



# InSight Adapter (ISA3) Technical Specification

The Ember InSight™ Adapter (ISA3) provides the programming, debugging, and data emulation capability for an EM35x-based application. Ember’s EM35x chip family integrates the ARM® Cortex™-M3, 32-bit microcontroller core. The ISA3 converts between the Ember JTAG and Serial Wire (SW) commands, Packet Trace Interface, TCP/IP, and UDP for an easy-to-deploy system over 10/100 Ethernet.

As part of the EM35x Developer Kit, the ISA3 connects to the EM35X module through two interfaces: the 10-pin InSight Port (ISP) and the 12-pin InSight Data Emulation Interface (DEI). These two interfaces provide access to most EM35x GPIO as well as the EM35x programming and debug I/O.

The ISA3 also contains power management logic to transform Power-over-Ethernet (PoE) into IC-friendly voltage planes. The PoE functionality allows a design team to integrate the EM35x-based debugging environment into an existing network infrastructure and remotely deploy hardware during the development phase without having to remain close to a wall outlet. In addition, a self-powered, USB connection is also available for applications that interface directly to a PC or USB device. You can use the ISA3 to perform the following tasks:

- Program or debug EM35x applications using Serial Wire or JTAG.
- Monitor packets sent and received by the radio.
- Send and receive serial port data.
- Send and receive debugging data.
- Power cycle the EM35x.
- Control reset, bootloader and GPIO signals.

Therefore, the ISA3 contains the same functionality as the previous Ember product family. With InSight Desktop and the ISA3, an EM35x-based network integrates into an existing EM2xx-based or EM2420-based network. The ISA3 cannot be used to debug or program an EM250, EM260 or EM2420.

This document describes ISA3 features and specifications. For more information on the different services and IP ports supported by the ISA3, see Ember document 120-4030-000, *EM35x Development Kit User Guide*.

## New in this Revision

Revision E: LED states for bootload mode added to Table 6.

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## Features

The ISA3 offers:

- Programming and debugging of the Ember EM35x chip family
- Programming speed up to 3 MHz (tested to 10' cable length)
- Power-over-Ethernet conversion, no power supply needed
- One self-powered USB 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 100 Mbps Ethernet
  - Auto-MDIX detection and switching (allowing use of both normal and crossed RJ-45 cables)
- Access to the EM35X UART (TTL-compatible) via the InSight Data Emulation Interface
- Access to Virtual UART (VUART) serial port emulation via InSight Port
- InSight Port signals individually buffered for RCM operation down to 2.1 V
- Target Power Select Switch (Internal vs. External)
- Target Over-current Detection
- USB-support for administration and configuration
- ISA3 factory defaults button
- Cables included with ISA3:
  - USB cable
  - InSight Port cable
  - InSight Data Emulation Interface cable
  - Ethernet patch cable

### ISA3 Enclosure

The ISA3 PCB enclosure is secured on the bottom by four screws. You can deploy the adapter in any convenient orientation on a bench-top or throughout the application environment. Do not open the enclosure.

If you experience issues or problems with the adapter, contact Ember Customer Support at [http://www.ember.com/support\\_index.html](http://www.ember.com/support_index.html).

Table 1 lists the interfaces and mechanical characteristics of the ISA3.

Table 1. Mechanical characteristics of the ISA3

Parameter	Description
Dimensions Enclosure End plate	4.625" x 2.85" x 1.0" (l x w x h) 2.53" x 0.68"
Interfaces InSight Data Emulation Interface InSight Port  RJ-45 for PoE and 10/100 Data USB  Factory Defaults Firmware Erase Target Power Select	12-pin, dual-row, 0.1" pitch 10-pin, dual-row, 0.05" pitch  10-pin, 802.3af standard connector USB-B Type Connector for power and serial administration  Push button (Normally Open) Push button (Normally Open) Single-pole double-throw toggle switch
LEDs (left to right: Green, Red, Yellow, Orange)	 <p>Power Status Activity Target</p>

## Supplying Power to the ISA3

**Warning:** The Power-over-Ethernet circuitry within the ISA3 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 ISA3 with either:

- USB connector using USB cable from PC or USB power supply
- 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. Ember recommends the power injector supplied in the Developer Kits (from NetGear), which Ember has tested and determined performs satisfactorily. If

you plan to use a different PoE injector, contact Ember Customer Support at [http://www.ember.com/support\\_index.html](http://www.ember.com/support_index.html) before connecting.

