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# ConnectCore<sup>®</sup> 9C/Wi-9C

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Hardware Reference Manual

## Revision history—90000789

Revision	Date	Description
A	August, 2006	Initial release.
B	February, 2007	Updated antenna graphics.
C	May, 2007	Minor updates for the NetOS 7.2 release.
D	June, 2010	Made minor corrections in content, images and tables.
E	June, 2017	Updated branding and added statements for RED compliance.

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## Maximum power and frequency specifications

## About the Modules

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The ConnectCore 9C and ConnectCore Wi-9C modules are powerful ARM9-based modules in a compact and universal SO-DIMM (Small Outline Dual Inline Memory Module) form factor. The modules provide core processing functionality with integrated wired and wireless network connectivity and a complete set of peripheral options in a footprint-compatible interchangeable SO-DIMM form factor that allows you to optimize your system for either Ethernet, WLAN, or both.

- The ConnectCore 9C provides 10/100 Ethernet connectivity only.
- The ConnectCore Wi-9C provides both 10/100 Ethernet and 802.11b/g wireless networking capabilities.
- All modules are fully compliant with EU directive 2002/95/EC (RoHS).

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## Common module features

- 32-bit NS9360 high performance RISC processor @ 155 MHz
- Up to 256 MB Flash and 256 MB SDRAM
- Compact SO-DIMM (Small Outline-Dual Inline Memory Module) design
- Low power consumption
- Industrial/extended operating temperature
- 10/100 Mbps Ethernet interface with optional on-board RJ-45 connector
- IEEE802.3af compliant power pass-through (mid-span and end-span)
- Up to four high-speed serial ports — UART and SPI mode configurable
- I<sup>2</sup>C bus interface
- USB 2.0 Host and Device interfaces
- Optional on-board USB Host connector
- Integrated LCD controller
- Up to eight independent 16-/32-bit programmable timers, counters, or four PWM functions
- Four programmable external interrupts
- Up to 55 shared General Purpose Input/Output (GPIO) ports
  - Up to seven high-current (8mA) pins
- 8-bit wide data/address bus with external chip select
- Processor-powered on-chip Real-Time Clock (RTC)
- Population options available (processor speed, memory, connectors)

## Wi-9C specific features

- 802.11b/g WLAN interface
- WEP, WPA, and WPA2/802.11i security standard
- Single or dual-diversity antenna options

## Memory

The module's standard memory configuration is 4 MB Flash and 16 MB SDRAM.

## Memory clocks

Memory clocks = 77.5 MHz

- Not available for off-DIMM use
- `clk_out[0]` — Not used; turned off by code
- `clk_out[1]` — Connected to `clk_in`
- `clk_out[2]` — Used for one bank of two X16 SDRAMS
- — Not used

## Other system clocks

- Source clock is a 29.4912 MHz crystal or spread spectrum oscillator.
- USB uses a 48.000 MHz oscillator
- Ethernet versions have a 25.0000 MHz crystal

## Interfaces

The ConnectCore 9C/Wi-9C module supports several system interfaces. This section details the features of these interfaces.

### Ethernet

The module provides a 10/100 Mbps Ethernet interface with optional on-board RJ-45 connector and integrated LEDs. On modules not populated with the RJ-45 connector, the Ethernet PHY signals are available on the SO-DIMM edge connector.

- Full-duplex or half-duplex
- Station, broadcast, or multicast address filtering
- 2 kB RX FIFO
- 256-byte TX FIFO with on-chip buffer descriptor ring
- Separate TX and RX DMA channels
- Intelligent receive-side buffer size selection
- Full statistics gathering support
- External CAM filtering support

### WLAN

The ConnectCore Wi-9C provides integrated 802.11b/g wireless networking capabilities.

Standard compliance: IEEE 802.11g-2003

Frequency: 2.4 GHz

Data rates: Up to 54 Mbps with fallback

Modulation:

- DBPSK (1 Mbps)
- DQPSK (2 Mbps)
- CCK (5.5, 11 Mbps)
- BPSK (6, 9 Mbps)

- QPSK (12, 18 Mbps)
- 16-QAM (24, 36 Mbps)
- 64-QAM (48, 54 Mbps)

Transmit power: 12 dBm typical

Receive sensitivity:

Receive sensitivity		
Data Rate	MIN	TYP
11Mbps	-76 dBm	-87 dBm
54Mbps	-65 dBm	-73 dBm

Antenna connectors: U.FL or RP-SMA

Dual-diversity: Available on modules with two U.FL or RP-SMA connectors

### USB 2.0 host and device

- USB v2.0 full speed (12 Mbps) and low speed (1.5 Mbps)
- Independent OHCI Host and Device ports
- Internal USB PHY
- External USB PHY interface

The module provides a population option for a four-port hub with onboard dual-connector (500mA, 5V only) and full speed/low speed support.

