Cisco 5915 Embedded Services Router Hardware Technical Guide

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This guide describes the Cisco 5915 Embedded Services Router (ESR) including product specifications, installation procedures, and hardware information.

Note The documentation set for this product strives to use bias-free language. For purposes of this documentation set, bias-free is defined as language that does not imply discrimination based on age, disability, gender, racial identity, ethnic identity, sexual orientation, socioeconomic status, and intersectionality. Exceptions may be present in the documentation due to language that is hardcoded in the user interfaces of the product software, language used based on RFP documentation, or language that is used by a referenced third-party product.

About This Guide

This guide is organized into the following sections:

Audience

This guide is for system integration engineers who are incorporating the Cisco 5915 ESR board into a chassis.

Related Documentation

Use these publications to help you configure Cisco IOS software features:

- The most current Cisco IOS configuration guides and command references are located at the following URL: http://www.cisco.com/en/US/products/ps10148/products_installation_and_configuration_guides_list.html
- For information about MIBs, refer to the following URL: http://tools.cisco.com/ITDIT/MIBS/servlet/index

Additional documentation for the Cisco 5900 ESR Series can be found at: www.cisco.com/go/5900

Conventions

This document uses the following typographical conventions:

Convention	Description
boldface font	Commands, command options, and keywords are in **boldface**.
italic font	Command arguments for which you supply values are in *italics*.
[ ]	Command elements in square brackets are optional.
{x | y | z}	Alternative keywords in command lines are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string because the string will include the quotation marks.
`screen` font	System displays are in `screen` font.

Convention	Description
boldface screen font	Information you must enter verbatim is in **boldface screen** font.
italic screen font	Arguments for which you supply values are in *italic screen* font.
⟶	This pointer highlights an important line of text in an example.
^	Represents the key labeled Control—for example, the key combination ^D in a screen display means hold down the Control key while you press the D key.
< >	Nonprinting characters such as passwords are in angle brackets.

Notes use the following conventions:

Note Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the publication.

Cautions use the following conventions:

Caution Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Warnings use the following conventions:

Warning **Safety warnings appear throughout this publication in procedures that, if performed incorrectly, may cause harm to you or the equipment. A warning symbol precedes each warning statement.**

Introduction

The Cisco 5900 Series Embedded Service Routers (ESR) are optimized for mobile and embedded networks that require IP routing and services. The flexible, compact form factors of the Cisco 5900 routers, complemented by Cisco IOS Software and Cisco Mobile Ready Net capabilities, provide highly secure data, voice, and video communications to stationary and mobile network nodes across wired and wireless links.

The Cisco 5915 ESR (Figure 1 and Figure 2) is a PCI-104 based, small form-factor router intended for mobile and vehicle networking applications. Like its predecessor Mobile Access Router Card, used in the Cisco 3200 Rugged Integrated Services Router (ISR), the Cisco 5915 ESR is targeted particularly at transportation customers (especially heavy, light, and metro rail) and global defense organizations.

The Cisco 5915 ESR is a high-performance router designed for harsh environments. Its highly durable construction provides reliable operation in extreme temperatures and in rugged terrain where mobile devices are often subject to greater degrees of shock and vibration. The inclusive and compact design simplifies integration and offers system integrators the ability to use the Cisco 5915 ESR in a wide variety of applications. The user interface for Cisco 5915 ESR is through edge fingers. Air-cooled and conduction-cooled models accommodate diverse operational environments. The Cisco 5915 ESR is based on industry standards, and provides Cisco customers with an extensive ecosystem of products and suppliers for designing and developing systems.

Figure 1 Cisco 5915 Embedded Services Router - Top Side View

Figure 2 Cisco 5915 Embedded Services Router - Bottom Side View

Cisco 5915 ESR Conduction-Cooled Card

The Cisco 5915 ESR conduction-cooled card (Figure 3 and Figure 4) operates at a temperature range of -40ºC to +85ºC (rail temperature). Thermal plates conduct the heat away from the components to the enclosure rails through the wedge locks. The conduction cooling removes the need for internal fans.

