Power over Ethernet Configuration Guide, Cisco Catalyst IE9300 Rugged Series Switches

Cisco Catalyst IE9300 Rugged Series
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1 Power over Ethernet

Topics:

- Power over Ethernet
- Configure PoE+ and UPoE+
- Feature History: PoE

Explains how Power over Ethernet enables simultaneous transmission of power and data over Ethernet cables

Power over Ethernet

Explains how Power over Ethernet (PoE) enables Ethernet cables to provide both electrical power and data connectivity to network devices.

Power over Ethernet (PoE) is a technology that enables Ethernet cables to deliver both electrical power and data to powered devices.

PoE:

- delivers DC power to devices over copper Ethernet cabling
- eliminates the need for separate power supplies and outlets
- improves flexibility for placing Ethernet end devices

A powered device receives redundant power when connected to both a PoE switch port and an AC power source. The device does not receive redundant power if it is connected only to the PoE port.

A PoE-capable switch port automatically supplies power when it detects:

- An IEEE standard powered device (PD), such as Cisco IP phones
- IEEE 802.3af-compliant powered devices, up to 15.4 W
- IEEE 802.3at-compliant powered devices, up to 30 W
- IEEE 802.3bt-compliant powered devices, up to 90 W

PoE types

PoE types	Maximum power per port
PoE+	30 W
UPoE+	90 W

Note

- Both PoE+ and UPoE+ support lower wattages
- To ensure redundant power, connect a powered device to both a PoE switch port and an AC power source. A device connected only to the PoE port does not receive redundant power.

PoE support for Cisco Catalyst IE9300 Rugged Series switches

This topic explains the Power over Ethernet (PoE) support for Cisco Catalyst IE9300 Rugged series switches, including supported models, port capabilities, PoE budgets, and key PoE features available in specific software releases.

IE-9310-16P8S4X-E and IE-9310-16P8S4X-A (mixed port) switches are supported in the Cisco Catalyst IE9300 Rugged Series starting with IOS XE 17.18.1.

PoE support, supported ports, and wattage details for the Cisco Catalyst IE9300 Rugged Series Switches are:

Switch model	Supported ports	PoE budget
IE9320 10 GE PoE switches (IE-9320-24P4X-A and IE-9320-24P4X-E)	24 ports of up to 30W PoE output on all downlink ports	720 W
IE9320 10 GE mGig 4PPoE switch (IE-9320-16P8U4X-A and IE-9320-16P8U4X-E)	• 16 ports of up to 30 W PoE output on all GE downlink ports • 8 ports of up to 90 W PoE output on all 2.5 GE downlink ports	720 W
IE9320 GE PoE switches (IE-9320-24P4S-A and IE-9320-24P4S-E)	24 ports of up to 30 W PoE output on all downlink ports	480 W
IE9310 mixed port switches IE-9310-16P8S4X-A and IE-9310-16P8S4X-E	16 ports of up to 30 W PoE output on Copper GE downlink.	480 W

PoE features

The IE9320 10GE PoE, IE9320 10GE mGig 4PPoE and IE9320 GE PoE switches support these PoE features from Cisco IOS XE 17.12.x release onwards while IE9310 mixed port switches support these features from Cisco IOS XE 17.18.x release onwards:

- **PoE power policing:**

  When enabled, the device monitors power usage by comparing real-time consumption with the maximum power allocated to the device, helping to prevent power overuse.

  For more information, see Power Monitoring and Power Policing section.

- **Perpetual PoE:**

  Provides uninterrupted power to connected powered devices even during switch boot-up, ensuring continuous operation for critical devices.

  For more information, see Configuring Perpetual PoE and Fast POE section.

- **Fast PoE:**

  Enables rapid restoration of PoE power after system power loss and recovery by storing port status in flash memory, allowing ports to power on quickly.

  For more information, see Configure Perpetual PoE and Fast PoE on page 22 section.

- **Load shedding:**

  Load shedding is the process in which the system shuts down PoE devices when a power supply fails. The switch first shuts down low-priority devices. If the switch still lacks enough power, it shuts down high-priority devices in descending order of port number. You can configure port priority using the CLI. Load shedding is enabled by default.

