



A Guide to Simple IP Camera Deployment Using ZyXEL PoE Solutions



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Overview:

This article contains guidelines on how to introduce IP cameras into your local network using ZyXEL switches. This article focuses on the hardware and power over Ethernet (PoE) considerations. Methods on how to improve and troubleshoot these issues will also be included. This article assumes that IP camera service is deployed for small to medium businesses and uses unicast instead of multicast. Interaction between the IP camera and server will be strictly through the same layer-2 domain and will not cross any gateways.

Objectives:

- Explain the limitations of PoE
- Explain the various IP camera models to consider
- Introduce the ZyXEL PoE modes
- Introduce PoE injectors
- Introduce the PoE features through Web GUI
- Present PoE configuration examples using Web GUI
- Troubleshooting guide for PoE

PoE Implementation Consideration

When implementing PoE into your network, you will need to consider the limitations of PoE.

1. Supported PoE standard of the PSE and class of the PD
2. Power budget
3. Cable type and length

For ZyXEL switch models, model names ending with "P" or "HP" indicates it is a PoE switch. "P" indicates support for 802.3af only. The 802.3af IEEE standard defines and powers-on class 0, 1, 2, and 3 powered devices. These devices' maximum power requirement do not exceed 15 watts. "HP" models, on the other hand, indicates support for 802.3at. These models can power-on class 0, 1, 2, 3, and 4 devices.

Below are the types of PoE Classes and their corresponding power ranges:

Class	Current Range (mA)	Power Range (W)	Allocated Power by Class
0	0-4	0.44-12.94	15.4
1	9-12	0.44-3.84	4
2	17-20	3.84-6.49	7
3	26-30	6.49-12.95	15.4
4	36-44	12.95-25.50	30



A PSE cannot provide unlimited amount of power to every PD connected to it. The PSE has a maximum amount of power that it can distribute among all its ports. This is called the total power consumption or power budget. Power budget differs among PoE switch models. You will need to refer to the individual datasheets of these PoE switches. Each PD will require and consume a portion of the switch's power budget. When there is not enough power left in the power budget, the PoE switch will start prioritizing which PD should stay powered-on. The ZyXEL PoE switch has two PoE modes: "Classification" and "Consumption" mode. These two modes have different power management behaviors. The article will discuss more about these modes later.

The Ethernet cable is the next variable to consider. Using cross-copper or straight-copper should not affect the PoE distribution since PoE relies on pins 1, 2, 3, and 6. This also explains why PoE cannot be supplied through a fiber optic media. The Ethernet cable must also not exceed approximately 100 meters. This is the maximum length for providing reliable data transmission.

IP Camera Consideration: Today's IP cameras all have different features and specific uses. But ultimately, what is important to the PoE switch is how much power the IP camera will need to consume. Here are some features to consider:

PTZ (Pan-Tilt-Zoom): This feature enables your camera to turn your camera vertically or horizontally. This feature also allows your camera to zoom in or out of focus. This can improve the field of vision of your surveillance system.

IR (Infrared): This feature, also called night-vision, allows your camera to capture monochromatic videos in darkness. This is ideal for outdoor surveillance or areas where lights are not always turned-on.

HD (High Definition): High definition cameras are generally any camera that can provide video quality of more than 1 megapixel. Since most IP cameras today can provide at least 1 megapixel of resolution, it is best to judge the IP camera based on its maximum resolution.

Motion Sensor: This allows the IP camera to automatically focus on a moving object within the frame. This is most ideal for road or highway surveillance.

Audio: This feature allows your IP camera to not only stream video traffic but audio traffic as well. Your IP camera will need to have a microphone attached or built-in.

Heater/Fan: This additional accessory of the IP camera allows resilience in environments with extreme weather conditions. Note that the heater/fan will contribute to the power consumption of the camera.