### Serial

- Bit rates from 75 bps to 921.6 kbps: asynchronous mode
- Bit rates from 1.2 kbps to 11.25 Mbps: synchronous mode
- UART provides:
  - High performance hardware and software flow control
  - Odd, even, or no parity
  - 5, 6, 7, or 8 bits
  - 1 or 2 stop bits
  - Receive-side character and buffer gap timers
- Four receive-side data match detectors
- Two dedicated DMA channels per module; 8 channels total
- 32 byte TX FIFO and 32 byte RX FIFO per module

### I<sup>2</sup>C

- I<sup>2</sup>C v.1.0 configurable to master or slave
- Bit rates: fast (400 kHz) or normal (100 kHz) with clock stretching

- 7-bit and 10-bit address modes
- Supports I<sup>2</sup>C bus arbitration

## External Memory bus

- 8-bit address bus
- 8-bit data bus
- 1 external chip select

## LCD

- Dual 64-deep, 32-bit wide FIFOs for buffering incoming display data
- Support for color and monochrome single- and dual-panel for Super Twisted Nematic (STN) displays with 4- or 8-bit interfaces
- Support for Thin Film Transistor (TFT) color displays
- Resolution up to 800 x 600 pixels
- 15 gray-level mono, 3375 color STN, and 64K color TFT support
  - Patented gray-scale algorithm
- 1, 2, or 4 bits-per-pixel (bpp) palettized displays for mono STN
- 1, 2, 4, or 8 bpp palettized color displays for STN and TFT
- 16 bpp true-color non-palettized, for color STN and TFT
- Programmable timing for different display panels
- 256 entry, 16-bit palette RAM, arranged as a 128 x 32-bit RAM
- Frame, line, and pixel clock signals
- AC bias signal for STN, data enable signal for TFT panels
- Support for multiple data formats

## ConnectCore 9C configurations

The ConnectCore 9C module is available in these base configurations:

- **Fully populated.** A fully populated module includes on-board Ethernet PHY, Ethernet magnetics with RJ-45, a USB hub and Type A female connector.
- **With Ethernet but no USB Host.** With this setup, Ethernet PHY or Ethernet magnetics with RJ-45 are on the module. The module does not have an on-board USB hub and Type A female connector, although USB Host and Device signals are available on the edge connector.

- **No additional on-board connectors.** With this setup, there is no Ethernet RJ-45 with integrated magnetics on the module, but does have the Ethernet PHY. The module does not have an on-board USB Hub and type A female connector.

---

**Note** Modules without an on-board Ethernet connector provide the Ethernet PHY signals through the SO-DIMM edge connector. Modules with on-board USB hub have access to hub ports 3 and 4 through the SO-DIMM edge connector. Modules without on-board USB hub have access to HDM!, DP1, GPIO16, and GPIO17 through the SO-DIMM connector. All modules have access to the USB device only signals which require an external PHY through the SO-DIMM connector (see appendix A, USB Device only Table).

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Design aid schematics are available for interfacing to all of the module versions.

See the *cc9c-wi-9c\_baseboard\_design\_aids* file at [www.digi.com/support](http://www.digi.com/support) > *ConnectCore 9C* or *ConnectCore Wi-9C* documentation.

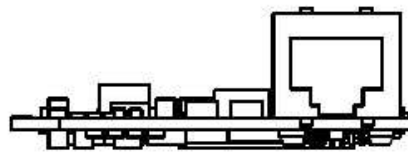
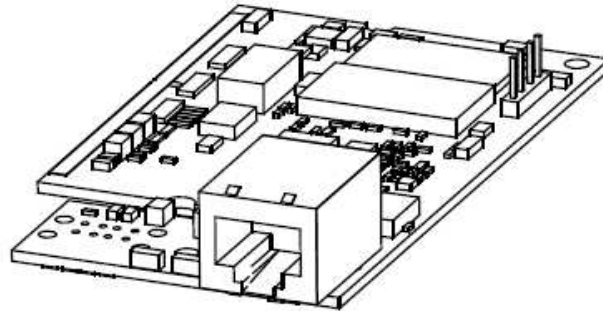
See the table in [Module / SO-DIMM signal characteristics](#).

Additional population options are available. For information, contact your local Digi sales office or distributor.

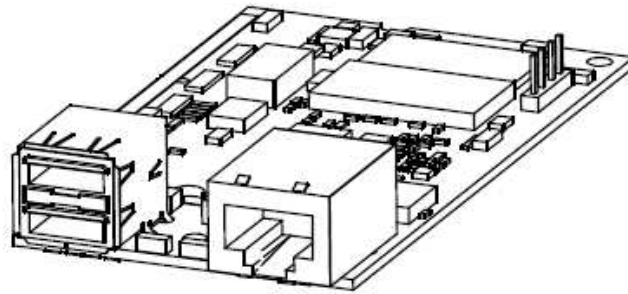
## Configuration diagrams

The diagrams in this section show configurations for the ConnectCore 9C module, illustrated with top and edge views.

