site is configured for static IP addresses, refer to document UG108, the *EM250 Development Kit User Guide*, about configuring nodes for static IP addresses.

To set up an InSight environment:

1. Connect the supplied Ethernet switch so it has access to a DHCP server.
2. Connect to the Ethernet switch router:
 - All InSight adapters
 - The workstation where InSight Desktop is installed
3. Identify the RCM that is labeled Sink: connect it to the InSight adapter that is labeled `ember00`.
4. Connect the remaining RCMs and InSight adapters.

5. Connect each RCM to the EM250 Module area of a breakout board.
6. Connect the remaining RCMs to breakout boards.
7. Verify that each RCM powers up by checking whether its red LED is on. If not, check the RCM Power Select switch on its InSight adapter and verify it is set to Int as shown in Table 5.

Interfaces

Figure 1 and Figure 2 show the interfaces on the front and back panels of the InSight Adapter.

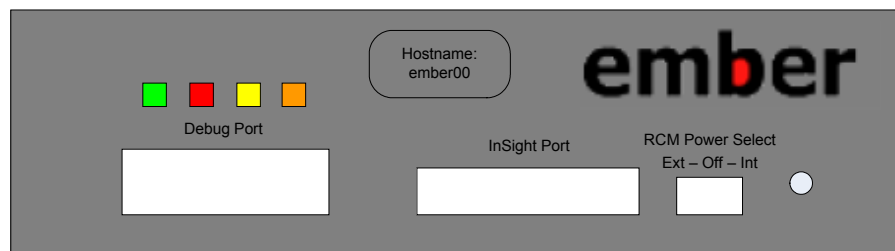


Figure 1. InSight Adapter front panel

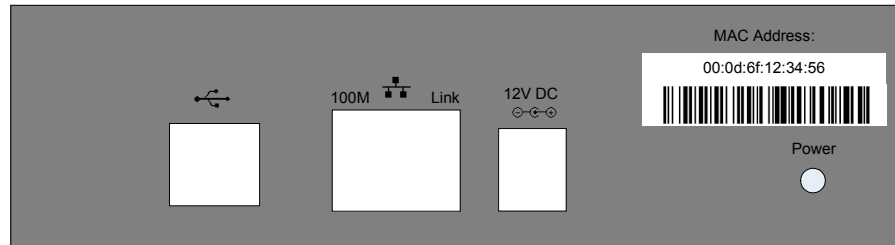


Figure 2. InSight Adapter back panel

Back Panel Interfaces

Figure 2 contains three PC-based interfaces (a USB connector, an RJ-45 connector, and a DC power jack) and one LED indicator. The LED indicator (blue) illuminates when valid power is connected to the InSight Adapter. The InSight Adapter can be powered either by the 12V DC jack (J3) or by Power-over-Ethernet. Therefore, the InSight Adapter ships with a 12V DC power supply with appropriate AC plugs for your region, while the EM2xx Kit ships with a Power-over-Ethernet injector.

Note: PoE and a DC power supply can be connected to the InSight Adapter at the same time. Logic in the InSight Adapter gives priority to the DC power supply.

DC Power Jack

The DC power jack on the InSight Adapter allows for a robust connection (5000 cycles) to the 12V DC power supply provided. The 2.1 x 5.5mm jack from CUI, Inc (MFG P/N: PJ-105A-SMT) is rated to 16V DC at 2.5A. The center pin of the jack is +V with shroud connected to the GND plane. If you want to use a different DC power supply, contact Customer Support at www.silabs.com/zigbee-support.

RJ-45 Connector

The RJ-45 is a 10-pin surface-mount interface for a standard Cat5 cable. It provides access to the Ethernet backchannel via 10/100 Ethernet link. The connector also provides for a 48V interface from the Ember Development Kit's Power-over-Ethernet injector. The connector on the InSight Adapter integrates the Link and Activity LEDs for an immediate feedback for proper installation.

USB

The USB connector (USB-B type) is used only for administration and configuration of the InSight Adapter. A standard 4-foot USB cable (USB-B to USB-A) ships with the InSight Adapter; however, you can use any USB cable. For more information on configuration and administration commands, refer to document UG108, the *EM250 Development Kit User Guide*.

LED Power Indicator

The blue LED on the back panel illuminates when valid power is connected to the InSight Adapter. This LED should stay lit—but not blinking—during normal operation. If the LED blinks, disconnect power and contact Customer Support at www.silabs.com/zigbee-support.

Front Panel Interfaces

The front panel (shown in Figure 1) contains two data interfaces, a voltage selector switch, a reset button, and four LEDs. The two data interfaces include the InSight Data Emulation Interface (labeled “Debug Port” in Figure 1) and the InSight Port. The voltage selector switch enables appropriate buffering on the InSight Port cable. The four LEDs indicate the operation state of the InSight Adapter.

InSight Port

The 10-pin, dual-row, 0.05-inch-pitch InSight Port is the programming and debug interface for the EM2xx family of chips. It contains the four SIF Signals (SIF_MOSI, SIF_MISO, SIF_LOADB, and SIF_CLK), two Packet Trace signals (PTI_EN and PTI_DATA), and voltage and ground connections. An InSight Port cable is shipped with the InSight Adapter. With the InSight Port (Samtec P/N: `FFSD-05-D-12.00-01-N`), direct connection to the EM2xx-based design (either the Ember RCM or customer-designed module) is available. When the InSight Port cable is attached, full access to the features of InSight Desktop is available.