**Note:** Power-over-Ethernet is disabled when the ISA3 is connected to USB. However, the Ethernet data is still available.

Table 2 describes the electrical characteristics of the ISA3.

Table 2. DC electrical characteristics of the ISA3

Parameter	Min.	Typ.	Max.	Unit
USB Connector Voltage supply Current draw (5V)	3.3	5 500	5	V mA
Power-over-Ethernet Power rating		1.44		W
InSight Port current source (to RCM or EM35x-based design)		50	250	mA
InSight Port voltage source (to RCM or EM35x-based design) <sup>1</sup>	2.70	3.10	3.30	V
Temperature range	0		55	C

<sup>1</sup> Due to the power distribution circuit of the ISA3, the target voltage drops as the load current increases. Therefore, when the target current is 250 mA, the target voltage is 2.70 V. The resistance of the target current measurement circuit is 2.5Ω from the on-board target regulator to the target itself, so for every 50 mA current sourced, the target voltage will drop 125 mV. If a constant 3.3 V target voltage is desired with high current loads, the target should be powered externally rather than via the ISA3.

## Setting Up the ISA3

The Ember Developer Kit supports the InSight network, which runs over Ethernet. Each EM35x-based node is connected to the InSight network via its ISA3, which also takes node activity accessible to InSight Desktop. Together, ISA3s 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 Developer Kit is configured to support DHCP. If your site is configured for static IP addresses, see Ember document 120-4031-000, *EM35X Quick Start Guide*, about configuring nodes for static IP addresses.

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To set up an InSight environment:

1. Connect the supplied PoE switch so it has access to a DHCP server.
2. Connect to the PoE switch:
  - All ISA3s
  - The workstation where InSight Desktop is installed
3. Connect Breakout Boards with ISA3s via InSight Port and DEI Port cables.
4. Connect each RCM to the EM35X Module area of a breakout board.
5. Verify that each Breakout Board powers up by checking whether its power LEDs are on. If not, check the Target Power Select Switch on its ISA3 and verify it is set to Int as shown in Table 3.

## Interfaces

Figure 1 and Figure 2 show the interfaces on the front and back panels of the ISA3. Figure 3 shows the LEDs on the cover.

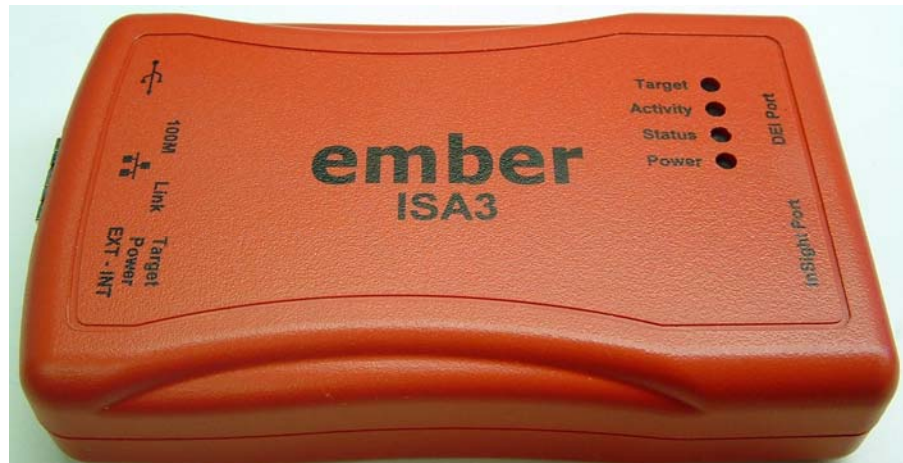
Figure 1. ISA3 front panel (InSight Port, DEI, Factory Defaults)



Figure 2. ISA3 back panel (USB, Ethernet, Target Power)



Figure 3. ISA3 cover



### Back Panel Interfaces

Figure 2 contains two PC-based interfaces (a USB connector and an RJ-45 connector) and one Target Power select switch. The ISA3 can be powered either by the USB connector (self-powered via PC or USB power supply brick) or by PoE via the RJ-45 connector. Therefore, the ISA3 ships with a USB power supply with appropriate AC plugs for your region, while the EM35x Kit ships with a PoE switch.