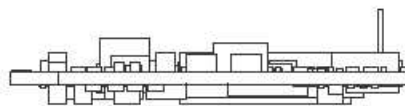
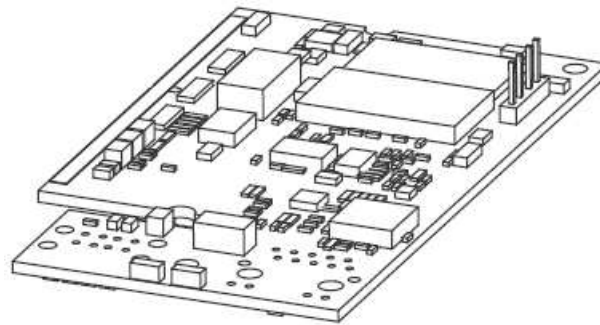
### Standard configuration with Ethernet without USB



### With Ethernet and USB



**Without Ethernet and USB**



## ConnectCore Wi-9C configurations

The ConnectCore Wi-9C module is available in these base configurations:

- **Fully populated, 2xRP-SMA.** A fully populated module using RP-SMA includes on-board Ethernet PHY, Ethernet magnetics with RJ-45, a USB hub and Type A female connector, and two RP-SMA connectors.
- **With Ethernet, without USB, and with single RP-SMA.** With this setup, Ethernet PHY or Ethernet magnetics with RJ-45 are on the module. The module does not have an on-board USB hub and Type A female connector. There is one RP-SMA connector.

- **No additional on-board connectors, with single RP-SMA.** With this setup, there is no Ethernet RJ-45 with integrated magnetics on the module. There is one RP-SMA connector with the Ethernet PHY. The module does not have an on-board USB Hub and Type A female connector.

---

**Note** Modules without an on-board Ethernet connector provide the Ethernet PHY signals through the SO-DIMM edge connector.

---

- **With Ethernet, without USB, and with 2xU.FL.** With this setup, Ethernet PHY or Ethernet magnetics with RJ-45 are on the module. The module does not have an on-board USB hub and Type A female connector, although USB Host and Device signals are available on the edge connector. There are two U.FL connectors.

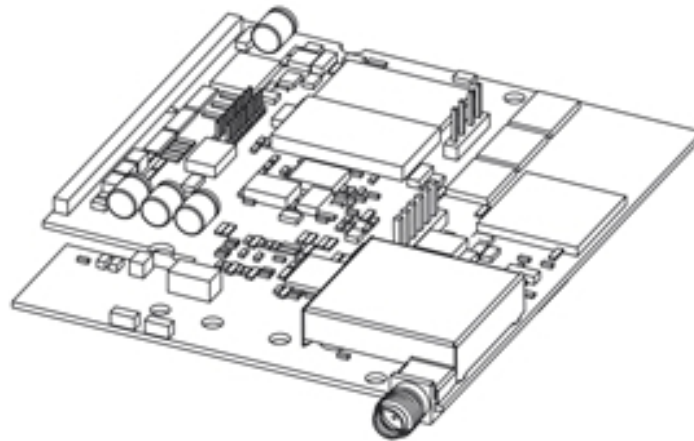
Additional population options are available. For information, contact your local Digi sales office or distributor.

## Configuration diagrams

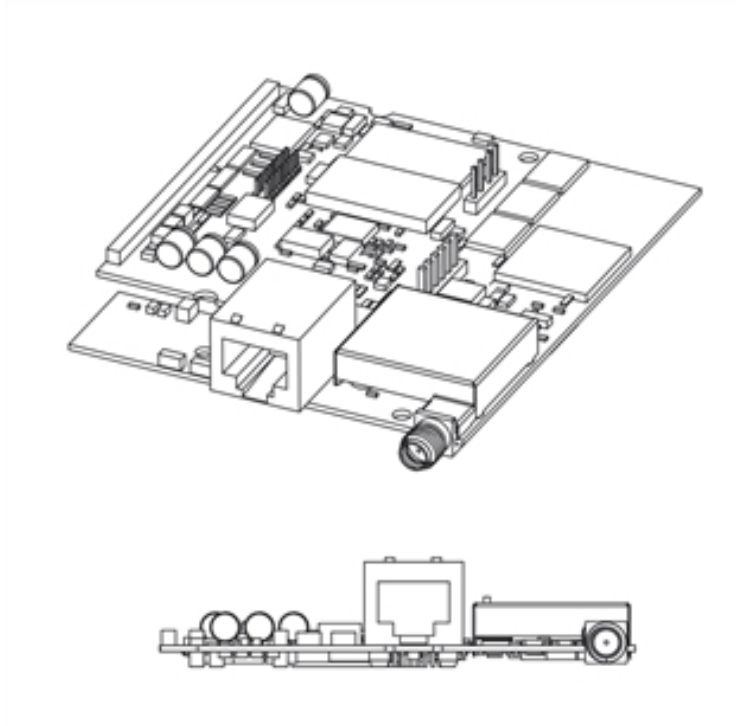
The diagrams in this section show configurations for the ConnectCore Wi-9C module, illustrated with top and edge views.