  For more information, see Load Shedding and Configure Port Priority sections.

Powered-device detection and initial power allocation

This topic explains how a switch detects IEEE-compliant powered devices and allocates initial power, including classification, negotiation, and monitoring of power requirements and budgets for connected devices.

The powered-device detection and initial power allocation process is a method by which a switch identifies IEEE-compliant powered devices and allocates the necessary power based on device requirements and negotiation protocols.

- The switch detects powered devices when the PoE-capable port is active, PoE is enabled, and the device is not powered by an AC adapter.
- Initial power allocation is determined by the device's maximum required power, which may be adjusted through CDP or LLDP negotiation.
- The switch classifies devices into power consumption classes and manages the power budget accordingly, granting or denying power based on availability and device requests.

Power allocation and device classification

After detecting a powered device, the switch determines its power requirements based on device type and negotiates power allocation using CDP or LLDP protocols.

- The switch classifies detected IEEE devices within a power consumption class and checks the available power budget before powering a port.
- The switch monitors and tracks power requests, updating the power budget as power is granted or denied.
- CDP is used for Cisco devices to determine specific power requirements, while IEEE 802.3at/bt and LLDP are used for third-party devices.
- If a fault such as undervoltage, overvoltage, overtemperature, oscillator fault, or short-circuit is detected, the switch turns off power to the port, generates a syslog message, and updates the power budget and LEDs.

The table lists power consumption classes and the maximum power level required from the device:

Table 1: Power consumption classes and maximum power levels

Power consumption class	Maximum power level required from device
0 (class status unknown)	15.4 W
1	4 W
2	7 W
3	15.4 W
4	30 W
5	45 W
6	60 W
7	75 W
8	90 W

The power consumption class and maximum power level required for the switches:

- E-3505-8P3S : Supports power consumption classes 1 through 4 (4 W to 30 W).
- IE3500 mGig (IE-3500-8U3X): Supports power consumption classes 1 through 8 (4 W to 90 W).

Power management modes

This topic explains the different power management modes available for PoE ports on switches, including how they determine device detection, power allocation, and management of power distribution among connected devices.

Power management modes:

- determine how the switch detects connected powered devices
- allocate power to ports based on the available power budget, and
- manage power distribution when multiple devices request power simultaneously.

PoE power management modes

Cisco switches support these PoE power-management modes:

- **Auto mode**: The default setting. The switch automatically detects if the connected device requires power. If enough power is available, the switch activates all powered devices. If there is not enough power, the switch cannot determine which devices will receive power. If granting power exceeds the system power budget, the switch denies power, turns off the port, generates a syslog message, and repeatedly checks the power budget. If a device is removed, the switch detects the disconnect and removes power from the port. You can specify the maximum wattage allowed on the port. If the device requests more than the configured maximum, the switch removes power from the port and returns it to the global power budget. Use the auto setting on any PoE port.
- **Static mode**: Preallocates power to the port, guaranteeing power availability even when no device is connected. The switch allocates the port-configured maximum wattage, which is not adjusted by device messages. Any device using less than or equal to the maximum wattage is guaranteed power. If the device's IEEE class is greater than the maximum, the switch does not supply power. If the device consumes more than the maximum, the switch shuts it down. If no wattage is specified, the switch preallocates the maximum value.. The switch powers the port only if it discovers a powered device.
- **Never mode** : Disables powered-device detection and never powers the PoE port, even if a device is connected. Use this mode to ensure that power is never applied, making the port data-only.

For most situations, the default configuration (auto mode) provides plug-and-play operation and requires no further configuration. However, you can configure a PoE port for a higher priority, to make it data only, or to specify a maximum wattage to disallow high-power powered devices on a port.

Power monitoring and power policing

Power monitoring, also called power sensing enables a PoE-capable switch to sense and monitor the real-time power consumption of a connected powered device. Power policing restricts power usage based on this monitoring.