**Note:** PoE and USB can be connected to the ISA3 at the same time. Logic in the ISA3 gives priority to the USB connection.

### RJ-45 Connector

The RJ-45 is a 10-pin surface-mount interface for a standard Cat5 cable. It provides access to the Ethernet 10/100 Ethernet link. The connector also provides for a 48 V

interface from the Ember Developer Kit’s Power-over-Ethernet switch. The connector on the ISA3 integrates the Link and 100M LEDs for an immediate feedback for proper installation.



### USB

The USB connector (USB-B type) is used for administration and configuration of the ISA3, as well as a power supply via either a PC or USB power supply brick. A standard 6-foot USB cable (USB-B to USB-A) ships with the ISA3; however, you can use any USB cable. For more information on configuration and administration commands, see Ember document 120-4030-000, the *EM35x Development Kit User Guide*.

### Target Power Select Switch

Because the EM35x IC family can operate with a supply voltage between 2.1 and 3.6 V and the core logic of the ISA3 is at 3.3 V, the ISA3 must be able to properly buffer the signals between the EM35x and itself. In addition, the ISA3 can supply power to the EM35x through the InSight Port. Therefore, the ISA3 contains digital control logic for the InSight Port voltage buffers based on the position of the two-position voltage selection toggle switch. Table 3 describes the toggle switch positions.

Table 3. Voltage selection toggle switch positions

Toggle switch position	Description
Ext – Int 	The InSight Port enables current draw from the ISA3 power management block. This is at 3.3V and sources as much as 250 mA. See Table 2 for more details on voltage and current specs.
Ext – Int 	The EM35x-based hardware contains its own power supply (such as a battery source), and the InSight Port signals are buffered to that voltage level.  <b>Note:</b> The InSight Port Voltage Selection Logic requires 5 mA (max) of current from the “external” power supply.

### Front Panel Interfaces

The front panel (shown in Figure 1) contains two data interfaces and a factory defaults button. The two data interfaces include the InSight Data Emulation Interface (labeled “DEI 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 ISA3.

### InSight Port

The 10-pin, dual-row, 0.05-inch-pitch InSight Port is the programming and debug interface for the EM35x family of chips. It contains the five multipurpose JTAG/Serial Wire Signals (nJNST, JTDO/SWO, JTMS/SWDIO, JTDI, and JCLK/SWCLK), two Packet Trace signals (PTF and PTD), and voltage and ground connections. An InSight Port cable is shipped with the ISA3. With the InSight Port cable (Samtec P/N: FFSD-05-D-12.00-01-

N), direct connection to the EM35x-based design (either the Ember Module 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 EM35x 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) connector.

Figure 4 illustrates the InSight Port connector and Table 4 describes the pins on the InSight Port.

Figure 4. InSight Port connector

VBRD	1	2	PC2 (JTDO/SWO)
PC0 (nJRST)	3	4	PC3 (JTDI)
GND	5	6	JCLK/SWCLK
PC4 (JTMS/SWDIO)	7	8	nRESET
PA4 (PTF)	9	10	PA5 (PTD)

Table 4. InSight Port pins

Pin #	Signal name	Direction (to ISA3)	Description
1	VBRD	Power	2.1 to 3.6 V supply for the EM35x Module RCM
2	PC2 (JTDO/SWO)	Output	JTAG JTDO, serial wire out
3	PC0 (nJRST)	Output	JTAG reset
4	PC3 (JTDI)	Input	JTAG data in
5	GND	Power	Ground
6	JCLK/SWCLK	Input	JTAG clock, serial wire clock
7	PC4 (JTMS/SWDIO)	I/O	JTAG JTMS, serial wire data in/out
8	nRESET	Input	Active low EM35X Reset Signal (internal pull up on EM35X)
9	PA4 (PTF)	Output	Packet Trace enable signal
10	PA5 (PTD)	Output	Packet Trace data signal; 500 kbps

### InSight Data Emulation Interface

The 12-pin, dual-row, Extended Debug Connector allows additional access to a subset of the EM35x series GPIO. On the EM35X, it allows access from the UART passthrough port 4901 to the EM35x UART connection on the EM35x Breakout Board. The DEI cable (3M P/N: 70-0100-1832-6) is custom to the Ember ISA3 and is provided as part of the ISA3 assembly. For more information on the EM35x Breakout Board, refer to the *EM35x Breakout Board Technical Specification* (120-2009-000).