### Standard configuration

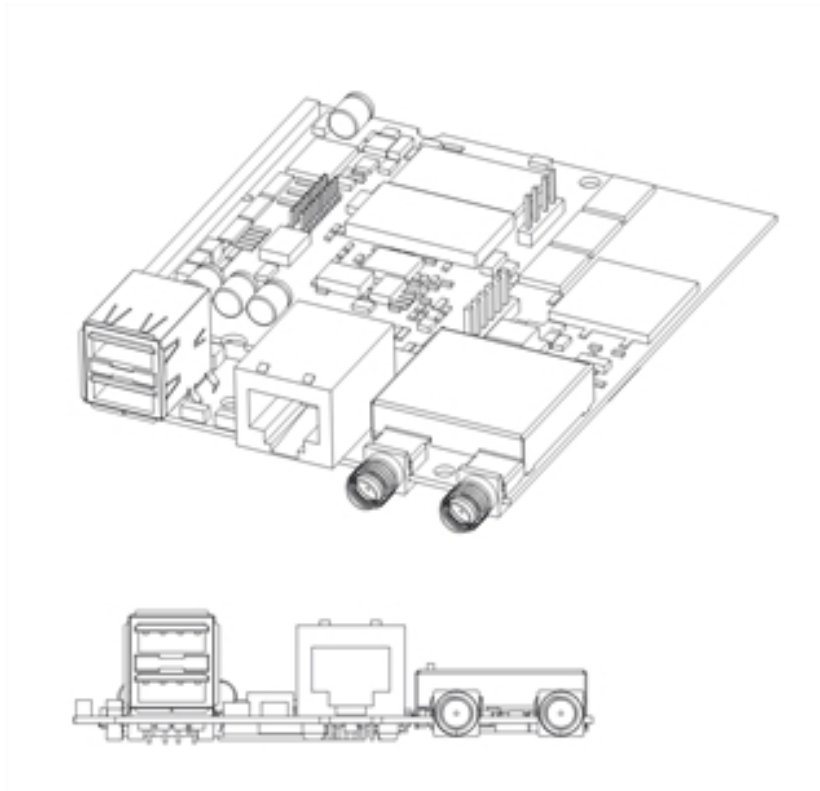
**No Ethernet, No USB, With 1xRP-SMA connector**



