



Configuring Power over Ethernet

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Information About Power over Ethernet

Power over Ethernet (PoE) is a technique for delivering DC power to devices over copper Ethernet cabling, eliminating the need for separate power supplies and outlets. Using PoE can improve flexible options for placing Ethernet end devices, and reduce the time and expense of installing electrical cabling.

A PoE-capable switch port automatically supplies power to one of these connected devices if the switch senses that there is no power in the circuit:

- An IEEE standard powered device, such as a new Cisco IP phone.
- An IEEE 802.3af-compliant powered device, which can receive up to 15.4 W of DC power
- An IEEE 802.3at-compliant powered device, which can receive up to 30 W of DC power
- An IEEE 802.3bt-compliant powered device, which can receive up to 90 W of DC power

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

Types of PoE

There are two types of PoE: PoE+, and Universal Power over Ethernet Plus (UPoE+). PoE+ delivers 30 W to a port while UPoE+ delivers 90 W to a port. However, both PoE+ and UPoE+ support lower wattages.

PoE features

- **PoE power policing:** When power policing is enabled, the device polices power usage by comparing the real-time power consumption with the maximum power allocated to the device.

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

- **Perpetual PoE:** Perpetual PoE provides uninterrupted power to a connected powered device even when the power sourcing equipment switch is booting.

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

- **Fast PoE:** Fast PoE enables the quick start of PoE power after a system power loss and recovery. If Fast PoE is enabled, status of PoE ports is stored in flash so that if there is a power loss and recovery, ports can be powered on as quickly as possible.

Powered-device detection and initial power allocation

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

Power consumption class	Maximum power level required from device
6	60 W
7	75 W
8	90 W

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

- E-3505-8P3S and IE-3500H-14P2T : Supports power consumption classes 1 through 4 (4 W to 30 W).
- IE3500H mGig 4PPoE switches (IE-3500H-12P2MU2X):
 - 12 GE downlink ports support power consumption classes 1 through 4 (4 W to 30 W).
 - Two 2.5 mGig downlink ports support power consumption classes 1 through 8 (4 W to 60 W).
- IE3500 mGig (IE-3500-8U3X): Supports power consumption classes 1 through 8 (4 W to 90 W).

Power Management Modes

The device supports these PoE modes:

- **Auto:** The auto mode is the default setting. The switch automatically detects if the connected device requires power. If the switch discovers a powered device connected to the port, and if the switch has enough power, it grants power, updates the power budget, and turns on power to the port on a first-come, first-served basis, and updates the LEDs. For LED information, see the hardware installation guide.

If the switch has enough power for all the powered devices, they all come up. If enough power is available for all the powered devices connected to the switch, power is turned on to all the devices. If enough PoE is not available, or if a device is disconnected and reconnected while other devices are waiting for power, it cannot be determined which devices are granted or are denied power.

If granting power exceeds the system's power budget, the switch denies power, ensures that power to the port is turned off, generates a syslog message, and updates the LEDs. After power is denied, the switch periodically rechecks the power budget and continues to attempt to grant the request for power.

If a device that is being powered by the switch is then connected to wall power, the switch might continue to power the device. The switch might continue to report that it is still powering the device irrespective of whether the device is being powered by the switch or receiving power from an AC power source.

If a powered device is removed, the switch automatically detects the disconnect and removes power from the port. You can connect a nonpowered device without damaging it.

You can specify the maximum wattage that is allowed on the port. If the IEEE class maximum wattage of the powered device is greater than the configured maximum value, the switch does not provide power to the port. If the switch powers a powered device, but the powered device later requests, through CDP or LLDP messages, more than the configured maximum value, the switch removes power to the port. The power that was allocated to the powered device is reclaimed into the global power budget. If you do not specify a wattage, the switch delivers the maximum value. Use the auto setting on any PoE port.