How it works

- The switch monitors real-time power consumption on individual PoE ports.
- The switch records power consumption data, including peak usage, and reports it through the CISCO-POWER-ETHERNET-EXT-MIB.
- When power policing is enabled, the switch compares the real-time power consumption to the maximum power allocated to the device, also called the cutoff power.
- If the powered device exceeds the cutoff power, the switch can:
  - Shut down the PoE port and disable power (error-disabled state), or
  - Generate a syslog message and blink the port LED amber while continuing to provide power, depending on configuration.

- By default, power policing is disabled on all PoE ports.
- If error recovery from the PoE error-disabled state is enabled, the switch automatically recovers the port after a configured interval.
- If error recovery is disabled, manually re-enable the port using the **shutdown** and **no shutdown** interface commands.
- If power policing is disabled, no action occurs when the powered device consumes more than the allocated power, which may adversely affect the switch or other devices.

Compatibility

Power monitoring is backward-compatible with Cisco intelligent power management and CDP-based power consumption features to ensure proper power supply to the powered device.

Power consumption values

This topic explains how power consumption values are configured and managed on PoE ports, including the difference between configured and actual power usage, and considerations for power policing and supply changes.

Power consumption values are the configured and actual power usage on PoE ports. These values include allocation, policing, and management of power for connected devices.

- You can configure the initial power allocation and the maximum power allocation on a PoE port. These configured values determine when the switch turns power on or off on the port.
- The maximum power allocation is not the same as the actual power consumption of the powered device.
- The cutoff power value used by the switch for power policing is different from the configured maximum power allocation.
- When power policing is enabled, the switch monitors and enforces power usage limits on the port. The switch policies power consumption that exceeds the cutoff power.
- When manually setting the maximum power allocation, you must account for power loss over the cable from the switch port to the powered device.
- The cutoff power is the sum of
  - The rated power consumption of the powered device and
  - The worst-case power loss over the cable.
- The actual power consumed by a powered device on a PoE port is approximately the cutoff power plus a calibration factor of 0.5 W (500 mW).
- The actual cutoff power value may vary slightly. For example, about 5% less than the configured value.
- It is recommended to enable power policing when PoE is enabled on the switch.

  Example: For a Class 1 device, if policing is disabled and the cutoff power is set using the command **power inline auto max 6300**, which sets the maximum power allocation to 6.3 W or 6300 mW), the switch will provide power to devices needing up to 6.3 W.
- If the CDP power-negotiated value or IEEE classification exceeds the configured cutoff value, the switch will not provide power to the device.
- After power is turned on, the switch does not police real-time power consumption. As a result, the device may consume more power than allocated, which can affect the switch and other PoE devices.

This configuration ensures proper power management and protection of the switch and connected devices by monitoring and policing power consumption effectively.

Monitoring power status

Use the **show** commands to monitor and verify the PoE configuration.

Table 2: show commands for power status

Command	Purpose
show power inline police	Displays power-policing data.

Load shedding

This topic explains the concept of load shedding, which is the process by which the switch manages PoE devices based on port priority when a power supply fails. It describes how devices are shut down and reconnected according to available power and port configuration.

Load shedding is a process enabled by default on the switch that shuts down PoE devices based on port priority when a power supply fails.

- All low-priority powered devices are shut down first.
- If the PoE power budget is sufficient, devices are reconnected starting with the lowest-numbered ports.
- If the budget is insufficient, high-priority ports are shut down in descending order of port numbers until power consumption returns to normal.

To configure high-priority ports, you must change the priority before the port is powered on. If the port is already powered on, switch it off, change the priority, and then switch it back on.

- By default, all powered devices are low priority.
- High-priority ports can be configured using the CLI.
- Priority changes must be made before powering on the port, or the port must be cycled off and on after changing priority.

When power is restored or a new power supply is added, the switch powers on devices on a first-come-first-serve basis. Devices are powered on in the order they request power.

For more information, see Configure Port Priority .

Configure PoE+ and UPoE+

This topic explains how to configure PoE+ and UPoE+ on IE9300 Series switches. It provides an overview of the configuration process and key considerations for enabling these features.

This section provides instructions for configuring PoE+ and UPoE+ on Cisco Catalyst IE9300 Rugged Series Switches .

Configure power management mode on a PoE Port

Learn how to configure a power management mode on a PoE port, including command usage, mode options, and how to verify and save your configuration.