Figure 5 illustrates the DEI Port connector and Table 5 describes the pins on the DEI Port.

Figure 5. DEI Port connector

VBRD	1	2	PB1 (SC1TXD/SC1MOSO)
PC6 (nTX_ACTIVE)	3	4	PB2 (SC1RXD/SC1MISI)
PB4 (SC1RTS/SC1SSEL)	5	6	PB3 (SC1CTS/SC1MCLK)
PB6 (ADC1/INTB)	7	8	PC5 (TX_ACTIVE)
PC1 (ADC3/TRACEDATA0)	9	10	PA7 (REG_EN/TMR1C4)
PB0 (TRACECLK/INTA)	11	12	GND

Table 5. DEI Port pins

Pin #	Signal name	Direction (to ISA3)	Description
1	VBRD	Power	2.1 to 3.6V supply for the RCM
2	PB1 (SC1TXD/SC1MOSO)	Input	SC1TXD – SC1MOSO –
3	PC6 (nTX_ACTIVE)	Open Collector	Button0
4	PB2 (SC1RXD/SC1MISI)	Output	SC1RXD – SC1MISI –
5	PB4 (SC1RTS/SC1SSEL)	Input	SC1RTS – SC1SSEL –
6	PB3 (SC1CTS/SC1MCLK)	Output	SC1CTS – SC1MCLK –
7	PB6 (ADC1/INTB)	Open Collector	Button1
8	PC5 (TX_ACTIVE)	Input	TX_ACTIVE
9	PC1 (ADC3/TRACEDATA0)	Input	TRACEDATA0 – ADC3 –
10	PA7 (REG_EN/TMR1C4)		REGEN – TMR1C4 –
11	PB0 (TRACECLK/INTA)		TRACECLK – INTA –
12	GND	Power	Ground

### ISA3 Factory Defaults Button

The ISA3 factory defaults button is accessible via a small hole to the left of the InSight Port connector, as seen in Figure 1. By depressing the button with a paper clip on power-up, the ISA3 jumps into its factory defaults state machine, configuring the ISA3 with all default settings and a known good configuration.





### Cover Interfaces

The cover (shown in Figure 3) contains four LEDs which indicate the operation state of the ISA3.

### LED Indicators

Four LEDs on the front panel indicate the operational state of the ISA3. Table 6 describes the LED states.

Table 6. ISA3 LED indicator states

LED	State	Description
 Power Green	Off	ISA3 not powered
	On	ISA3 has power (from USB or PoE)
 Status Red	Off	No Error
	Blinking	Internal Error. Contact Ember Support.
 Activity Yellow	On , Solid (No Blinking)	ISA3 Bootloader Mode
	On (Blinking, (2 sec interval)	Idle Heartbeat
	On, Flashing Quickly	Either of the following: 1) Acquiring IP address 2) Establishing USB connection 3) Processing J-Link command
 Target Orange	Off	Target voltage is 0 V. Note: This LED is also off in ISA3 Bootloader Mode.
	On	Target voltage is above 0 V, either from internal or external supply (dictated by Target Power Select Switch).
	Blinking	Internal supply shut off due to over-current detection.

### After Reading This Document

If you have questions or require assistance with the procedures described in this document, contact Ember Customer Support. The Ember Customer Support portal provides a wide array of hardware and software documentation such as FAQ's, reference designs, user guides, application notes, and the latest software available to download. To obtain support on all Ember products and to gain access to the Ember Customer Support portal, visit [http://www.ember.com/support\\_index.html](http://www.ember.com/support_index.html).

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