- **Static:** The switch preallocates power to the port (even when no powered device is connected) and guarantees that power will be available for the port. The switch allocates the port-configured maximum wattage, and the amount is never adjusted through the IEEE class or by CDP messages from the powered device. Because power is preallocated, any powered device that uses less than or equal to the maximum

wattage, is guaranteed to be powered when it is connected to the static port. The port no longer participates in the first-come, first-served model.

However, if the powered device's IEEE class is greater than the maximum wattage, the switch does not supply power to it. If the switch learns through CDP messages that the powered device is consuming more than the maximum wattage, the switch shuts down the powered device.

If you do not specify a wattage, the switch preallocates the maximum value. The switch powers the port only if it discovers a powered device.

- **Never:** The switch disables powered-device detection and never powers the PoE port even if an unpowered device is connected. Use this mode only when you want to make sure that power is never applied to a PoE-capable port, making the port a data-only port.

For most situations, the default configuration (**auto** mode) works well, providing plug-and-play operation. No further configuration is required. However, configure a PoE port 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

When policing of the real-time power consumption is enabled, the device takes action when a powered device consumes more power than the maximum amount allocated, which is also referred to as the *cutoff-power value*.

When PoE is enabled, the device senses and monitors the real-time power consumption of the connected powered device. This is called *power monitoring* or *power sensing*. The device also polices the power usage with the *power policing* feature.

Power monitoring is backward-compatible with Cisco intelligent power management and CDP-based power consumption. It works with these features to ensure that the PoE port can supply power to a powered device.

The device senses the real-time power consumption of the connected device as follows:

1. The device monitors the real-time power consumption by individual ports.
2. The device records the power consumption, including peak power usage, and reports this information through the CISCO-POWER-ETHERNET-EXT-MIB.
3. If power policing is enabled, the device polices power usage by comparing the real-time power consumption with the maximum power allocated to the device. The maximum power consumption is also referred to as the *cutoff power* on a PoE port.

If the device uses more than the maximum power allocation on the port, the device can either turn off the power to the port, or can generate a syslog message and update the LEDs (the port LED is now blinking amber) while still providing power to the device based on the device configuration. By default, power-usage policing is disabled on all the PoE ports.

If error recovery from the PoE error-disabled state is enabled, the device automatically takes the PoE port out of the error-disabled state after the specified amount of time.

If error recovery is disabled, you can manually re-enable the PoE port by using the **shutdown** and **no shutdown** interface configuration commands.

4. If policing is disabled, no action occurs when the powered device consumes more than the maximum power allocation on the PoE port, which could adversely affect the device.

Power Consumption Values

You can configure the initial power allocation and the maximum power allocation on a port. However, these values are the configured values that determine when the device should turn on or turn off power on the PoE port. The maximum power allocation is not the same as the actual power consumption of the powered device. The actual cutoff power value that the device uses for power policing is not equal to the configured power value.

When power policing is enabled, the device polices the power usage *at the switch port*, where the power consumption is greater than that by the device. When you manually set the maximum power allocation, you must consider the 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.

We recommend that you enable power policing when PoE is enabled on your device. For example, for a Class 1 device, if policing is disabled and you set the cutoff-power value by using the **power inline auto max 6300** interface configuration command, the configured maximum power allocation on the PoE port is 6.3 W (6300 mW). The device provides power to the connected devices on the port if the device needs up to 6.3 W. If the CDP power-negotiated value or the IEEE classification value exceeds the configured cutoff value, the device does not provide power to the connected device. After the device turns on the power on the PoE port, the device does not police the real-time power consumption of the device, and the device can consume more power than the maximum allocated amount, which could adversely affect the device and the devices connected to the other PoE ports.