**With Ethernet and 1xRP-SMA connector, no USB**

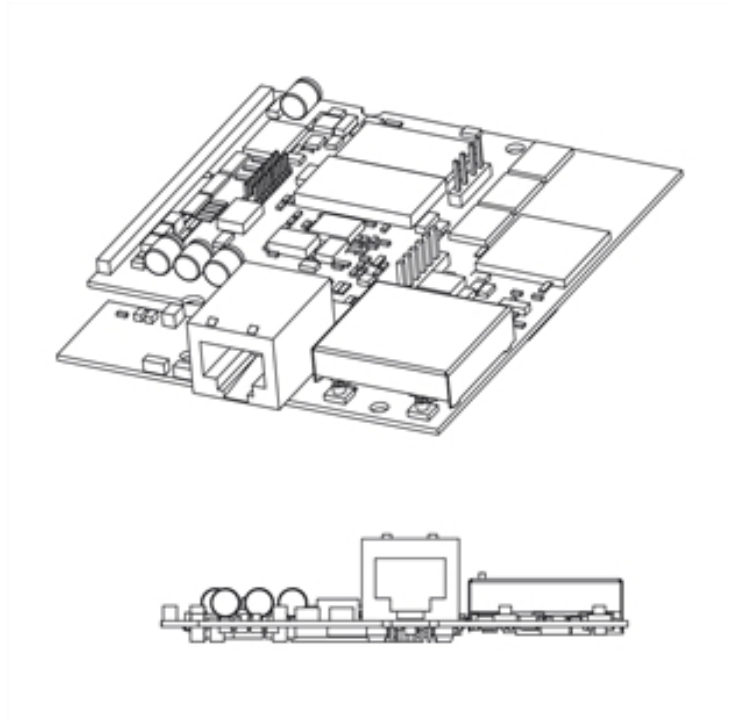


**Fully populated with Ethernet, USB, and 2xRP-SMA connectors**



**With Ethernet and 2xU.FL connectors, no USB**





## What's on the module?

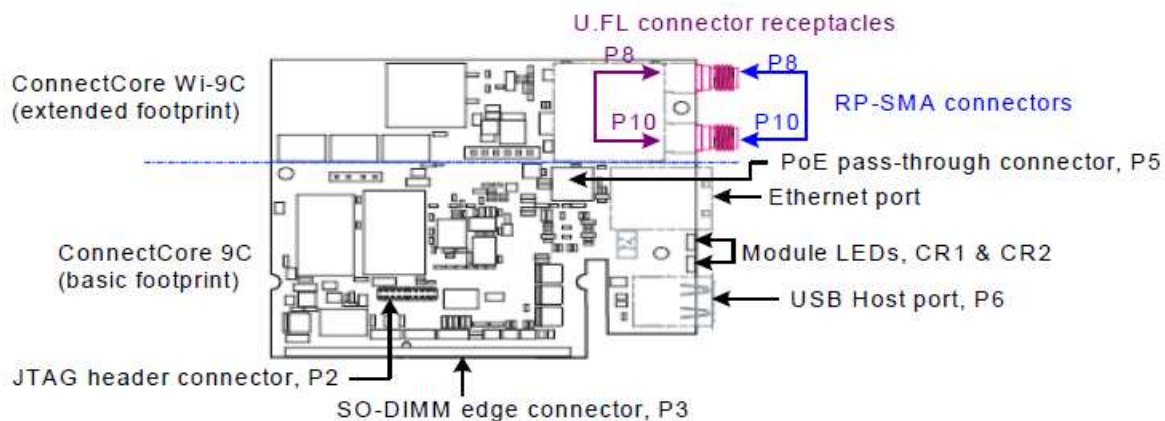
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This chapter describes the ConnectCore 9C/Wi-9C modules. See [Module specification](#) for the mechanical specifications and electrical characteristics of the modules.

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## Module layout

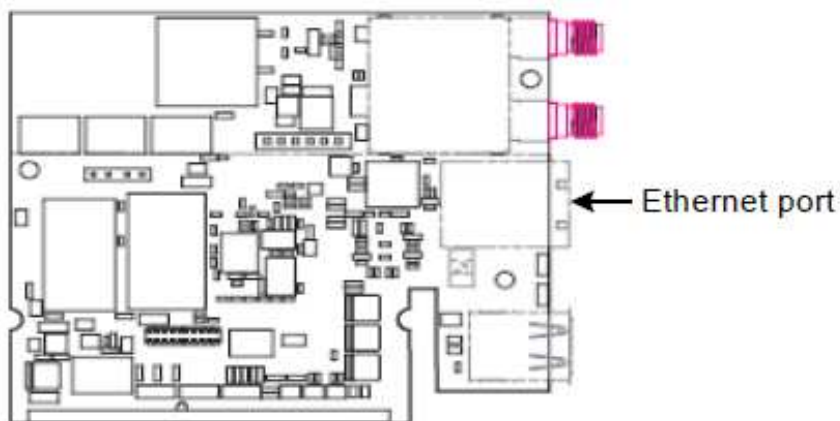
The module design you use depends on whether you want to use the ConnectCore Wi-9C wireless capabilities. The basic footprint for the ConnectCore 9C and ConnectCore Wi-9C is the same; an extension of the footprint provides the active components and antenna connectors for wireless functionality.



**Note** The ConnectCore Wi-9C module is populated with either one RP-SMA connector, two RP-SMA connectors, or 2 U.FL connectors (see [About the Modules](#) for all module configuration options). The U.FL connectors are located in the same positions as the RP-SMA connectors, but do not extend past the edge of the module.

## Ethernet connector

The Ethernet connector is an 8-wire RJ-45 jack with integrated magnetics that meets the ISO 8877 requirements for 10/100BASE-T. The connector provides both Ethernet interface pins (in the upper portion) and two integrated LEDs (in the lower portion).



## Ethernet connector pins

There are eight Ethernet connector pins in the upper portion of the connector. Pin 1 is in the upper left corner of the connector, above the yellow LED. Pins 4, 5, 7, and 8 are used with Power-over-Ethernet (PoE) only (see [Ethernet connector pins](#)).

Pin	Signal	802.3af End-Span (Mode A)	802.3af Mid-Span (Mode B)	Description
1	TXD+	Negative $V_{Port}$		Transmit data +
2	TXD-	Negative $V_{Port}$		Transmit data -
3	RXD+	Positive $V_{Port}$		Receive data +
4	EPWR+		Positive $V_{Port}$	Power from switch +
5	EPWR+		Positive $V_{Port}$	Power from switch +
6	RXD-	Positive $V_{Port}$		Receive data -
7	EPWR-		Negative $V_{Port}$	Power from switch -
8	EPWR-		Negative $V_{Port}$	Power from switch -

### Ethernet LEDs

The RJ-45 connector has two LEDs located near the outer lower corners of the Ethernet port. These LEDs are controlled by the Ethernet PHY on the module, and are not programmable.

