Implementation Options

This chapter contains the following sections:

Thermal Design Considerations

The following sections outline the methods for dealing with thermal issues and the mounting options involving the Cisco-designed conduction cooling plate.

As the Cisco ESR6300 is intended for use in extreme environments, industrial temperature rated components are used. The SKUs with a thermal plate make integration easier by abstracting the component level thermal concerns. Cisco has already performed the thermal analysis at the component level so that the integrator need only be concerned with the thermal plate temperature. As a general rule, the thermal plate of the card needs to make contact with an adequate thermal mass to draw heat away from the card. This can be done in a number of ways.

The important note is that the thermal plate temperature, as measured at the center of the top surface of the thermal plate, must not exceed 85° C. As long as this requirement is satisfied, all of the card's components will be within a safe operating temperature range on the high temperature side.

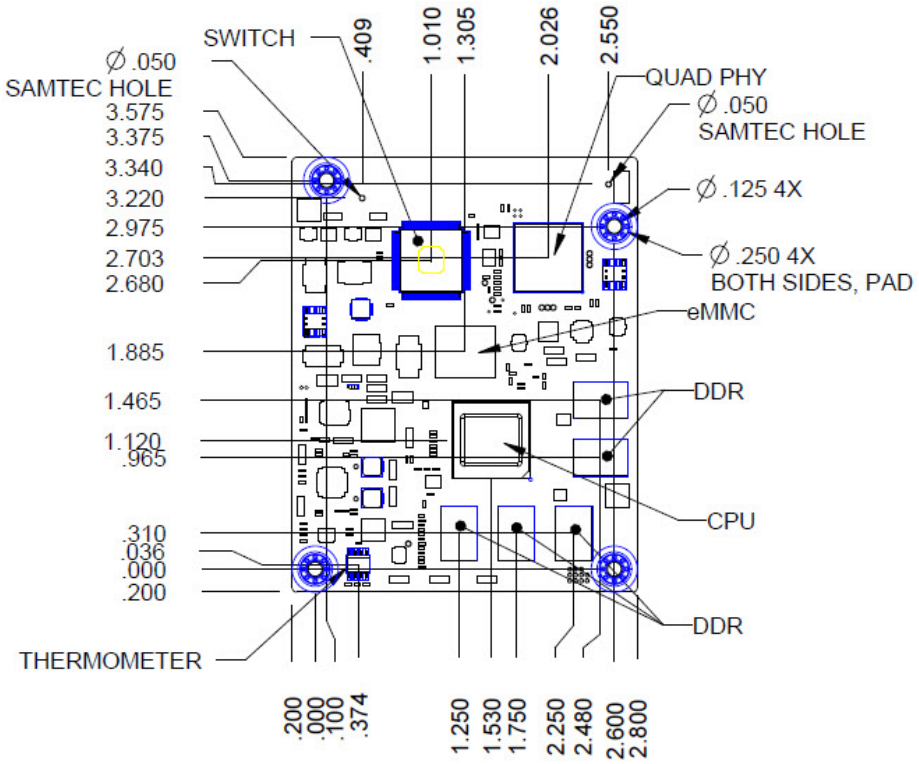
Heat dissipation methods:

As a general rule, the thermal plate of the board needs to make contact with an adequate thermal mass to draw heat away from the board. There are many ways to achieve this goal.

Examples:

- Transfer heat away from the thermal plate and into the enclosure wall by utilizing a “shelf” of metal. The shelf encompasses the entire Cisco ESR6300 thermal plate surface. This shelf is illustrated by item 1 in the following figure.
- Mount the Cisco ESR6300 thermal plate directly to the enclosure wall by using thermal interface material.