Check below for some idea about IP camera features and its maximum power requirement. Please note that the prices for these IP cameras will not be included in this article:



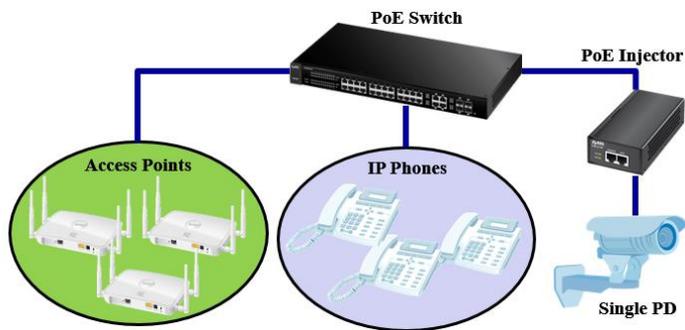
Vendor	Model	PTZ	IR	HD	Motion Sensor	Audio	Heater/ Fan	Max Power
Cisco	6500PD IP Camera	No	Yes	Yes	Yes	Yes	No	10W
	6400E IP Camera	No	Yes	Yes	No	Yes	No	12.2W
	6030 IP Camera	Yes	Yes	Yes	No	Yes	No	12.7W
Foscam	FI9853EP	No	Yes	Yes	Yes	No	No	4.2W
	FI9821EP	Yes	Yes	Yes	Yes	No	No	7.5W
Q-See	QCN7006B	No	Yes	Yes	No	No	No	4W
	QCN8009D	No	Yes	Yes	No	No	No	5W
	QCN8014Z	Yes	No	Yes	No	Yes	Yes	22W

PoE Injectors

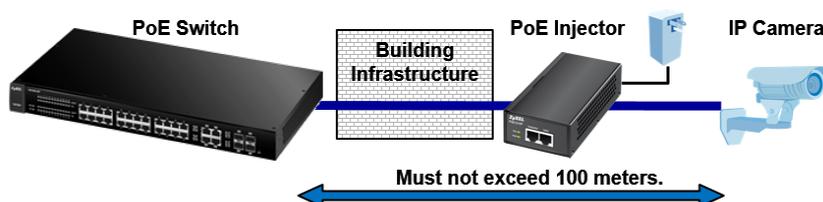
PoE injectors, unlike PoE switches, has only one port reserved for supplying PoE. One end of the PoE injector is used for data only, while the other end is for transferring data and power. The PoE injector itself must be connected to a power outlet.

Here are two circumstances when a PoE injector is preferred over a PoE switch:

1. If a PoE switch no longer has enough power remaining to supply a few PDs, installing PoE injectors are more cost-effective than installing another PoE switch.



2. Suppose that the Ethernet cable from the PoE switch to the PD is not long enough. Furthermore, the Ethernet cabling is built under the building's foundation and cable replacement is not convenient. You can install a PoE injector between the PoE switch and PD. However, please note that the PoE injector does not act as a repeater. In other words, the total length of the Ethernet cable from PoE switch to PoE injector to PD must not exceed 100 meters.





PoE Status in Web GUI:

You can find the PoE Status page in: **Basic Setting -> PoE Setup**

This page contains information about the PoE status of your switch and PDs. You can use this page to determine how much power your switch has remaining and how much power each PDs are currently consuming.

PoE Mode		Classification
Total Power (W)		375.0
Consuming Power (W)		0.0
Allocated Power (W)		0.0
Remaining Power (W)		375.0

Port	State	Class	PD Priority	Power-Up	Consuming Power (mW)	Max Power (mW)	Max Current (mA)
1	Enable	0	Low	802.3at	0	0	0
2	Enable	0	Low	802.3at	0	0	0
3	Enable	0	Low	802.3at	0	0	0
4	Enable	0	Low	802.3at	0	0	0
5	Enable	0	Low	802.3at	0	0	0
6	Enable	0	Low	802.3at	0	0	0
7	Enable	0	Low	802.3at	0	0	0
8	Enable	0	Low	802.3at	0	0	0

PoE Mode: *This is the currently configured PoE mode of your switch.*

Total Power (W): *This is the total power, in watts, that the switch can provide among all its ports.*

Consuming Power (W): *This is the total power, in watts, that the switch is currently providing among all its ports.*

Allocated Power (W): *This is the total Max Power, in watts, the administrator configured among all the switch's port. This is only relevant in consumption mode.*

Remaining Power (W): *This is the total remaining power, in watts, that your switch has available. This is calculated by the Total Power minus the Consuming Power.*

State: *indicates whether the port has been enabled for PoE or not.*

Class: *indicates which PoE class the PD belongs to. Can be either 0, 1, 2, 3, or 4.*

PD Priority: *indicates the configured PoE priority for this port. Can be either low, high, or critical.*

Consuming Power (mW): *indicates how much power, in milliwatts, the PD of this port is consuming in real-time.*

Max Power (mW): *indicates the maximum power, in milliwatts, configured for this port. This is only relevant when using consumption mode.*



Max Current (mA): indicate how much current, in milliamperes, the port is supplying.