Universal Power Over Ethernet

Universal Power Over Ethernet (UPOE) technology extends the IEEE 802.3bt at PoE standard to provide the capability to source up to 90 W of power (refer to the datasheet for the specific power available for each PID) over standard Ethernet cabling infrastructure (Class D or better) by using the spare pair of an RJ-45 cable (wires 4,5,7,8) with the signal pair (wires 1,2,3,6). Power on the spare pair is enabled when the switch port and end device mutually identify themselves as UPOE-capable using CDP or LLDP and the end device's requests for power to be enabled on the spare pair. When the spare pair is powered, the end device can negotiate up to 90 W of power from the switch using CDP or LLDP.

If the end device supports detection and classification on both signal and spare pairs, but does not support the CDP or LLDP extensions required for UPOE, a 4-pair forced mode configuration automatically enables power on both signal and spare pairs from the switch port.

If the Single Signature PD provides a valid detection on the spare pair, then the switch port starts to deliver power to the spare pair as well.



Note When the port is denied power, the class value is shown in the **upoe** command output, not in the base **poe** command.

PoE limitations

The PoE budget for the IE3x00 defaults to 125W regardless of the power supplies used, even when using power supplies that can provide up to a supported maximum of 170W, 240W, or 480W. You can configure the power budget to use the maximum supported wattage.



Note Before changing the power budget, the minimum power requirements for the switch need to be considered as well. Please refer to the datasheet for your switch for more details.

The attached power supply powers the IE3x00 switch operation as well as PoE power. When increasing the maximum PoE budget, you must subtract the power draw of the IE3x00 switch from the capacity of the attached power supply. You do so to prevent the IE3x00 switch from overdrawing the capacity of the attached power supply. For example, the IE3400 switch with an expansion module supports a maximum PoE budget of 480W. The IE3400-8P2S with an attached IEM-3400-8P draws 67W. With a 480W capacity power supply, the maximum you should configure the PoE budget is (480W-67W) 413W.

To use the power supply's maximum supported wattage for the PoE budget, configure the power supply max wattage in global configuration mode:

1. Verify the maximum amount that the power supplies support for the PoE budget.
2. Subtract the operating power of the IE3x00 switch according to its datasheet from the maximum capacity of the power supply. This is your max PoE budget.
3. Use the **power inline max max-wattage** command to increase the PoE budget based on the power supplies used. *max-wattage* is the maximum available PoE power.

How to Configure PoE and UPOE

The following tasks describe how you can configure PoE and UPOE.

Use the global configuration command **power inline wattage max max-wattage** to configure the PoE budget of DIN rail switches. Limiting the PoE budget prevents overdrawing power and exceeding the capacity of the power source. For more information, see [Configure PoE budget, on page 9](#)

Configuring a Power Management Mode on a PoE Port



Note When you make PoE configuration changes, the port that are being configured drops power. Depending on the new configuration, the state of the other PoE ports and the state of the power budget, the port might not be powered up again. For example, port 1 is in the auto and on state, and you configure it for static mode. The device removes power from port 1, detects the powered device, and repowers the port. If port 1 is in the auto and on state, and you configure it with a maximum wattage of 10 W, the device removes power from the port and then redetects the powered device. The device repowers the port only if the powered device is a class 1, class 2.

Procedure

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	Enter your password, if prompted.

	Command or Action	Purpose
	Device> enable	
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	interface interface-id Example: Device(config)# interface gigabitethernet1/1	Specifies the physical port to be configured, and enters interface configuration mode.
Step 4	power inline {auto [max max-wattage] never static [max max-wattage] consumption milli-watts-consumption } Example: Device(config-if)# power inline auto	Configures the PoE mode on the port. The following are the keywords: • auto: Enables detection of powered devices. If enough power is available, automatically allocates power to the PoE port after device detection. This is the default setting. Note • The power inline auto max command should be used only to adjust the port's cut-off power if the connected powered device (PD) does not support Layer 1 classification via LLDP/CDP and requires a manual increase in power. • Configure the power inline auto max value to the maximum of 30 W for IEEE 802.3at or 802.3af PDs. The power inline auto max value should exceed 30W only when an IEEE 802.3bt compliant Dual Signature PD or a Class 5 (or higher) Single Signature PD is connected to the port. • max max-wattage: Limits the power allowed on the port. If no value is specified, the maximum is allowed. • never: Disables device detection and power to the port. Note If a port has a Cisco-powered device connected to it, do not use the power inline never command to configure the port. A false link-up