Note

When you make PoE configuration changes on a port, the port being configured drops power. Whether the port powers up again depends on the new configuration, the state of other PoE ports, and the overall power budget. For example, changing a port from auto mode to static mode causes the device to remove power, detect the connected device, and repower the port. Similarly, configuring a maximum wattage causes the device to remove power and redetect the device, repowering only if the device class matches the configured limits.

Perform this task to configure power management mode on a PoE port.

Procedure

1. Use the **enable** command to enable the privileged EXEC mode.

   Example

   ```
   Switch#enable
   ```

   Enter your password if prompted.

2. Use the **configure terminal** to enter global configuration mode.

   Example

   ```
   Switch#configure terminal
   ```

3. Use the **interface** *interface-id* command to specify the interface to configure.

   Example

   ```
   Switch(config)#interface gigabitethernet2/0/1
   ```

   Enters interface configuration mode for the specified port.

4. Use the **power inline** { **auto** [**max** *max-wattage*] | **never** | **static** [**max** *max-wattage*] } command to configure the PoE power management mode.

   Example

   ```
   Switch(config-if)#power inline auto
   ```

   Enables powered-device detection and automatic power allocation if sufficient power is available. This is the default setting.

   Example

   ```
   Switch(config-if)#power inline auto max 10000
   ```

   Limits power to 10,000 mW on the port in auto mode.

Example

```
Switch(config-if)#power inline never
```

Disables power to the port, making it data-only.

Example

```
Switch(config-if)#power inline static max 15000
```

Preallocates 15,000 mW power to the port, guaranteeing power availability upon device detection

Example

```
Switch(config-if)#power inline consumption 12000
```

Sets the PoE consumption value to 12,000 mW for the connected device. The power consumption can range from 4000 to 90000 mW

The device allocates power to a port configured in static mode before it allocates power to a port configured in auto mode.

5. Use the **end** command to return to privileged EXEC mode.

Example

```
Switch(config-if)#end
```

6. Use the command to display the PoE status for a device, for the specified interface.

Example

```
Switch# show power inline gigabitethernet1/0/1
```

Displays the PoE status for a device, for the specified interface.

7. *(Optional)* Use the **copy running-config startup-config** command to save the current configuration to the startup configuration file.

Example

```
Switch#copy running-config startup-config
```

Configure power policing

Learn how to configure power policing on your device to monitor and control the real-time power consumption of connected powered devices. Use this procedure to enable policing, set actions, and verify error recovery settings.

By default, the device monitors the real-time power consumption of connected powered devices. You can configure the device to police the power usage.

Perform this task to configure power policing on the device.

Procedure

1. Use the **enable** command to enable privileged EXEC mode.

   Example

   ```
   Device#enable
   ```

   Enter your password if prompted.

2. Use the **configure terminal** command to enter global configuration mode.

   Example

   ```
   Device#configure terminal
   ```

3. Use the **interface** *interface-id* command to specify the physical port to configure.

   Example

   ```
   Device(config)#interface gigabitethernet2/0/1
   ```

4. Use the **power inline police** [**action** { **log** | **errdisable** }] command to configure power policing on the port.

   Example

   ```
   Device(config-if)#power inline police
   ```

   This command configures the device to take one of these actions if the real-time power consumption exceeds the maximum power allocation on the port:

   - **power inline police (default):** Shuts down the PoE port, turns off power to it, and puts it in the error-disabled state.

     Note

     You can enable error detection for the PoE error-disabled cause by using the **errdisable detect cause inline-power** global configuration command. You can also enable the timer to recover from the PoE error-disabled state by using the **errdisable recovery cause inline-power interval interval** global configuration command.

   - **power inline police action errdisable:** Turns off power to the port if the real-time power consumption exceeds the maximum power allocation on the port.
   - **power inline police action log:** Generates a syslog message while still providing power to the port.

   If you do not specify the **action log** keywords, the default action shuts down the port and puts the port in the error-disabled state.

5. Use the **exit** command to exit interface configuration mode.

Example

```
Device(config-if)#exit
```

Exits interface configuration mode, and returns to global configuration mode.