You can find the PoE Setup page in: **Basic Setting -> PoE Setup -> PoE Setup**

Port	PD	PD Priority	Power-Up	Max Power (mW)
*	<input type="checkbox"/>	Critical	802.3af	
1	<input checked="" type="checkbox"/>	Low	802.3at	
2	<input checked="" type="checkbox"/>	Low	802.3at	
3	<input checked="" type="checkbox"/>	Low	802.3at	
4	<input checked="" type="checkbox"/>	Low	802.3at	
5	<input checked="" type="checkbox"/>	Low	802.3at	
6	<input checked="" type="checkbox"/>	Low	802.3at	
7	<input checked="" type="checkbox"/>	Low	802.3at	
8	<input checked="" type="checkbox"/>	Low	802.3at	

PoE Mode: select either classification mode or consumption mode. More detailed description of these modes can be found later.

PD: this indicates whether the port has been configured to supply PoE or not. This is important if you want to avoid sudden loss of service by an unauthorized PD connection.

PD Priority: this indicates the priority of the port. During a PoE over-budget event, the port with the lowest priority will be disabled first. If priorities are the same, the switch will disable the higher port number.

Power-Up: this is ZyXEL's solution for powering-on PDs with a current output outside the standard defined range. Each mode uses a different criteria for power delivery. It is advised that if the default power-on option does not power-on your PD, try changing the power-on option in this order: 802.3at -> 802.3af -> Legacy -> Pre-802.3at.

802.3af: port is powered-on using the IEEE 802.3af standard.

Legacy: port is powered-on using a peak high inrush current criteria. Once current output exceeds this limit, device will not be powered-on.

Pre-802.3at: port is powered-on if the average output current of PD within a set duration does not exceed a high inrush current criteria.

802.3at: port is powered-on using the IEEE 802.3at standard.

Max Power (mW): you can configure a limit for maximum power supplied per port. If the PD requests for power greater than this value, PD will not power-on.



PoE Modes Comparison:

The ZyXEL PoE switch has two PoE modes. "Classification" and "Consumption" mode. The main difference between these modes is how the switch handles the power budget by setting limits or reserving how much power the device can supply per port.

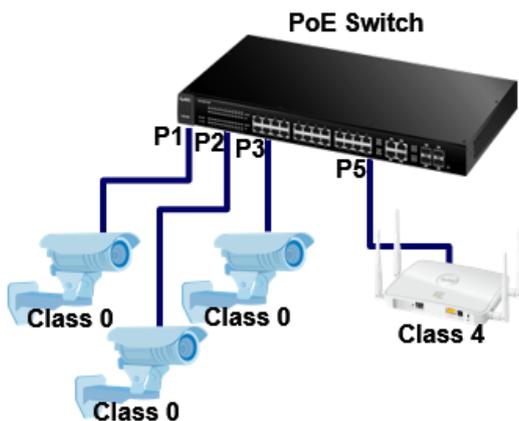
Classification Mode

In classification mode, the switch will reserve power automatically after the class of the PD is identified and is not based on the actual power the PD is consuming.

Class	Current Range (mA)	Power Range (W)	Allocated Power by Class
0	0-4	0.44-12.94	15.4
1	9-12	0.44-3.84	4
2	17-20	3.84-6.49	7
3	26-30	6.49-12.95	15.4
4	36-44	12.95-25.50	30

If we connect a class 0 device on a ZyXEL PoE switch, the switch will reserve 15.4 watts on that port. The benefit of this is that the PD may start with a low power requirement. Yet, during actual usage, power requirement can rise up to the maximum power range indicated on the table above. With classification mode, the ZyXEL switch guarantees that no connected PD will be powered-off unless a new PD is introduced and adding this PD exceeds the total power budget.