Figure 1: Thermally Significant Components of Cisco ESR6300 Board



RefDes	Part Type	Thermal Design Power (W)	Allowable Junction Temperature	Allowable Case Temperature	Package Type	Theta JC (degC/W)	Theta JB (degC/W)
U83	Quad Phy	1.5	125	—	TFBGA196	7.9	23.5
U45	Switch	2.5	125	—	TQFP128	7.7	15.5
U16	eMMC	1.0	—	90	FBGA153	—	—
U47	CPU	9.3	105	—	TFBGA430	0.6	4.3
U25U26U27U72U73	DDR	0.2 each	—	95	FPGA96	3.0	—
U2401	Temperature Sensor	—	125	—	MSOP8	—	—

Validating a Thermal Solution

To validate a thermal solution, monitor the thermal sensor of the Cisco ESR6300 cards in a thermal chamber set to the desired maximum ambient operating temperature and with traffic running.

Each card has a single sensor located on the corner of the card, which makes contact with the thermal plate using thermal interface material. The temperature of the sensors should be less than 90.5C. The **show environment all** command can be executed from the IOS prompt to monitor the thermal sensor temperatures

```
router# show environment all
ALARM CONTACT 1
   Status:      not asserted
   Description: external alarm contact 1
   Severity:    minor
   Trigger:     closed
ALARM CONTACT 2
   Status:      not asserted
   Description: external alarm contact 2
   Severity:    minor
   Trigger:     closed
Supervisor Temperature Value: 51 C
Temperature State: GREEN
System Temperature thresholds
---------------------------------
Minor Threshold    : 80 C (Yellow)
Major Threshold    : 90 C (Red)
Critical Threshold : 96 C
Shutdown Threshold : 105 C
Pwr Supply         Type     Status
------------------------------------
POWER SUPPLY-A      DC      OK
POWER SUPPLY-B      DC      OK
 SYSTEM TEMPERATURE is OK
 System Temperature Value: 36 Degree Celsius
 Extension Board Temperature Value: 32 Degree Celsius
```

Product Specifications

The following table lists the product specifications for the Cisco ESR6300.

Table 1: Memory

DRAM	4GB
SPI Flash	16MB for the rommon (boot loader)
eMMC Flash	4GB (in pSLC mode) for Cisco IOS

Table 2: Environmental

Industrial-grade components	-40F to +185F (-40C to +85C) component local ambient temperature specifications

Operating temperature	Temperature range of a completed solution depends on the enclosure thermal design characteristics used by the integrator. If –NCP SKU is used, integrator is responsible for designing a thermal solution that meets the component level requirements provided in this document.
Non-Operating Temperature	-40F to +185F (-40C to +85C)
Operating altitude	15,000ft (4,572m)
Non-operating altitude	40,000ft (12,200m)
Humidity	95% +/- 5% RH

Table 3: Hardware

Input voltages	+5Vdc (+/- 5%) and +3.3Vdc (+/- 3%)
Total Power Consumption	5.0W typical at idle, at +77F (+25C) 9.6W typical with full traffic, at +158F (+70C) 12W measured maximum
Mass	ESR-6300-NCP-K9: 41 grams ESR-6300-CON-K9: 212 grams
Mean Time Before Failure	ESR-6300 (-CON and –NCP) standalone. Ground, Fixed, Controlled: 1,065,092 (in hours)

Power Requirements

The ESR6300 requires +5 VDC and +3.3 VDC to operate. The following table lists the DC power requirements.

Note There are no timing or sequencing requirements for the power input.

Voltage Rail	Tolerance	Typical Current (A)	Maximum Current (A)
5V	+/- 5%	N/A	2.2
3.3V	+/- 3%	N/A	0.5
P3_3V RTC	+10% / -60%	400e-9	700e-9

Power Over Ethernet (PoE)

The ESR6300 supports IOS software control of PoE if the partner adds the appropriate circuitry to their host chassis. A maximum of 120W of power is supported through to PDs via the per port PSE controllers.

Note The actual amount of power available for POE may be less depending on size of the power supply included by the integrator.

The integrator should contact Cisco for any additional details.

SFP Support

Both 100BASE-X and 1000BASE-X SFP transceivers are supported by the router.