Figure 3 Cisco 5915 ESR Conduction-Cooled Card - Bottom View

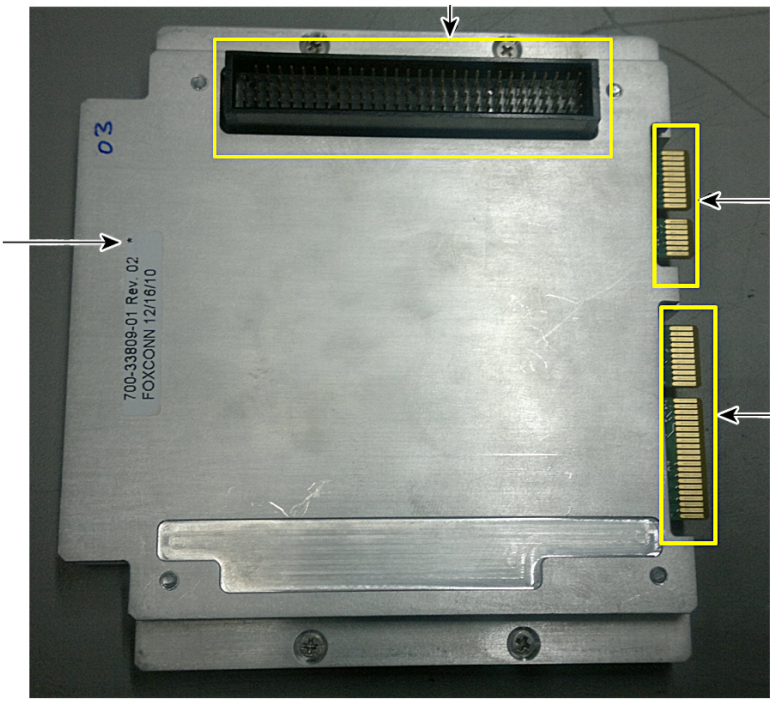


Table 1 Cisco 5915 ESR Conduction-Cooled Card - Bottom View Markings

1	PCI Connector	3	Edge Finger (Main)
2	Edge Finger (Auxiliary)	4	Thermal Plate (Bottom)

Figure 4 Cisco 5915 ESR Conduction-Cooled Card - Top View

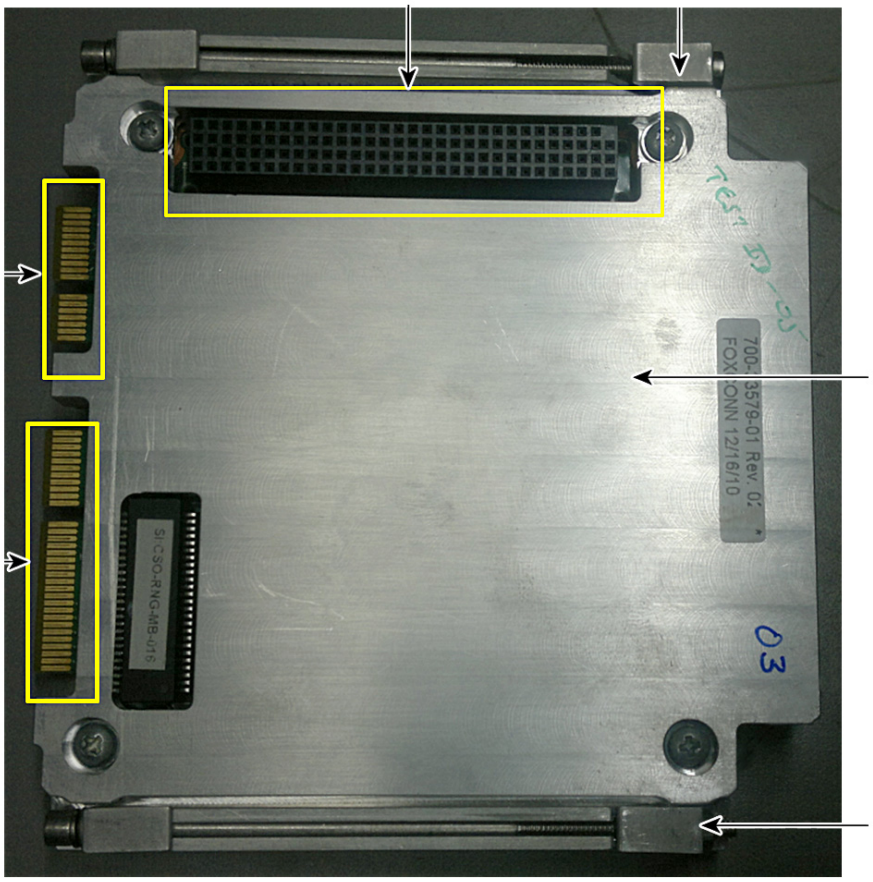


Table 2 Cisco 5915 ESR Conduction-Cooled Card - Top View Markings

1	PCI Connector	4	Wedge Lock
2	Wedge Lock	5	Edge Finger (Main)
3	Thermal Plate (Top)	6	Edge Finger (Auxiliary)

Installing the Cisco 5915 ESR Conduction-Cooled Card

Warning **When performing the following procedures, wear a grounding wrist strap to avoid ESD damage to the Cisco 5915 ESR conduction-cooled card. Some platforms have an ESD connector for attaching the wrist strap. Do not directly touch the edge finger or PCI connector pins with your hand or any metal tool to avoid component failure.**

To install the Cisco 5915 ESR conduction-cooled card, perform the following procedure:

Step 1 Carefully align the edges of the thermal plate between the upper and lower edges of the module slot.

Step 2 Verify that all the wedge locks are loose just enough to hold all the wedge lock pieces together.

Step 3 Slide the card into the module slot.

Step 4 Tighten the wedge locks using a hex torque screwdriver adjusted to 8.0 +/- 0.5 in-lb.