	Command or Action	Purpose
		can occur, placing the port in the error-disabled state. • static: Enables detection of powered devices. Preallocate (reserve) power for a port before the device discovers the powered device. The device reserves power for this port even when no device is connected, and guarantees that power will be provided upon device detection. Note • The power inline static max command should be used only to adjust the port's cut-off power if the connected powered device (PD) does not support Layer 1 classification via LLDP/CDP and requires a manual increase in power. • Configure the power inline static max value to the maximum of 30 W for IEEE 802.3at or 802.3af PDs. The power inline static max wattage value should exceed 30W only when an IEEE 802.3bt compliant Dual-Signature PD or a Class 5 (or higher) Single-Signature PD is connected to the port. • consumption: Sets the PoE consumption (in mW) of the powered device connected to a specific interface. The power consumption can range from 4000 to 90000 mW. Use the no power inline consumption command to return to the default settings. The power inline consumption wattage command allows you to override the default power requirement defined by the IEEE classification. By doing so, any difference between the IEEE-mandated power and the actual power required by the device is reclaimed into the global power budget. This reclaimed power can then be allocated to additional devices, enabling you to extend and utilize the switch power budget more efficiently.

	Command or Action	Purpose
		Note The power inline consumption wattage command is not supported for Dual Signature PDs. The device allocates power to a port configured in static mode before it allocates power to a port configured in auto mode.
Step 5	end Example: Device(config-if) # end	Returns to privileged EXEC mode.
Step 6	show power inline Example: Device# show power inline	Displays the PoE status for a device.
Step 7	copy running-config startup-config Example: Device# copy running-config startup-config	(Optional) Saves your entries in the configuration file.

Configure PoE budget

Use this task to configure the PoE budget of DIN railswitches.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	power inline wattage max max-wattage Example: Device(config-if) # power inline wattage max 360	Configures the max-wattage power allowed on the port. If no value is specified, the default max-wattage value is 125 W. Refer to the datasheet for the max-wattage power available for each switch variant.
Step 4	end Example:	Returns to privileged EXEC mode.

	Command or Action	Purpose
	Device (config-if) # end	

Configuring Power Policing

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

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	interface interface-id Example: Device (config) # interface gigabitethernet1/1	Specifies the physical port to be configured, and enters interface configuration mode.
Step 4	power inline police [action {log errdisable}] Example: Device (config-if) # power inline police	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: 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.

	Command or Action	Purpose
		• power inline police action log: Generates a syslog message while still providing power to the port. If you do not enter the action log keywords, the default action shuts down the port and puts the port in the error-disabled state.
Step 5	exit Example: Device(config-if)# exit	Exits interface configuration mode, and returns to global configuration mode.
Step 6	Use one of the following: • errdisable detect cause inline-power • errdisable recovery cause inline-power • errdisable recovery interval interval Example: Device(config)# errdisable detect cause inline-power Device(config)# errdisable recovery cause inline-power Device(config)# errdisable recovery interval 100	(Optional) Enables error recovery from the PoE error-disabled state, and configures the PoE recovery mechanism variables. By default, the recovery interval is 300 seconds. interval interval : Specifies the time in seconds, to recover from the error-disabled state. The range is 30 to 86400.
Step 7	exit Example: Device(config)# exit	Returns to privileged EXEC mode.
Step 8	Use one of the following: • show power inline police • show errdisable recovery Example: Device# show power inline police Device# show errdisable recovery	Displays the power-monitoring status, and verifies the error recovery settings.
Step 9	copy running-config startup-config Example: Device# copy running-config startup-config	(Optional) Saves your entries in the configuration file.

Monitoring Power Status

Use the following **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.