Supported 1000M SFP Modules

SFP	Distance	Fiber	Commercial(0C to 70C)	Extended(-5C to 85C)	Industrial(-40C to 85C)	DOM
GLC-SX-MM-RGD	220-550 m	MMF	—	—	X	
GLC-LX-SM-RGD	550 m/10 km	MMF/SMF	—	—	X	X
GLC-ZX-SM-RGD	70 km	SMF	—	—	X	X
GLC-SX-MMD	220-550 m	MMF	—	X	—	X
GLC-LH-SMD	550 m/10 km	MMF/SMF	—	X	—	X
GLC-ZX-SMD	70km	SMF	—	X	—	X
GLC-LH-MMD	550 m/10 km	MMF/SMF	—	X	—	X
GLC-BX-U	10 km	SMF	X	—	—	X
GLC-BX-D	10 km	SMF	X	—	—	X
GLC-EX-SMD	40 km	SMF	—	X	—	X
GLC-T-RGD	100 m	N/A	—	—	X	
GLC-T, GLC-TE (see note below)	100 m	N/A	X	—	—	

Note The GLC-T and GLC-TE are the only copper SFPs supported by Cisco, and the **service unsupported-transceiver** CLI must be added if they are used.

Supported 100M Fast Ethernet SFP Modules

SFP	Distance	Fiber	Commercial(0C to 70C)	Extended(-5C to 85C)	Industrial(-40C to 85C)	DOM
GLC-FE-100FX-RGD	2 km	MMF	—	—	X	
GLC-FE-100LX-RGD	10 km	SMF	—	—	X	
GLC-FE-100FX	2 km	MMF	X	—	—	
GLC-FE-100LX	10 km	SMF	X	—	—	
GLC-FE-100EX	40 km	SMF	X	—	—	
GLC-FE-100ZX	80 km	SMF	X	—	—	
GLC-FE-100BX-U	10 km	SMF	X	—	—	
GLC-FE-100BX-D	10 km	SMF	X	—	—	

Note The following CLIs are used to show the output for DOM features:

```
Router#sh hw-module subslot 0/0 transceiver 0 status
Router#sh hw-module subslot 0/0 transceiver 0 idprom detail
```

The subslot comes from the first two digits in the interface name, and the transceiver port number comes from the last digit.

SFPs Supported in IOS XE 17.7.1

The following SFPs are supported in IOS XE release 17.7.1:

Table 4: Supported SFPs added in IOS XE 17.7.1

SFP	Distance	Fiber	Commercial 0C ~ +70C	Extended -5C ~ +85C	Industrial -40C ~ +85C	DOM
GLC-T-RGD	100 M	Copper			YES	
CWDM-SFP-1470	100 km	Duplex	YES			YES

SFP	Distance	Fiber	Commercial 0C ~ +70C	Extended -5C ~ +85C	Industrial -40C ~ +85C	DOM
CWDM-SFP-1610	100 km	Duplex	YES			YES
CWDM-SFP-1530	100 km	Duplex	YES			YES
DWDM-SFP-3033	80 km	Duplex	YES			YES
DWDM-SFP-3112	80 km	Duplex	YES			YES
GLC-BX-D-I	10 km	Single Strand			YES	YES
GLC-BX-U-I	10 km	Single Strand			YES	YES
GLC-TE	100 km	Copper			YES	NO

LED Definitions

Eight LEDs are available for general use. Six of these are already defined and two are reserved for use by the integrator. See the following table.

LED	Color	Description
System (SYS)	Off Flashing Green Green Flashing Yellow Yellow	No Power Boot up phase Normal Operation Zeroization Process started Power is OK but possible internal failure
Power (PWR)	Off Green Yellow	Power is not present System is powered on System power fault detected
Alarm (ALM)	Off Red	Normal operation Alarm State on the Alarm Input
VPN	Off Green	No VPN tunnel At least one VPN tunnel is up
USB CONS	Off Green	RS232 Console Port is active. USB Console port is inactive. USB Console port is active. RS232 Console port is inactive.

LED	Color	Description
SSD	Off Flashing Green	No SSD Activity SSD Activity Detected
RSVD	Yellow Green	Reserved
RSVD	Yellow Green	Reserved

In addition, eight more LEDs are defined, one each for the 6 GE ports, and two for the 2 SFP ports. See the following table.