Refer to the scenario:



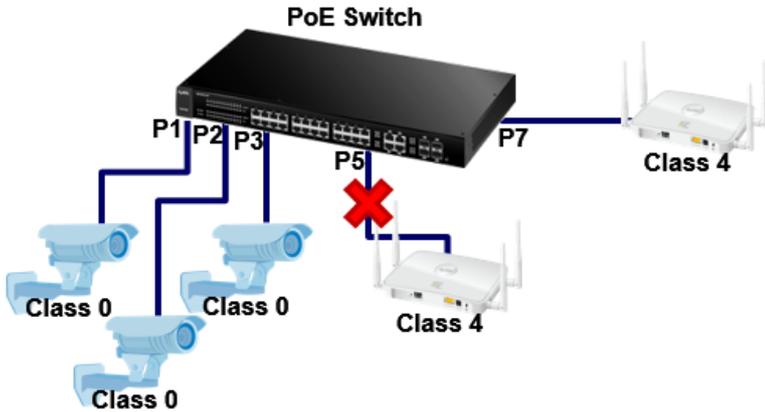
Power Budget: 80 watts

Port	Priority	Consuming Power (W)	Allocated Power (W)
1	Low	5.5	15.4
2	High	5.7	15.4
3	Low	6.2	15.4
4	High	--	--
5	Low	6.5	30
6	Critical	--	--
7	Critical	--	--

Power Remaining: 3.8



Initially, three class 0 devices and one class 4 device are connected to the PoE switch. Their total power requirement will sum up to 76.2 watts. Remember that in classification mode, power is reserved by class and not the actual power being consumed. For this particular model, the switch has a power budget of 80 watts. The remaining power that the PoE switch can supply is 3.8 watts. So what happens when we add another class 4 device?



Power Budget: 80 watts

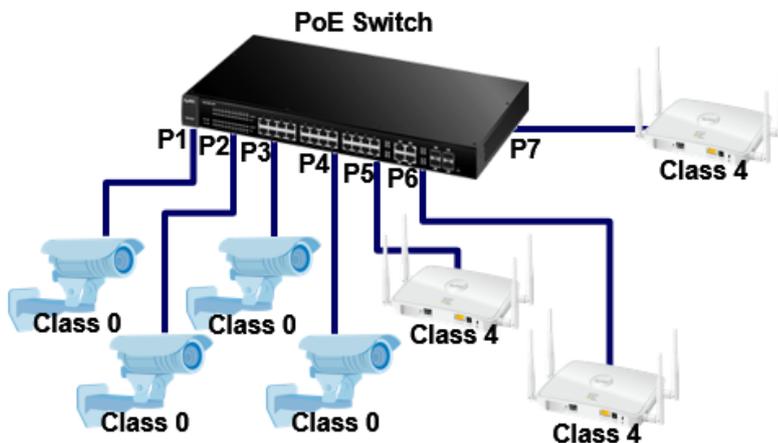
Port	Priority	Consuming Power (W)	Allocated Power (W)
1	Low	5.5	15.4
2	High	5.7	15.4
3	Low	6.2	15.4
4	High	--	--
5	Low	6.5	30
6	Critical	--	--
7	Critical	7.1	30

Power Remaining: -26.2

Adding another class 4 device will cause the switch to go over its power budget. What happens now is that the switch needs to determine which port to disable PoE. This is decided by the priority of the port. By order of importance: Critical > High > Low. Ports of lower priorities will be the first ports the switch disables PoE. If two ports have the same priority, the higher port number will be disabled. In this scenario, Port 5 is disabled. The remaining power is now 3.8 watts.

Consumption Mode

In consumption mode, administrators can manually configure the maximum power the PoE can allocate per port. Unlike classification mode, consumption mode has two reasons a PD will be disabled: one is when the power budget is used up, and the other is when the PD consumes power beyond the configured maximum power.



Power Budget: 80 watts

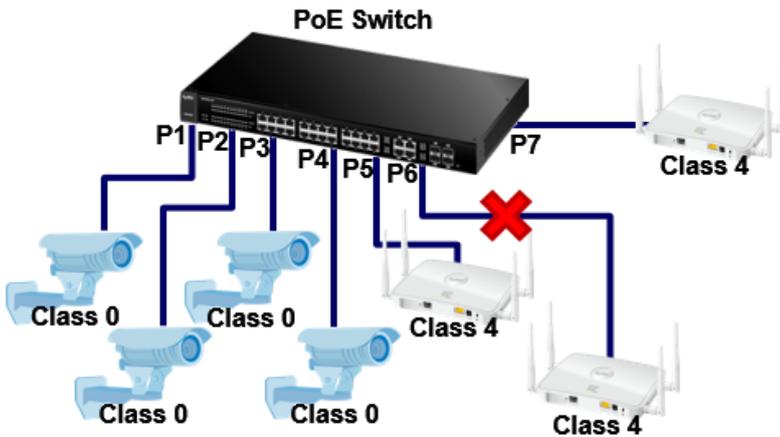
Port	Priority	Consuming Power (W)	Max Power (W)
1	Low	5.5	10
2	High	5.7	10
3	Low	6.2	10
4	High	5.3	10
5	High	14.2	20
6	Critical	13.1	20
7	Critical	15.8	20