LED	Description
Green	Network link: On indicates an active network link; Off indicates that no network link is present.
Yellow	Network activity: Flashing when network traffic detected; Off when no network traffic detected.

### 802.3af Power over Ethernet (PoE) pass-through connector, P5

The PoE pass-through connector, P5, mates with the P20 header on the development board. This PoE pass-through feature passes PoE power connections from the Ethernet signal cable to the user's equipment through P5. The PoE feature provides a power source for compliant "powered" equipment, and is nominally 48VDC with a possible 30–57VDC 13 W maximum range.



### Connector description

Pin	Signal	Description
1	TX_CT	Ethernet transformer transmit CT
2	RJ45_7/8	Ethernet connector pins 7 and 8
3	RX_CT	Ethernet transformer receive CT
4	RJ45_4/5	Ethernet connector pins 4 and 5

### PoE support

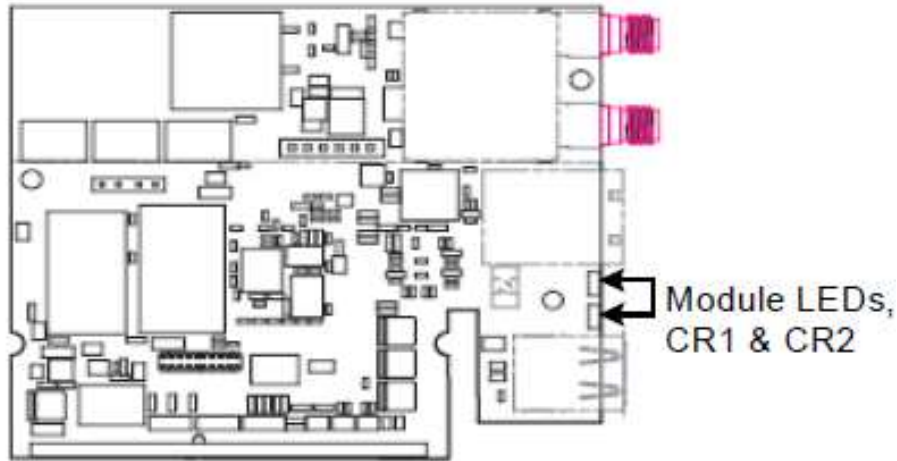
If you are planning to add PoE support to your product, see the most recent revision of the IEEE 802.3af specification available at <http://www.ieee802.org/3/af/>. The document provides detailed information about the standard and its proper implementation.

### Module LEDs

By default, the ConnectCore 9C/Wi-9C modules use the CR1 and CR2 LEDs as described:

- **ConnectCore Wi-9C module:** To indicate WLAN-related information, such as association status and network activity.
- **ConnectCore 9C and Wi-9C modules:** CR1 will flash a repeating blink pattern in a major system failure; for example, a processor exception or Power on Self Test failure.

The ConnectCore Wi-9C LED assignments can be reassigned; that is, you can use different GPIOs to drive CR1/CR2 LEDs.



### Description

ID	Connects to	Default	Description
CR1	GPIO67	Off	Setting to output logic “0” turns on the LED.
CR2	GPIO66	Off	Setting to output logic “0” turns on the LED.

### ConnectCore Wi-9C default use

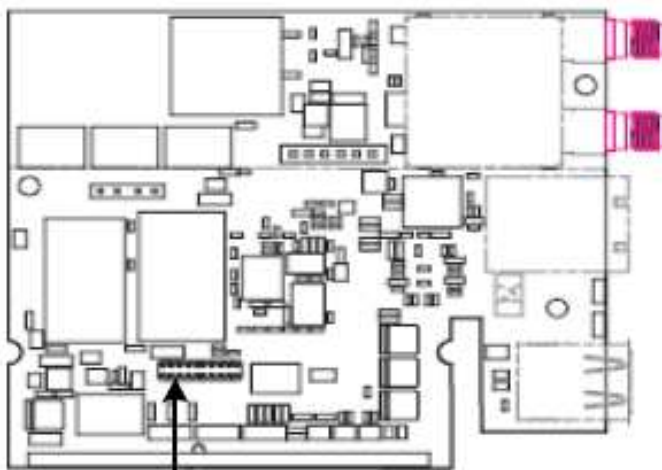
ID	Color	LED	Blink pattern	Status/Activity
CR1	Green	Link integrity	On	The unit is associated to an access point (infrastructure mode)
			Slow	The unit is in ad-hoc mode
			Quick	The unit is scanning for a network
CR2	Yellow	Network activity	Blinking	Network traffic is received or transmitted
			Off	Network is idle

**Note** The network activity LED is used for diagnostic purposed during boot-up.

### JTAG 20-pin header connector, P2

The JTAG connector is a standard, male, ARM 20-pin pinout in a miniature connector, with a 50-mil pitch. A JTAG adapter, which ships with each Jump Start kit, expands the JTAG connector to a 100 mil pitch. Use the included JTAG adapter to connect the debugger.