6. *(Optional)* Enable error recovery from the PoE error-disabled state and configure recovery variables.
   a) Use the **errdisable detect cause inline-power** command to enable detection of PoE-related errors that cause a port to enter error-disabled state.

      Example

      ```
      Device(config)#errdisable detect cause inline-power
      ```

   b) Use the **errdisable recovery cause inline-power** command to enable automatic recovery from the PoE error-disabled state.

      Example

      ```
      Device(config)#errdisable recovery cause inline-power
      ```

   c) Use the **errdisable recovery interval** *interval* command to specifies the time in seconds to recover from the error-disabled state.

      Example

      ```
      Device(config)#errdisable recovery interval 100
      ```

      The range is 30 to 86400 seconds. The default is 300 seconds.

7. Use the **exit** command to exit the global configuration mode.

   Example

   ```
   Device(config)#exit
   ```

   Returns to privileged EXEC mode.

8. *(Optional)* Verify power policing and error recovery settings.
   a) Use the **show power inline police** command to display the power-monitoring status.

      Example

      ```
      Device#show power inline police
      ```

   b) and **show errdisable recovery** command to verify the error recovery settings.

      Example

      ```
      Device#show errdisable recovery
      ```

9. *(Optional)* Use the **copy running-config startup-config** command to save your configuration.

Example

```
Device#copy running-config startup-config
```

This command saves your entries in the configuration file.

Configure port priority

Learn how to configure the priority level of a switch port to ensure critical devices remain powered during load-shedding events.

By default, all the ports on the switch are low-priority. Low-priority ports are the first to be shut down under load-shedding. Load-shedding is the process in which the switch shuts down ports when the power budget is low or a power supply fails.

However, you can configure ports to be high-priority. You may want to do so for ports assigned to critical powered devices. A port configured as static is treated as high priority for load-shedding. You also can configure a high-priority port to a low-priority port.

> **Note**
>
> The system treats any port that is configured as static as high-priority.

Before you begin

Ensure that the port that you want to configure is turned off.

Procedure

1. Use the **configure terminal** command to enter global configuration mode.

   Example

   ```
   Switch#configure terminal
   ```

2. Use the **interface** *interface-id* command to specify the physical port to be configured and enter interface configuration mode.

   Example

   ```
   Switch(config)#interface gigabitethernet2/0/1
   ```

3. Use the **power inline port {low | high}** command to configure the priority level of the port.

   Example

   ```
   Device(config-if)# power inline port priority high
   ```

Example

> **Note**
>
> If the port's priority level is set to high, you should issue the **shutdown** and **no shutdown** commands on the interface.

Feature History: PoE

Lists release history, feature descriptions, and supported models for Power over Ethernet (PoE) features in Cisco IOS XE Dublin 17.12.x and later.

This table IE-9320-16P8U4X-E captures release-related information for features explained in this module. Unless specified, each feature continues to be supported in later releases.

Release	Feature	Feature Information
Cisco IOS XE Dublin 17.12.x	Power over Ethernet (PoE)	PoE delivers DC power to devices over copper Ethenet cabling and removes the need for separate power supplies and outlets. You can configure PoE on the following Cisco Catalyst IE9300 Rugged Series Switch models: • IE-9320-24P4X-A and IE-9320-24P4X-E • IE-9320-16P8U4X-A and IE-9320-16P8U4X-E • IE-9320-24P4S-A and IE-9320-24P4S-E

2 PoE Features

Topics:

- Fast PoE and Perpetual PoE
- Configure Perpetual PoE and Fast PoE
- Feature History: PoE

Fast PoE and Perpetual PoE

This topic explains Fast PoE and Perpetual PoE, which are features that restore or preserve power to connected devices during system boot or reboot on supported switches.

- Fast PoE restores power to endpoint devices quickly after a power failure or reset, without waiting for IOS-XE to boot up.
- Perpetual PoE preserves power to powered devices (PDs) during IOS-XE reboot, ensuring that devices remain powered and connected.

Fast PoE and Perpetual PoE operation

PoE support for Cisco Catalyst IE9300 Rugged Series Switches includes Fast PoE, which restores power during system boot, and Perpetual PoE, which preserves power during system boot.