Removing the Cisco 5915 ESR Conduction-Cooled Card

Warning **When performing the following procedures, wear a grounding wrist strap to avoid ESD damage to the Cisco 5915 ESR conduction-cooled card. Some platforms have an ESD connector for attaching the wrist strap. Do not directly touch the edge finger or PCI connector pins with your hand or any metal tool to avoid component failure.**

To remove the Cisco 5915 ESR conduction-cooled card, use the following steps:

Step 1 Loosen the wedge locks using a hex screwdriver and complete seven (7) counter-clockwise turns.

Caution Do not loosen the wedge locks past seven (7) counter-clockwise turns for removal. Doing so could cause the wedge lock to fall off the card into the chassis.

Step 2 Carefully remove the Cisco 5915 ESR conduction-cooled card out of the conduction-cooled chassis.

Cisco 5915 ESR Air-Cooled Card

The Cisco 5915 ESR air-cooled card operates at a temperature range of -40ºC to +70ºC. Forced air is used to cool the card.

Note Cisco 5915 ESR air-cooled card installation depends on the system in which it will be used, hence the installation information does not fall under the scope of this document.

The Cisco 5915 ESR air-cooled board (Figure 5 and Figure 6) is used without thermal plates in an air-cooled environment. The minimum air-flow required depends on the installation environment. System integrators must perform the necessary thermal simulation to calculate the system level air-flow requirement.

Note For more information about the Cisco 5915 ESR hot components and thermal limits refer to the *Cisco 5915 ESR Thermal Data for Air-Cooled Cards Guide*. To obtain the *Cisco 5915 ESR Thermal Data for Air-Cooled Cards Guide*, contact your Cisco account representative.