The JTAG connector on the module is *keyed*, as are the two connectors on the JTAG adapter, which means there is only one way to attach ribbon cables to the module and JTAG adapter. For details, see [JTAG adapter assembly](#).



JTAG header connector, P2

### Pin assignment

Pin	Signal	Description
1	3.3V	ARM9 I/O supply
2	3.3V	ARM9 I/O supply
3	TRST#	Test mode reset
4	GND	Ground
5	TDI	Test data in
6	GND	Ground
7	TMS	Test mode select
8	GND	Ground
9	TCK	Test clock
10	GND	Ground
11	RTCK	Returned test clock (ARM core only)
12	GND	Ground
13	TDO	Test data out
14	GND	Ground
15	DBSRST#	System reset
16	GND	Ground
17	N/A	N/A

Pin	Signal	Description
18	GND	Ground
19	BISTEN#	ARM9 mode select: <ul style="list-style-type: none"> <li>■ Debug = Pull high: 220 ohms to pin 2 (3.3V)</li> <li>■ Boundary scan / normal = Pull low: 220 ohms to pin 20 (GND)</li> </ul>
20	GND	Ground

## JTAG adapter assembly

Use the JTAG adapter assembly, shipped with the ConnectCore 9C/Wi-9C Jump Start Kit, to attach your debugger to the module. The JTAG adapter assembly consists of the Digi JTAG Link USB debugger with a ribbon cable attached and the JTAG adapter with a ribbon cable attached. The Jump Start Kit also includes a USB cable.

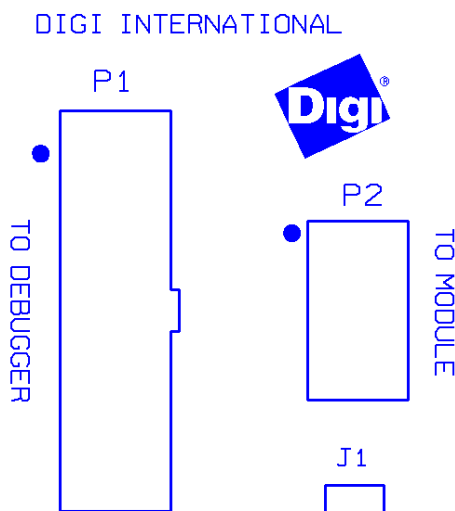
The two connectors on the JTAG adapter are *keyed*, as is the JTAG connector header (P2) on the module. Keyed connectors eliminate cable attachment errors by ensuring that there is only one way to mate the connectors.

### JTAG adapter

The JTAG adapter has two 20-pin connectors, P1 and P2.

- **P1** is a keyed male connector into which you attach the debugger's ribbon cable.
- **P2** is a keyed male connector into which you attach the ribbon cable that plugs into the module.
- **J1** is a jumper that determines the mode in which the module operates: debug or boundary scan. Depending on the JTAG adaptor you are using, J1 has either two pins or three pins.

This drawing shows the JTAG adapter with a 2-pin J1 header.



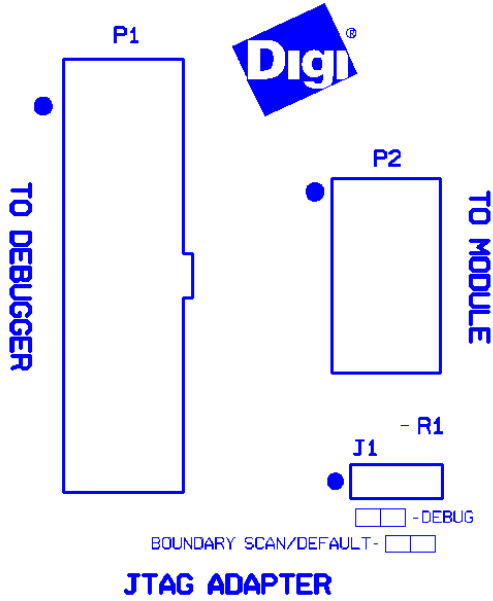
For **debug** mode — Do not plug a jumper onto J1.

For **boundary scan** mode — Plug a jumper onto J1.



For the 3-pin version having pins 1 and 2 jumpered puts you into debug mode, this again is the 'default' mode. Having pins 2 and 3 jumpered puts you into a boundary scan mode.