LED	Color	Description
GE 1/0 LAN	Off Green Flashing Green	No Link Link Activity
GE 1/1 LAN	Off Green Flashing Green	No Link Link Activity
GE 1/2 LAN	Off Green Flashing Green	No Link Link Activity
GE 1/3 LAN	Off Green Flashing Green	No Link Link Activity
GE 0/0 WAN	Off Green Flashing Green	No Link Link Activity
GE 0/1 WAN	Off Green Flashing Green	No Link Link Activity
SPF 0/0 WAN	Off Yellow Flashing Yellow	No Link Link Activity

LED	Color	Description
SPF 0/1 WAN	Off Yellow Flashing Yellow	No Link Link Activity

Note There is no Link Speed indicator signal for LED on ESR board. Instead, software must read the internal ESR Ethernet registers to report the speed of the link. Cisco has standardized the ESR design to report "Link Established" and "Link Traffic Activity" on a single LED, but not Link speed.

Block Diagrams

System integrators can find block diagrams that represents how the ESR board connects into their system located here:

- Basic GigE Router
- Basic GigE Router with SFP WAN
- Console Port Options
- GigE Router with no PoE
- GigE Router with PoE+

Mechanical and Environmental Testing

The tests listed in the following table were successfully executed on the conduction-cooled models of the Cisco ESR6300. These tests used a representative enclosure that conforms to the mounting and thermal mechanisms shown in Thermal Design Considerations, on page 1. Because this type of testing is highly dependent on factors such as the test enclosure design, the thermal solution, the front panel connectors, and the mounting, the following test results should only be used as a reference.

Table 5: Tempurature

High and Low Temperature Cycle Stress (Operational)	High Temperature: 74°C (165°F) Low Temperature: -40°C (-40°F) Reference: MIL-STD-810F, Method 501.4, Procedure II and Method 502.4, Procedure II; SAE J1455 (Rev AUG94), Section 4.1.3

Thermal Shock (Non-Operational)	High Temperature: 85°C (185 °F) Low Temperature: -40°C (-40 °F) Cycle: 2 hours high temperature, 2 hours low temperature Test Period: 2 hour pre-soak at low temperature, followed by 5 cycles Repetition: 5 test periods Reference: MIL-STD-810F, Method 503.4; SAE J1455 (Rev AUG94), Section 4.1.3.2
High Temperature Component Thermal Test (Operational)	Method: Thermocouples on all critical/hot components at board level. Bring temperature of top center surface of thermal plate to 85°C (185 °F) and allow it to stabilize. Ensure that all components are within manufacturer thermal specifications.

Table 6: Altitude

Low Pressure/Altitude (Operational)	Altitude: 4,572m (15,000ft) Equivalent Absolute Pressure: 57.2 kPa (8.3 lbf/in2) Temperature: -40°C (-40°F) to 74°C (165°F) Altitude Ramp Rate: 10m/s (max) Temperature Ramp Rate: 1.5°C (min) to 4.5°C (max) Reference: MIL-STD 810F, Method 500.4, Procedure II; SAE J1455 (Rev AUG94), Section 4.1.3.1
	Altitude: 12,192m (40,000ft) Temperature: 25°C (77°F) ambient
Low Pressure/Altitude (Non-Operational)	Altitude: 12.2km (40,000 ft) Equivalent Absolute Pressure: 18.6kPa (2.7lbf/in2) Temperature: -40°C (-40°F) to 85°C (185°F) Altitude Ramp Rate: 10m/s (max) Temperature Ramp Rate: 1.5°C (min) to 4.5°C (max) Reference: MIL-STD-810F, Method 500.4; SAE J1455 (Rev AUG94), Section 4.1.3.1