Power Remaining: 14.2



Let us assume this is the PoE status of the network environment in the beginning. Notice that the power budget for this device is 80 watts. This time, we have four Class 0 and three Class 4 devices. Note that in consumption mode, power budget is deducted by the actual power consumed by the PD and not reserved by the class of the PD. In this topology, the total power consumed is only 65.8 watts. This means that in consumption mode, there is still 14.2 watts of power available.

Now please observe scenario 1:



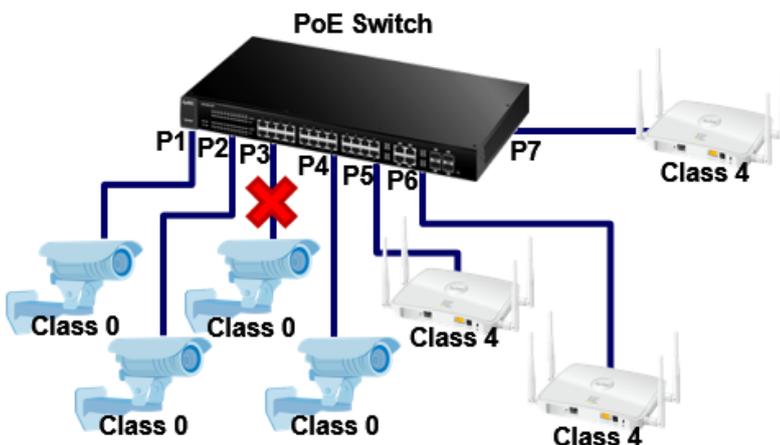
Power Budget: 80 watts

Port	Priority	Consuming Power (W)	Max Power (W)
1	Low	5.5	10
2	High	5.7	10
3	Low	6.2	10
4	High	5.3	10
5	High	16.5	20
6	Critical	20.1	20
7	Critical	15.8	20

Power Remaining: 4.9

If you recall the PD classification table, the device's power requirement has a range according to class. This means that consuming power is not always stable. For scenario 1, a class 4 device consuming power rose up to 20.1 watt. This exceeded the max power limit configured by the administrator. Because of this, the switch had to disable PoE in port 6.

Now observe scenario 2:



Power Budget: 80 watts

Port	Priority	Consuming Power (W)	Max Power (W)
1	Low	7	10
2	High	7.7	10
3	Low	5	10
4	High	8.1	10
5	High	17.7	20
6	Critical	16.4	20
7	Critical	18.2	20

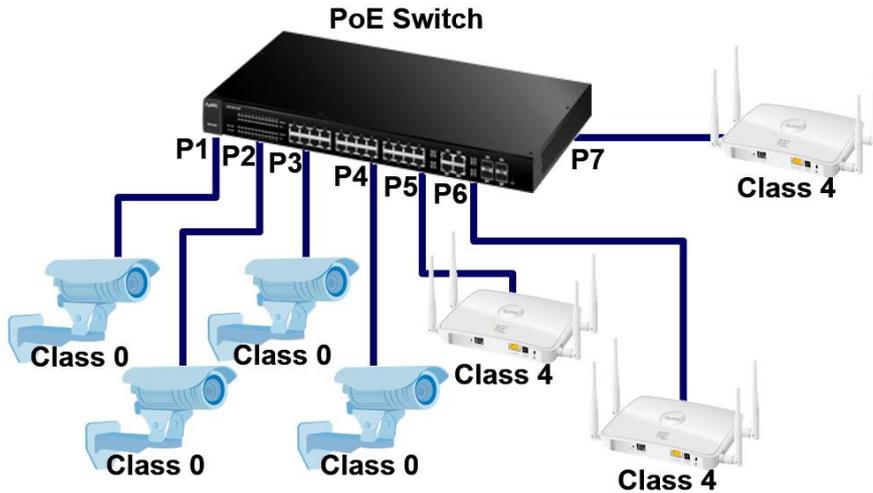
Power Remaining: 0

This time, the power budget has reached its limit. The switch must now attempt to disable PoE on a port. Since port 3 has the lowest priority and the highest port number, this port is disabled.