This drawing shows the JTAG adapter with a 3-pin J1 header. The pin positions for debug and boundary scan are shown in the lower right of the drawing:

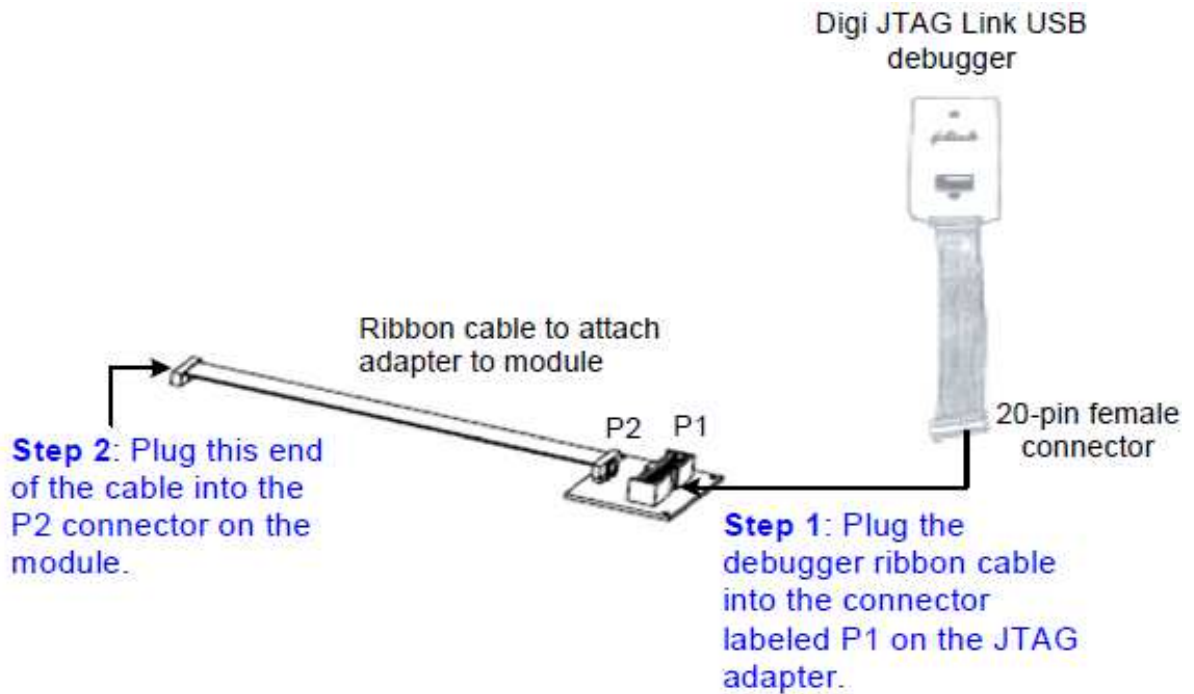


For **debug** mode — Plug a jumper on pins 1 and 2.

For **boundary scan** mode (the default) — Plug a jumper on pins 2 and 3.

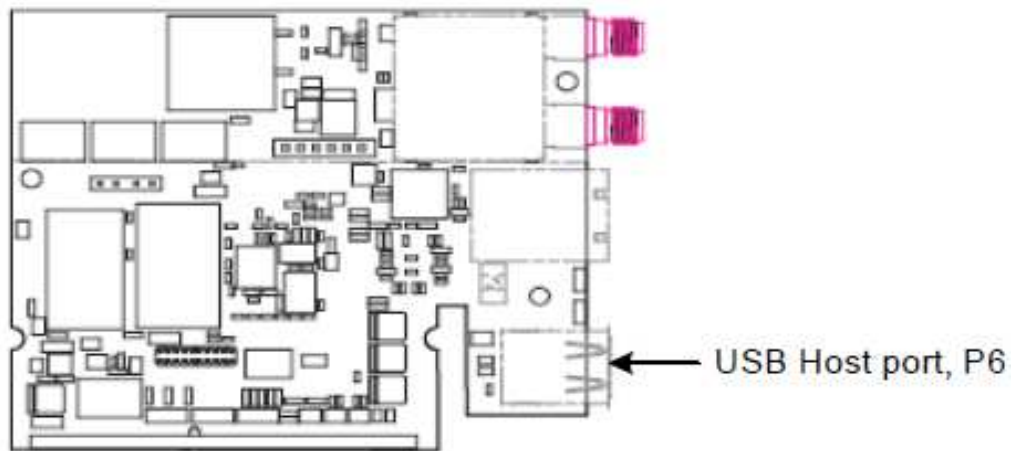
### Assembly

1. Plug the debugger ribbon cable into the connector labeled P1 on the JTAG adapter.
2. Plug the adapter ribbon cable (attached to P2 on the adapter) into the P2 connector on the module.



## USB Host connector, P6

When populated, the USB Host connector is on the same side of the module as the Ethernet connector, separated from the Ethernet connector by CR1 and CR2.



See [USB interface](#) for information about the USB interface.

## Edge connector, P3 ConnectCore 9C and Wi-9C

The edge connector is a 144-pin SO-DIMM connector located on the short edge of the module. P3 mates with P15 (also a 144-position SO-DIMM connector) on the development board or an SO-DIMM connector on your design.