Figure 5 Cisco 5915 ESR Air-Cooled Card - Bottom View

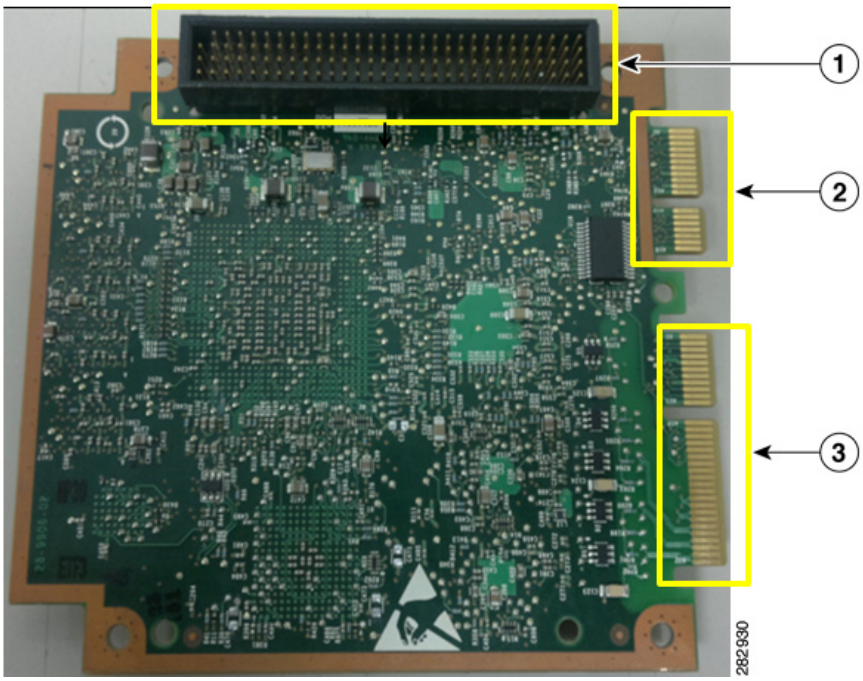


Table 3 Cisco 5915 ESR Air-Cooled Card - Bottom View Markings

1	PCI Connector	3	Edge Finger (Main)
2	Edge Finger (Auxiliary)		

Figure 6 Cisco 5915 ESR Air-Cooled Card - Top View

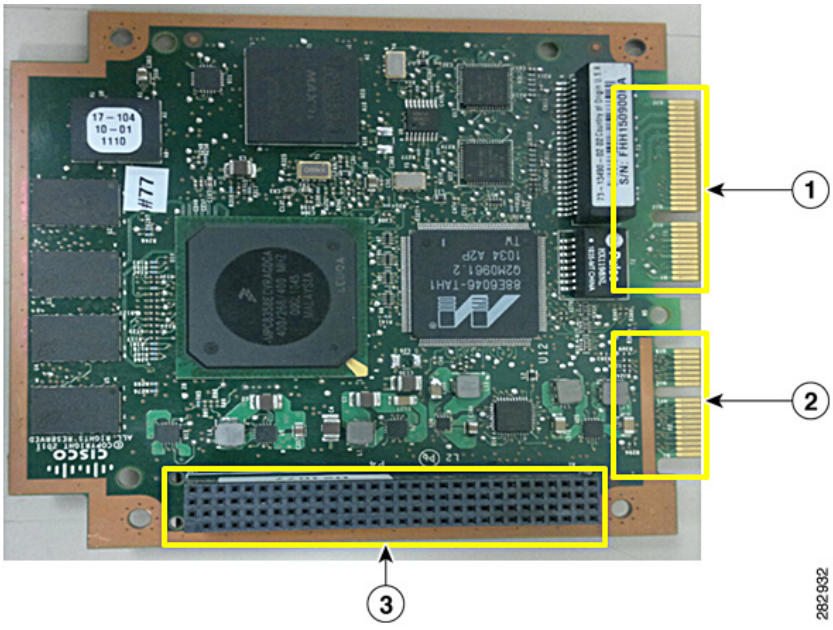


Table 4 Cisco 5915 ESR Air-Cooled Card - Top View Markings

1	Edge Finger (Main)	3	PCI Connector
2	Edge Finger (Auxiliary)		

Cisco 5915 ESR LED Definitions

Cisco 5915 ESR supports the LED control signals described in Table 5. These signals go to the edge fingers and connect to LEDs in the solution developed by a system integrator.

See Table 8 for pin location of LEDs on the edge finger interface.

Note All LED outputs can drive 12mA through a 2.2Vf LED. All LED outputs are active high signals.

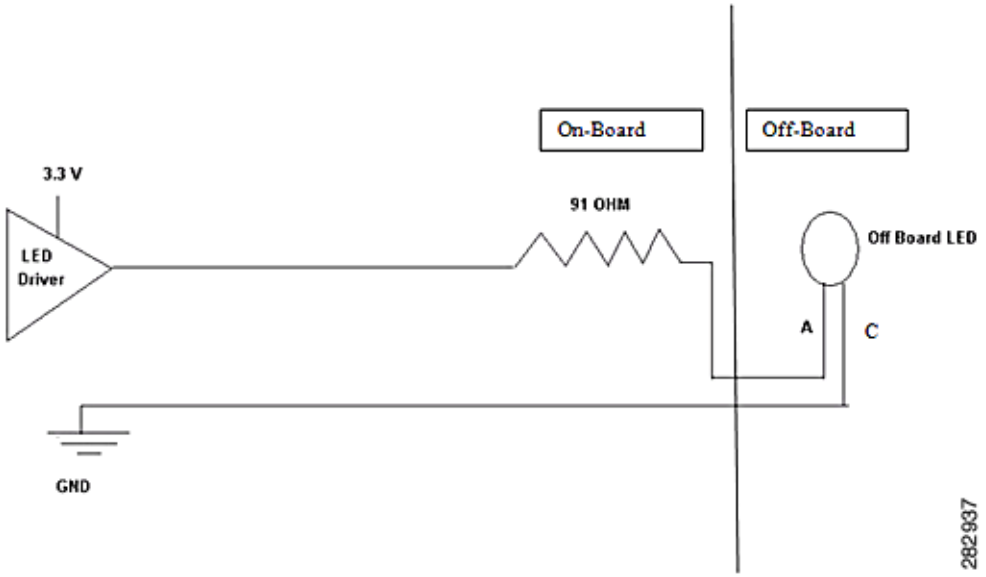
Table 5 LED Definitions

LED names	Activity
System LED	• OFF—No power. • BLINKING—Boot up phase or in ROMMON monitor mode. • SOLID—Steady state, IOS load completed and running.
Temperature LED	• OFF—Thermal reading is within the range. • BLINKING—Thermal reading is out-of-range.
Port link status	• OFF—Link is down. • SOLID—Link is up.
Port activity status	• OFF—No Activity. • BLINKING—Link is transmitting or receiving.
Factory default LED	• OFF—Not activated. • BLINKING[1]—Signal assertion is detected. Factory default procedure is initiated. • ON—Unit restored to Factory default state.

1. Blinking state is not supported in IOS image 15.2(1)GC.

All Off-board LED signals are connected to the anode of the LED and the cathode of the LED is connected to ground (Figure 7).

Figure 7 LED Connections



Factory Default

To enable the factory default capability, the **service declassify** command must be added to the IOS configuration file. Following are the options available for this command:

- *erase-flash*
- *erase-nvram*
- *erase-all*

Table 6 lists the settings and the completion time for these options.