- You enable Fast PoE and Perpetual PoE by using the CLI. See Configure Perpetual PoE and Fast PoE on page 22 in this guide.

Fast PoE operation:

1. When **poe-ha** is enabled on a port, the switch provides power to connected endpoint devices immediately after a power failure or reset, before IOS-XE forwarding starts.
2. The system loads and validates the power sourcing equipment (PSE) firmware before initiating Fast PoE connections.
3. The system verifies that adequate power budget is available for all Fast PoE reconnections. If the budget is insufficient, Fast PoE ports are reconnected starting from the lower interface number until the budget is exhausted.
4. Fast PoE can be used after both reset and power cycle.

Perpetual PoE operation:

- Perpetual PoE ensures that PDs do not lose power when IOS-XE is rebooted by not resetting the PSE controllers, so their loads stay connected.
- The system securely stores the firmware information after validation and can detect if the firmware has not changed since the last validation after a reset.
- Perpetual PoE is sometimes referred to as Persistent PoE.

Restrictions for Fast PoE and Perpetual PoE

The following restrictions apply to Fast PoE and Perpetual PoE:

- You must configure Fast PoE or Perpetual PoE before physically connecting any endpoint. Alternatively, you can do a manual shut/no-shut of the ports drawing power.
- In case of an MCU firmware upgrade, power to the ports is interrupted and ports are backed up immediately after the upgrade.
- The Cree Lighting PD may flap at regular intervals if not configured with IP assigned from the DHCP server.
- If the PD does not support LLDP, you can configure with either static or 2-event to receive required power according to the PD specification.

,

Configure Perpetual PoE and Fast PoE

Configure Perpetual PoE and Fast PoE settings on switch interfaces to ensure uninterrupted and fast device power during reload and power cycles.

Perform this task to configure Fast PoE and Perpetual PoE.

Procedure

1. Use the **enable** command to enter privileged EXEC mode.

   Example

   ```
   Switch#enable
   ```

   Enter your password if prompted.

2. Use the **configure terminal** command to enter global configuration mode.

   Example

   ```
   Switch#configure terminal
   ```

3. Use the **interface** *interface-id* command to specify the physical port to be configured and enter interface configuration mode.

   Example

   ```
   Switch(config)# interface gigabitethernet2/0/1
   ```

4. Use the **power inline port perpetual-poe-ha** command to configure Perpetual PoE on the interface.

   Example

   ```
   Switch(config-if)#power inline port perpetual-poe-ha
   ```

   This ensures the powered device remains powered during a switch reload.

5. Use the **power inline port poe-ha** command to configure Fast PoE on the interface.

   Example

   ```
   Switch(config-if)# power inline port poe-ha
   ```

   This allows the powered device to power on quickly after a power cycle without waiting for IOS to boot.

6. Use the **end** command to exit interface configuration mode and return to privileged EXEC mode.

   Example

   ```
   Switch(config-if)# end
   ```

Note

- Configure Perpetual PoE before Fast PoE.
- If a powered device is connected after configuring Fast PoE, shut the port, and then use the no shut command to apply the changes.

Example: Configuring Fast PoE and Perpetual PoE

This example shows how you can configure perpetual PoE on a switch:

```
Device> enable
Device# configure terminal
Device(config)# interface gigabitethernet2/0/1
Device(config-if)# power inline port perpetual-poe-ha
Device(config-if)# end
```

Feature History: PoE

Lists release history, feature descriptions, and supported models for Power over Ethernet (PoE) features in Cisco IOS XE Dublin 17.12.x and later.

This table IE-9320-16P8U4X-E captures release-related information for features explained in this module. Unless specified, each feature continues to be supported in later releases.

Release	Feature	Feature Information
Cisco IOS XE Dublin 17.12.x	Power over Ethernet (PoE)	PoE delivers DC power to devices over copper Ethenet cabling and removes the need for separate power supplies and outlets. You can configure PoE on the following Cisco Catalyst IE9300 Rugged Series Switch models: - IE-9320-24P4X-A and IE-9320-24P4X-E - IE-9320-16P8U4X-A and IE-9320-16P8U4X-E - IE-9320-24P4S-A and IE-9320-24P4S-E