PoE Configurations in Web GUI:

We will now try to configure the proposed topology using Web GUI. Since this article is meant for IP camera deployment, we will assume IP camera service should have a higher priority. Since the two PoE modes have very different behavior, we will provide objectives and configurations for classification and consumption mode.



Devices:

Quantity	Device	Class	Power Budget
1	GS1920-24HP	--	375 W
4	IP Camera	0	--
3	NWA3560-N	4	--

Objective 1:

- Max power per port should be configured automatically based on the class of PD.
- The IP cameras must not go off-line if new PDs are introduced to the GS1920-24HP and if power requirement exceeds the power budget.

Step 1: Go to **Basic Setting -> PoE Setup -> PoE Setup**.

Step 2: Select **"Classification"**. Maximum allocated power will automatically be determined by the class of the PD.

Step 3: Set PD priority of the ports connected to IP cameras as **"Critical"**. This way, low PD priority will always be the first to go off-line when power consumption exceeds the power budget.



Dimension GS1920

MENU

- Basic Setting
- Advanced Application
- IP Application
- Management

System Info

- General Setup
- Switch Setup
- IP Setup
- Port Setup
- PoE Setup
- Interface Setup
- IPv6

PoE Setup PoE Status

PoE Mode: Classification Consumption

Port	PD	PD Priority	Power-Up	Max Power (mW)
*	<input type="checkbox"/>	Critical	802.3af	
1	<input checked="" type="checkbox"/>	Critical	802.3at	
2	<input checked="" type="checkbox"/>	Critical	802.3at	
3	<input checked="" type="checkbox"/>	Critical	802.3at	
4	<input checked="" type="checkbox"/>	Critical	802.3at	
5	<input checked="" type="checkbox"/>	Low	802.3at	
6	<input checked="" type="checkbox"/>	Low	802.3at	
7	<input checked="" type="checkbox"/>	Low	802.3at	
8	<input checked="" type="checkbox"/>	Low	802.3at	
9	<input checked="" type="checkbox"/>	Low	802.3at	
10	<input checked="" type="checkbox"/>	Low	802.3at	

Objective 2:

- Manually configure the max power per port of the GS1920-24HP.
- Ensure that there will always be 250 watts of remaining power for future PD installations.
- Ensure that IP cameras will never go off-line for any reason.

Step 1: Go to **Basic Setting -> PoE Setup -> PoE Setup.**

Step 2: Select **"Consumption"**. Maximum allocated power is now based on the administrator's configurations.

Step 3: The second objective is tricky. Let us first calculate how much power we can allocated among the 7 PDs.

PoE Status PoE Setup

PoE Mode	Classification
Total Power (W)	375.0
Consuming Power (W)	0.0
Allocated Power (W)	0.0
Remaining Power (W)	375.0

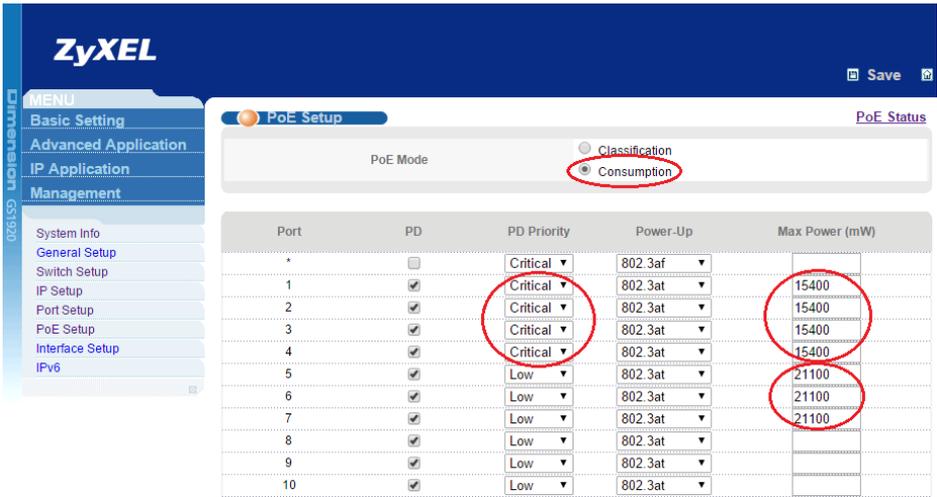
Total Power (375W) – Reserved Power for Future Installments (250W) = Power for the current PD (**125W**)

Step 4: Allocate the 125W among the PDs. Remember, third objective needs to ensure that all four IP cameras will not go off-line for any reason. Make sure that the class 0 IP cameras have max power set to 15.4W or 15400mW.