Table 6 Settings and Completion Time for Factory Default Capability Options

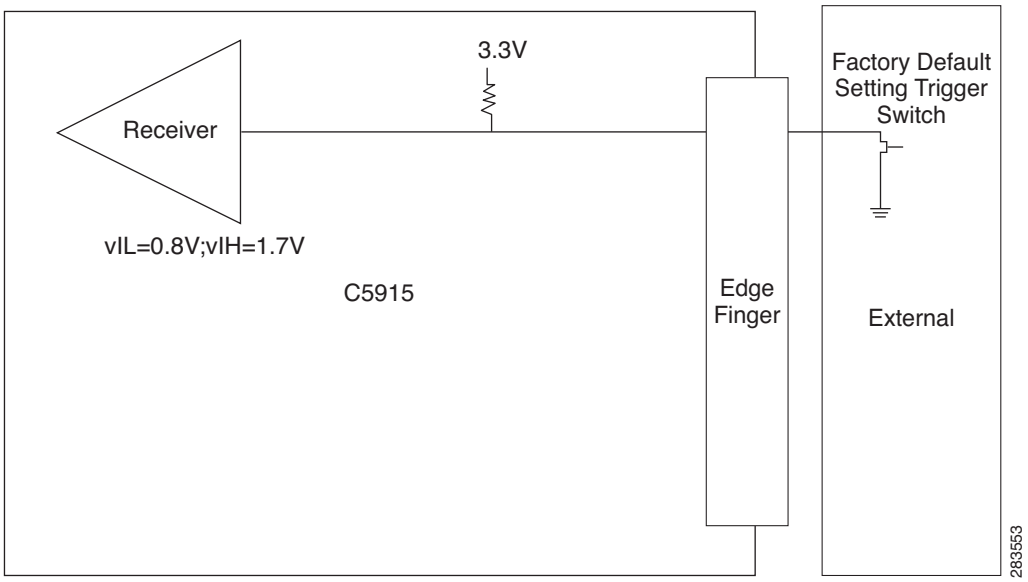
Option	Target	Typical Completion Time
erase-flash	This option erases the Flash file system that includes the IOS images and scrubs the main memory to ensure all code information is removed.	6–25 minutes[1]
erase-nvram	This option erases NVRAM and scrubs the main memory to ensure all code information is removed.	18 seconds
erase-all	This option is a superset of *erase-flash* and *erase-nvram* options.	6–25 minutes

1. The erase time of the Flash file system depends on the utilization of the Flash device. It takes more time to delete a fully utilized file system.

To start the Cisco 5915 ESR factory default process, pull the INPUT_CLEAR_L signal to GND (Figure 8). After the process is initiated, the LED_CLEAR signal toggles (blinks) for 0.5 seconds, then deasserts (turns off). After the process is completed, the LED_CLEAR signal asserts (turns on) and the

router halts. Once the router is power-cycled, the router will boot normally. If you choose to use the *erase-flash* option, the boot process stops at ROMMON because the Flash file system that normally contains IOS is empty. If you choose to use the *erase-all* option, the Cisco 5915 ESR will have no user data or binary code in router memory after the factory default process is complete.

Figure 8 Factory Default Setting Trigger Implementation



eMMC is a managed NAND. This means that our embedded switch or router system does not interact with the flash memory directly. The flash controller presents a block-style interface to our system, and it handles the flash management (analogous to the Flash Translation Layer). Our embedded switch or router system cannot access the raw flash directly.

The JEDEC standard has commands that are supposed to remove data from the raw flash. In Cisco's implementation, the "Erase" and "Sanitize" commands are used. The eMMC standard JESD84-B51 defines "Sanitize" as follows:

> The Sanitize operation is a feature … that is used to remove data from the device according to Secure Removal Type. The use of the Sanitize operation requires the device to physically remove data from the unmapped user address space.

After the sanitize operation is completed, no data ***should exist*** in the unmapped host address space.

Note **Zeroization does NOT erase removable media such as SD Card and USB Storage. This media must be removed from the system and erased or destroyed using procedures that are outside the scope of this document.**

Important Notice about Zeroization

Zeroize does a very thorough wipe of all non-protected parts of the eMMC flash using the best technology designed by the flash manufacturer today and can do so using the push of a button without the need for a console, ssh, or management session of any kind. It is the integrator's and end user's responsibility to determine the suitability regardless of the CLI keyword used to enable the feature.

Note **While Cisco IOS and Cisco IOS-XE use the command line text of "declassify" in the command line interface (CLI) to enable the zeroize feature, in no way does this represent any specific endorsement or acknowledgment of a Government approved flash erasure methodology.**

Declassification procedures are unique to each Government organization. Cisco solely provides the technical detail of the erasure operation here, not the policy distinction or any specific recommendation per classification.

Please refer to your respective Government Agency policies, procedures, and recommendations for the handling of sensitive data to see if this procedure meets with those requirements.

Temperature Out of Range Detection

When the Cisco 5915 ESR detects that the temperature is out of range, that is the temperature is either too high or too low, the router toggles (blinks) the LED_OVER_TEMP signal for 50 seconds. Assuming the temperature remains out of range during this period of time, the router deasserts (turns off) the LED_OVER_TEMP signal and reboots to ROMMON.

Using the Cisco 5915 ESR

The Cisco 5915 ESR can be deployed in a variety of applications and physical formats.

I/O signal access is provided via edge fingers. The edge fingers are intended to connect with standard, commercially available PCI-Express connectors.