Table 7: Humidity

Temperature & Humidity Cycle Stress (Non-Operational; Energized)	Humidity: 95% +/- 5% RH Pressure: 103.4 kPa (15 lbf in2) Temperature: -40°C (-40°F) to 65°C (149°F) Cycle: One, 24 hour cycle Reference: SAE J1455 (Rev AUG94), Section 4.2.3
Active Temperature/Humidity 10 Day Soak (Non-Operational; Energized)	Temperature: -40°C (-40°F) to 65 °C (149 °F) Humidity: 95% +/- 5% RH Cycle: Ramp from 25°C to -40°C over 75 minute period, dwell at -40°C for 240 minutes, ramp to 65°C over 120 minute period, dwell at 65°C for 240 minutes (95% +/- 5% RH), ramp to 25°C over 45 minute period, dwell at 25°C for 120 minutes (50% +/- 5% RH) Repetition: 20 total cycles (10 days total) Reference: MIL-STD-810F, Method 507.4; SAE J1211 (Rev NOV78), Section 4.2.2; SAE J1455 (Rev AUG94), Section 4.2.3

Table 8: Vibration

Random Vibration (Operational)	Acceleration: 1.04g rms vertical, 0.204g rms transverse, 0.740g rms longitudinal Duration: 2 hours per axis Test orientation: 3 axes Reference: MIL-STD-810F, Method 514.5, Category 4

Table 9: Shock

Crash Hazard Shock (Non-Operational)	Acceleration: 75G Duration: 8-13ms Test orientation: 3 axes (positive and negative) Number of shocks: 2 shocks in each direction, 12 shocks total Reference: MIL-STD-810F, Method 516.5, Procedure V

Functional Shock (Operational)	Acceleration: 40G Duration: 15-23ms Test orientation: All 6 faces, in 3 perpendicular axes Reference: MIL-STD-810F, Method 516.5, Procedure I
Bench handling shock (tip) (Operational)	Test orientation: All four edges of each face to form 10° angle with bench top Reference: MIL-STD-810F, Method 516.5, Procedure VI

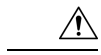
Overtemperature Detection

The ESR Board has a temperature sensor mounted on the edge of the board and thermally attached to the cooling plate. The location is U23, and identified as Thermometer in Thermal Design Considerations.

The digital temperature sensor measures the temperature of the conduction plate (or the integrators equivalent of the conduction plate), not the local ambient temperature. The product datasheet states the board will operate as long as the conduction plate is in the range of -40C to +85C. The alarms are set accordingly and will generate a syslog message, however, there is no SNMP trap.

The high temperature alarm thresholds are set as follows:

- Minor alarm at +80C the conduction plate temperature is close to the rated thermal limit of the unit, and will notify the user. The components are still within the specification, so there is no degradation to the long term reliability of the system.
- Major alarm at +90C the conduction plate temperature is over the rated thermal limit of the unit, and will notify the user. This will impact the long term reliability of the system.
- Critical alarm at +96C the conduction plate temperature is way over the rated thermal limit of the unit, and will notify the user. This will impact the long term reliability of the system. For the Critical Alarm threshold to be reached, it means that the ambient temperature of the system will be exceeded. Hardware failure is immanent, and the failure time will depend upon your installation. Depending on the severity at this point, the failure may be temporary or permanent.



Caution IOS will never shut down a device because the temperature exceeds the specification. Cisco does not guarantee the functionality, nor the long term reliability of a device operating beyond Cisco specifications, but lets the device continue operating until some piece of hardware physically shuts down. Operating outside of the temperature specifications will void the product warranty.

The status of the temperature sensors can be reported from the Cisco ESR6300 command line interface:

```
router# show environment all
ALARM CONTACT 1
   Status:      not asserted
   Description: external alarm contact 1
   Severity:    minor
   Trigger:     closed
ALARM CONTACT 2
```

```
   Status:      not asserted
   Description: external alarm contact 2
   Severity:    minor
   Trigger:     closed
Supervisor Temperature Value: 51 C
Temperature State: GREEN
System Temperature thresholds
------------------------------
Minor Threshold    : 80 C (Yellow)
Major Threshold    : 90 C (Red)
Critical Threshold : 96 C
Shutdown Threshold : 105 C
Pwr Supply         Type     Status
------------------------------------
POWER SUPPLY-A      DC      OK
POWER SUPPLY-B      DC      OK
```

Configuration Reset Overview

The push button input present in the Cisco ESR6300 Series, helps in the quick recovery of the router. Use this feature to recover your router that is hung or stuck. Press the push button and boot the preconfigured “golden.bin” image and “golden.cfg” configuration.