Step 5: With 63.4W remaining, we can distribute it equally to the remaining PDs.

$63.4W / 3 = \mathbf{21.1W}$

Step 6: Since the third objective states that IP cameras should never go off-line, we will need to configure IP cameras with the highest priority.



Troubleshooting PoE:

1. Verify the Ethernet cable condition.
 - a. Make sure that the Ethernet cable length does not exceed 100 meters.
 - b. If PD does not power-on, try swapping the Ethernet cable with a cable that has proven to have no issues powering-on different PDs.
2. Try creating a table to list down which ports were able to power-on PD during your test:

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)			
Switch Model X (2)			
Switch Model Y			

Testing must be done in an isolated environment. Meaning Switch will only be connected to one PD at a time during testing and no other. Consumption mode is the recommended PoE mode when doing this test.

Switch Model X (1) refers to the reported switch with issue.

Switch Model X (2) refers to a different switch but the same model as the reported switch.

Switch Model Y refers to a different switch but of a different model. Preferably a newer series.

PD Model X (1) refers to the reported PD that has issue.

PD Model X (2) refers to a different PD but same model as the reported PD.

PD Model Y refers to a different PD but of a different model.



Various kinds of conclusions can be made by inspecting the results. Some examples are:

a. Indicates that PD Model X (1) has hardware issue.

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	None	All	All
Switch Model X (2)	None	All	All
Switch Model Y	None	All	All

No ports among all switch could power-on PD Model X (1), while PD Model X (2) shows a different result.

b. Indicates that your switch has hardware issue.

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	None	None	None
Switch Model X (2)	All	All	All
Switch Model Y	All	All	All

Switch Model X (1) could not power-on any PD among any of its ports.

or

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	1-8	1-8	1-8
Switch Model X (2)	All	All	All
Switch Model Y	All	All	All

Switch Model X (1) could only power-on PD among some of its ports.

c. Indicates an interoperability issue.

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	None	None	All
Switch Model X (2)	None	None	All
Switch Model Y	All	All	All

Switch of the same model could not power-on PD of the same model among any of its ports.

or

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	1-16	1-16	All
Switch Model X (2)	1-16	1-16	All
Switch Model Y	All	All	All

Switch of the same model could only power-on PD of the same model among some of its ports.

or

Device	PD Model X (1)	PD Model X (2)	PD Model Y
Switch Model X (1)	1-16	1-16	All
Switch Model X (2)	16-24	16-24	All



Switch Model Y	All	All	All
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Switch of the same model could only power-on PD of the same model among different ports.

3. Verify which PoE mode the switch is using. Classification mode and consumption mode have different behaviors. If one PoE mode does not power-on the PD, try using the other mode.
4. Verify that the total consumed power among all PDs is within expectation. You can verify this in **Basic Setting -> PoE Setup**.
5. Use **Management -> Diagnostic -> System Log** to check for clues:
 - a. PoE Overload Event: means the PD requested more power than the configured max power on the specific port while in consumption mode.
 - b. PoE Power Management Event: means the overall consumed power exceeded the total power budget.
 - c. PoE Short-Circuit Event: means that connected PD may be faulty. It could also mean that the PD is using an older standard and not 802.3af/at. You can try changing the "Power-Up" option to "Legacy" or "Pre-802.3at" in the PoE Setup page.
6. Verify the IP camera model. Some IP camera models will spike in power consumption upon startup. PoE over-budget or port overload can happen if the PoE switch is configured to consumption mode. Visible symptom of this is when multiple IP cameras are able to power-on at the same time, but after the switch reboots, only some of the IP cameras are powered-on.
7. Always remember to upload the latest firmware version of the ZyXEL switch.
8. If you are still having trouble resolving the issue or that you are unsure with your conclusions, kindly contact your local support and provide the following:
 - a. Specific model of the IP camera
 - b. Datasheet of the IP camera models with trouble powering-on
 - c. Firmware of the ZyXEL switch models
 - d. Running configuration of your ZyXEL switches
 - e. Network topology
 - f. Screenshot of the PoE Status page when issue has occurred
 - g. The complete System Log display in web GUI or "show logging" in CLI

For more product information, visit us on the web at www.ZyXEL.com

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