Typically, integrators use a custom wiring board to access the I/O signals. For instance, one side of the wiring board is populated with the PCI-Express connectors, while the other side is populated with RJ-45s and/or circular shell connectors. This method works best when the enclosure is designed such that the end product I/O panel is very close to the edge finger side of the Cisco 5915 ESR.

Another I/O access option is to use a flex circuit assembly. A custom flex circuit assembly can be designed such that part of the assembly is rigid and part is more like a ribbon cable. The standard connectors (PCI-Express, RJ-45, circular shell, etc.) can be placed on the rigid parts of the assembly. This method provides a compact solution and is also useful when the end product I/O panel is not located close to the edge finger side of the Cisco 5915 ESR.

For integrators planning to use the conduction-cooled Cisco 5915 ESR, mounting holes are in the thermal plate. These mounting holes are used to hold an I/O board or flex circuit to the Cisco 5915 ESR. The mounting hole size is 0.125 Inches (diameter). Four 4-40 pan head screws are required.

For integrators planning to use the air cooled Cisco 5915 ESR, mounting holes are provided in the Printed Circuit Board (PCB) which can be used, along with a custom "L bracket" to hold an I/O board or flex circuit to the Cisco 5915 ESR.

Note Mounting hole and screw sizes for air cooled Cisco 5915 ESR depend on the system or environment in which the air-cooled cards are used.

Note When you connect routed ports of the Cisco 5915 ESR to routed ports on a neighboring device and autonegotiation is disabled on both sides of the connection, a crossover cable may be necessary (depending on the capabilities of the neighboring device). If autonegotiation is enabled, any type of cable connection can be used.

Product Specifications

Table 7 lists the technical specifications for Cisco 5915 ESR.

Table 7 Cisco 5915 ESR Product Specifications

Cisco 5915 ESR Feature	Feature Description
Hardware Encryption	• Onboard hardware encryption processor supporting IP Security (IPsec) • Secure Sockets Layer with transparent LAN services (SSL/TLS) • Triple Digital Encryption Standard (3DES) • Advanced Encryption Standard (AES) • Internet Key Exchange (IKE) • Message Digest - MD5 & SHA along with HMAC
Memory	
DRAM	512 MB
Flash Memory	256 MB
Interface Support	
Fast Ethernet	Two routed 10/100 copper ethernet ports Three switched 10/100 copper ethernet ports
Router Console Port	One RS-232 console port supporting modem flow control signaling.
Environmental	
Industrial-grade components	–40° F to +185° F (–40° C to +85°C) component local ambient temperature ranges
Operating temperature	• The conduction-cooled router can withstand extended temperature ranges of -40ºF to +185ºF (–40ºC to +85ºC). **Note** Temperatures are measured at card edge rail. Card edge rail must be 85º Celsius or lower. • The air-cooled router can withstand extended temperature ranges of -40ºF to +158ºF (–40ºC to +70ºC). • Temperature ranges for completed solutions depend on hardware configuration variables, including enclosures and third-party components.

Table 7 Cisco 5915 ESR Product Specifications (continued)

Cisco 5915 ESR Feature	Feature Description
Non-Operating Temperature	• -40ºF to +185ºF (-40ºC to +85ºC) for both the air-cooled and conduction cooled boards
Altitude (low-pressure operation)	• Up to 15,000 ft. (4500 m) for both the air-cooled and conduction-cooled boards
EMI/EMC	• Conforms to CISPR 22, FCC Part15B Class A limits • The system integrator is responsible for completing the necessary Safety/EMC testing and labelling the final product sold to the customer.
Hardware Specifications	
Power requirements/profile	• 5 VDC from PCI connector (5V) Max (theoretical): 4.26W Typical (rail temperature @ 25C): 3.00W[1] Typical (rail temperature @ 85C): 3.10W[1] InRush: 1.25A • 3.3 VDC from PCI connector (3.3V) Max (theoretical): 5.93W Typical (rail temperature @ 25C): 2.64W[1] Typical (rail temperature @ 85C): 3.06W[1] InRush: 1.32A • Total Max (theoretical): 10.19W Typical (rail temperature @ 25C): 5.64W[1] Typical (rail temperature @ 85C): 6.14W[1] **Note** There are no voltage rail sequencing requirements. Power supply voltage rails can power-up/power-down in any order. Both the 3.3V and 5V rails are required for the Cisco 5915 ESR.
Weight	Conduction cooled—290 grams Air cooled—75 grams
Mean Time Before Failure (MTBF)[2]	• Air cooled card and Conduction cooled card (Ground, Fixed, Controlled): 844,000 hours • Air cooled card and Conduction cooled card (Ground, Mobile): 140,000 hours

1. Based on lab testing with traffic on all ports (CPU utilization +90%).
2. All values determined using 90% Upper Confidence Level (UCL) for the steady-state failure rate calculated per Telcordia SR-332, Issue 2, September 2006.

Hardware Information

This section shows layout of the Cisco 5915 ESR cards, pinout assignments, and other hardware specification information.