Note: Any design involving an Ember EM2xx chip should route the InSight Port signals to test pins or, ideally, to a dual-row, 0.05-inch-pitch SMT footprint similar to the Samtec (MFG P/N: `FTSH-105-01-F-DV-K`).

Figure 3 illustrates the InSight Port connector and Table 3 describes the pins on the InSight Port.

VBRD	1	2	SIF_MISO
SDBG	3	4	SIF_MOSI
GND	5	6	SIF_CLK
nSIF_LOAD	7	8	nRESET
PTI_EN	9	10	PTI_DATA

Figure 3. InSight Port connector

Table 3. InSight Port pins

Pin #	Signal name	Direction	Description
1	VBRD	Power	2.1 to 3.6V supply for the RCM
2	SIF_MISO	Output	Serial Interface master in, slave out
3	SDBG	Output	Debug signal to be used on future pin-compatible products
4	SIF_MOSI	Input	Serial Interface master out, slave in
5	GND	Power	Ground
6	SIF_CLK	Input	Serial Interface clock
7	nSIF_LOAD	I/O	Serial Interface load strobe (open-collector with internal pull-up)"
8	nRESET	Input	Active low EM250 Reset Signal (internal pull up on EM250)
9	PTI_EN	Output	Packet Trace enable signal
10	PTI_DATA	Output	Packet Trace data signal; 500 kbps

InSight Data Emulation Interface

The 26-pin, dual-row, Extended Debug Connector allows additional access to the EM2xx series of chips. On the EM250, it allows access from the backchannel port 4901 to the EM250 UART connection on the EM250 Breakout Board. The DEI cable is custom to the Ember InSight Adapter and is provided as part of the InSight Adapter assembly. For more information on the EM250 Breakout Board, refer to document TS3, *EM250 Breakout Board Technical Specification*.

LED Indicators (Front Panel)

Four LEDs on the front panel indicate the operational state of the InSight Adapter. Table 4 describes the LED states.

Table 4. InSight Adapter LED indicator states ¹

LED states	Description
   	All LEDs illuminated: Power-on sequence of InSight Adapter initiated
   	Only orange LED illuminated: bootloader initiated with default configuration
   	Green LED illuminated with blinking red LED: InSight Adapter application has begun (Green) with OS Heartbeat (Red). Note: This is the normal operating state of the InSight Adapter. At this point it is safe to use with the InSight Desktop.
   	Green and Red LEDs illuminated with blinking Yellow LED: the InSight Adapter booted up in default configuration mode because both the config.txt and config.bak configuration files are corrupt.
   	Green and Yellow LED illuminated with blinking red LED: InSight Adapter is in Upload mode.
   	Red LED stays illuminated for a period of time > 30s; InSight Adapter Firmware is corrupt. Power cycle the InSight Adapter. If this persists, contact Customer Support.
   	Green LED stays illuminated; InSight Adapter is unsuccessfully trying to get an IP address from a DHCP Server.

¹ On ISAs built before 4/30/2006, red and orange LEDs are reversed.

Voltage Selection Toggle Switch

Because the EM2xx family can operate with a supply voltage between 2.1 and 3.6V and the core logic of the InSight Adapter is at either 1.8V or 3.0V, the InSight Adapter must be able to properly buffer the signals between the EM2xx and itself. In addition, the InSight Adapter can supply power to the EM2xx through the InSight Port.

Therefore, the InSight Adapter contains digital control logic for the InSight Port voltage buffers based on the position of the three-position voltage selection toggle switch. Table 5 describes the toggle switch positions.

Table 5. Voltage selection toggle switch positions

Toggle switch position	Description
Ext – Off – Int 	The InSight Port enables current draw from the InSight Adapter power management block. This is at 3V and sources as much as 50 mA.
Ext – Off – Int 	The InSight Port is disabled. This is the default shipping position.
Ext – Off – Int 	The EM2xx-based hardware contains its own power supply (such as a battery source), and the InSight Port signals are buffered to that voltage level. Note: The InSight Port Voltage Selection Logic requires 5 mA (max) of current from the “external” power supply.

InSight Adapter Reset Button

By depressing the InSight Adapter reset button, the InSight Adapter jumps into its reset state machine.

After Reading This Document

If you have questions about the information described in this document, please contact Customer Support at www.silabs.com/zigbee-support.



The information in this document is believed to be accurate in all respects at the time of publication but is subject to change without notice. Silicon Laboratories assumes no responsibility for errors and omissions, and disclaims responsibility for any consequences resulting from the use of information included herein. Additionally, Silicon Laboratories assumes no responsibility for the functioning of undescribed features or parameters. Silicon Laboratories reserves the right to make changes without further notice. Silicon Laboratories makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Silicon Laboratories assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. Silicon Laboratories products are not designed, intended, or authorized for use in applications intended to support or sustain life, or for any other application in which the failure of the Silicon Laboratories product could create a situation where personal injury or death may occur. Should Buyer purchase or use Silicon Laboratories products for any such unintended or unauthorized application, Buyer shall indemnify and hold Silicon Laboratories harmless against all claims and damages.

Silicon Laboratories, Silicon Labs, and Ember are trademarks of Silicon Laboratories Inc. Other products or brandnames mentioned herein are trademarks or registered trademarks of their respective holders.