The push button can be actuated only during the hardware initialization stage, after power-on, or at the reload command. The Reset button can not be used once the router gets into the Rommon mode or the IOS mode.

Note Configure a fall-back image with the name “golden.bin” (bootflash:); and a fall-back configuration with the name “golden.cfg” (bootflash: or nvram:). The partner / integrator must have added this optional feature to their carrier board to use the Configuration Reset and / or Zeroize features.

Example Command Line Output

```
ESR6300#write erase
*********************************************************************************************
Erasing Nvram will not clear license trust code.
*********************************************************************************************
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
ESR6300#
Sep 10 21:06:38.209: %SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram

ESR6300#show start
startup-config is not present. <-Confirmation that the startup configuration is gone.

ESR6300#dir
Directory of bootflash:/
150177  drwx      151552  Sep 10 2021 21:07:07 +00:00  tracelogs
15809   drwx        4096  Sep 10 2021 21:06:38 +00:00  .dbpersist
102753  drwx        4096  Sep 10 2021 21:03:34 +00:00  .installer
126465  drwx        8192  Sep 10 2021 21:02:32 +00:00  license_evlog
158081  drwx        8192  Sep 10 2021 21:02:29 +00:00  its
13      -rw-          30  Sep 10 2021 21:02:14 +00:00  throughput_monitor_params
23      -rw-      5242880  Sep 10 2021 21:01:38 +00:00  ssd
```

```
12      -rw-         156  Sep 10 2021 21:01:17 +00:00  boothelper.log
19      -rw-        16106  Sep 10 2021 21:01:08 +00:00  mode_event_log
118562  drwx        4096  Sep 10 2021 20:57:45 +00:00  pnp-tech
142274  drwx        4096  Sep 10 2021 20:57:01 +00:00  pnp-info
118561  drwx        4096  Sep 10 2021 20:56:54 +00:00  .prst_sync
11      -rw-         156  Sep 10 2021 20:55:56 +00:00  boothelper.old
28     -rw-      10855  Sep 10 2021 20:52:03 +00:00  golden.cfg <-The original configuration
 was saved here. You MUST use "golden.cfg".
25      -rw-   633006165  Jul 27 2021 19:25:19 +00:00  c6300-universalk9.17.06.01.SPA.bin
47425   drwx        4096  Jul 27 2021 19:09:38 +00:00  core
17      -rw-   633021206  Jul 27 2021 17:03:51 +00:00
c6300-universalk9.BLD_V176_1_THROTTLE_LATEST_20210716_141617_V17_6_0_135.SSA.bin
16      -rw-            14294  Apr 26 2021 23:04:15 +00:00  CCME_Lab_config.txt
 --More--
```

Pushbutton held for 5 seconds after power up while power is applied

```
System Bootstrap, Version 3.4(REL), RELEASE SOFTWARE
Copyright (c) 1994-2021  by cisco Systems, Inc.
ESR-6300-CON-K9 platform with 4194304 Kbytes of main memory
MCU Version - Bootloader: 8, App: 10
MCU is in application mode.
Reset button push detected. <- The bootloader detected the pushbutton pressed.
unable to open bootflash:golden.bin (14)
```

After the system has finished rebooting, the startup and running configuration will have what was stored in "golden.cfg".

```
License Usage
=============
network-essentials_250M
(ESR6300_P_250M_E):
  Description: network-essentials_250M
  Count: 1
  Version: 1.0
  Status: IN USE
  Export status: NOT RESTRICTED
  Feature Name: network-essentials_250M
  Feature Description: network-essentials_250M
  Enforcement type: NOT ENFORCED
  License type: Perpetual
```