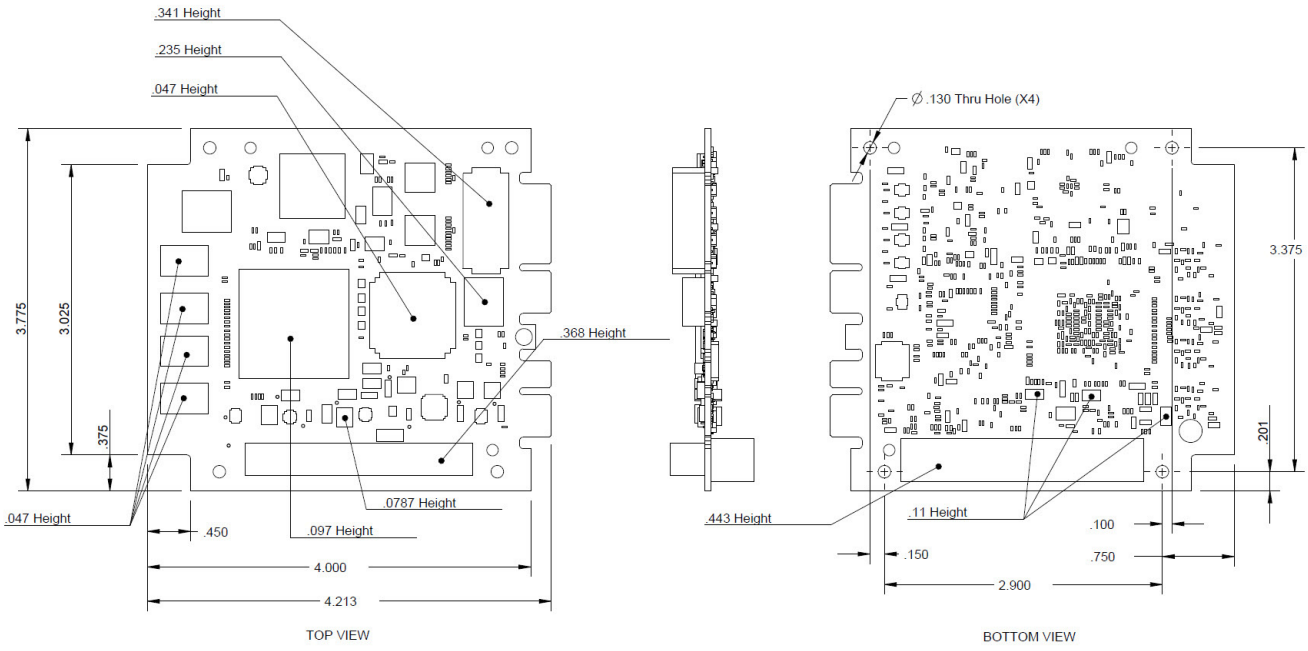
Cisco 5915 ESR Conduction-Cooled Card Layout and Dimensions

There is a zip file which contains graphics and .stp files available at:

https://www.cisco.com/c/dam/en/us/td/docs/solutions/GGSG-Engineering/Cisco_5915/Hardware_Install_Guide/SR5915-STEP.zip

The following figures show the layout and dimensions of the Cisco 5915 ESR conduction-cooled card. The dimensions are in inches.

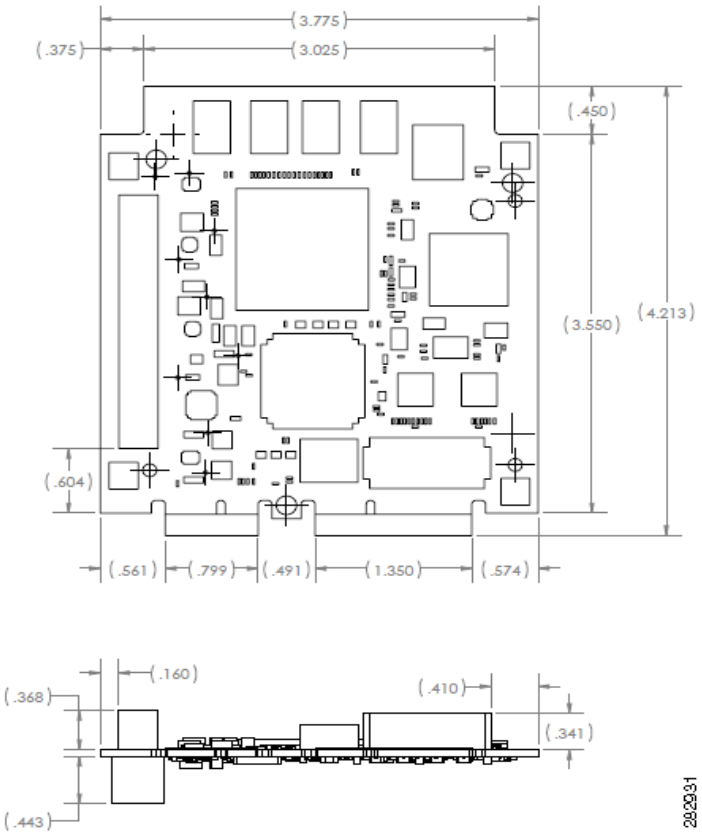
Figure 9 Layout of the Clsco 5915 ESR Conduction-Cooled Card



Cisco 5915 Air-Cooled Card Layout and Dimensions

Figure 10 shows the layout and dimensions of the Cisco 5915 ESR air-cooled card. The dimensions are in inches.

Figure 10 Layout of the Air-Cooled Card



Edge Fingers Interfaces

The Cisco 5915 ESR edge fingers provide system interface signal connectivity, while maximizing the real estate available for component placement. The connector solution is borrowed from the PCIe standard. The edge fingers consist of 64 pins in the main connector (Table 8). The signal interfaces are routed through these pins. The following part numbers are the mating connectors (solderable):

- EDGE Connector Main - Molex 87715-9106
- EDGE Connector Aux - Molex 87715-9006

Note All signals on the Auxiliary edge fingers are reserved. Leave these signals unconnected.

Table 8 Edge Finger Main Connector Mapping (64 pins)

Row	Column A (Top)	Column B (Bottom)
1	GND	GND
2	CONS_TXD_RS232	CONS_DTR_RS232
3	CONS_RTS_RS232	CONS_RXD_RS232
4	CONS_DSR_RS232	CONS_CTS_RS232

Table 8 Edge Finger Main Connector Mapping (64 pins) (continued)

Row	Column A (Top)	Column B (Bottom)
5	Reserved	GND
6	Reserved	LED_CLEAR
7	Reserved	INPUT_CLEAR_L
8	GND	GND
9	SYSTEM_LED	LED_OVER_TEMP
10	LED_FE0/2_LINK	LED_FE0/3_LINK
11	GND	GND
----------notch----------		
12	GND	GND
13	LED_FE0/4_LINK	LED_FE0/3_ACT
14	LED_FE0/0_LINK	LED_FE0/4_ACT
15	LED_FE0/1_LINK	LED_FE0/0_ACT
16	LED_FE0/2_ACT	LED_FE0/1_ACT
17	Reserved	Reserved
18	No Contact—Physical spacing	No Contact—Physical spacing
19	No Contact—Physical spacing	No Contact—Physical spacing
20	No Contact—Physical spacing	No Contact—Physical spacing
21	No Contact—Physical spacing	No Contact—Physical spacing
22	No Contact—Physical spacing	No Contact—Physical spacing
23	ETH_FE0/2_TX+	ETH_FE0/2_RX+
24	ETH_FE0/2_TX-	ETH_FE0/2_RX-
25	ETH_FE0/3_TX-	ETH_FE0/3_RX+
26	ETH_FE0/3_TX+	ETH_FE0/3_RX-
27	ETH_FE0/4_TX-	ETH_FE0/4_RX+
28	ETH_FE0/4_TX+	ETH_FE0/4_RX-
29	ETH_FE0/0_TX-	ETH_FE0/0_RX+
30	ETH_FE0/0_TX+	ETH_FE0/0_RX-
31	ETH_FE0/1_TX-	ETH_FE0/1_RX+
32	ETH_FE0/1_TX+	ETH_FE0/1_RX-

Note The FE0/0, FE0/1 are routed ports. FE0/2, FE0/3, and FE0/4 are switched ports.

PCI Connector

The Cisco 5915 ESR is PCI-104 compliant and supports the standard PCI connector. Table 9 lists the pinout assignments. However, the Cisco 5915 ESR does not connect to the PCI bus because it is not used. The only electrical connections to the PCI connector are +5V, +3.3V, and GND.

Note The Cisco 5915 ESR uses the variant of the PCI bus stacking connector, which is keyed on pin D30.

Table 9 PCI Bus Signal Assignments

Pin	A	B	C	D
1	GND	—	+5V	—
2	—	—	—	+5V
3	—	GND	—	—
4	—	—	GND	—
5	GND	—	—	GND
6	—	—	—	—
7	—	—	GND	—
8	+3.3V	—	—	+3.3V
9	—	GND	—	—
10	GND	—	+3.3V	—
11	—	+3.3V	—	GND
12	+3.3V	—	GND	—
13	—	GND	—	+3.3V
14	GND	—	+3.3V	—
15	—	+3.3V	—	GND
16	—	—	GND	—
17	+3.3V	—	—	+3.3V
18	—	GND	—	—
19	—	—	—	—
20	GND	—	—	GND
21	—	+5V	—	—
22	+5V	—	GND	—
23	—	GND	—	—
24	GND	—	+5V	—
25	—	—	—	GND
26	+5V	—	GND	—
27	—	+5V	—	GND
28	GND	—	+5V	—

Table 9 PCI Bus Signal Assignments (continued)

Pin	A	B	C	D
29	—	—	—	—
30	—	—	—	KEY