korenix

Industrial

Power Over Ethernet

Making Your Heavy Chores Easy

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About Korenix

Global Leader in Industrial PoE Market

Korenix, the global market leader in industrial PoE, dedicates on offering the total solution of industrial networking and computing devices that is reliable, rugged, user-friendly, and cost-effective. Product lines include industrial Ethernet switches, communication computers, intelligent I/O servers, serial device servers, media converters, serial cards, and especially the global exclusive industrial PoE solutions.

Korenix's core superiority is the know-how on industrial technologies and the openness toward innovation. Its strategy for establishing trustworthy and win-win partnership with business alliances creates you the greatest value and benefit.

Table of Contents

Table of Contents 1

Introduction 3

Overview of The PoE Technology 4

- How Power Delivered through The Cable 5
- Power Sourcing Equipment 7
- Powered Device 7
- Power on Procedure 9
- Disconnect Protection 11
- PoE-Plus 12

What PoE Benefits You 13

- Cost Effectiveness 13
- Simple Deployment 14
- Mobility and Flexibility 14
- Reliability 14
- Enchanced Management 14

Industrial PoE Challenges 15

- Reliability 15
- Diverse Output Voltage 16
- Ultra Power Demand and Max Power Limitation 17
- Potential Problem of DC Disconnect 18
- Wide-Ranged Operation Temperature 18
- Advanced Monitoring and Management 19

Real-World Industrial PoE Applications 21
PoE IP Surveillance on Bus 21
PoE Broadband Data Communication on Trains 23
Forced High-Power PoE WiMax Network 25

Superiority of Korenix Industrial PoE Solutions 27
PoE-Plus Capability: 30W High Power 27
Forced Powering 27
Wide Range Power Input/Output Voltage 28
Manual Power Limitation 29
AC Disconnect 29
Smart Powered Device Alive-Check 30
Redundant Power Supply 30
PoE Port Schedule 31
Enhancement for Environmental Requirements 31

Summary 32

Korenix Industrial PoE Solution Selection Guide 33

Glossary 35

Introduction

Power over Ethernet (PoE) is an evolving technology designed to deliver power and transmit data on an Ethernet cable at the same time. Modeling after the technology used in telecommunication systems which supplies power to telephones, PoE powers network devices without the need of AC electrical outlets. By eliminating the power cords and the power infrastructure, this technology greatly simplifies the wiring and deployment matters and brings lots of convenience and benefits in home, office, and industrial environments.

This document briefs PoE technology and discusses the concerns for practical PoE deployment especially in industrial environments.

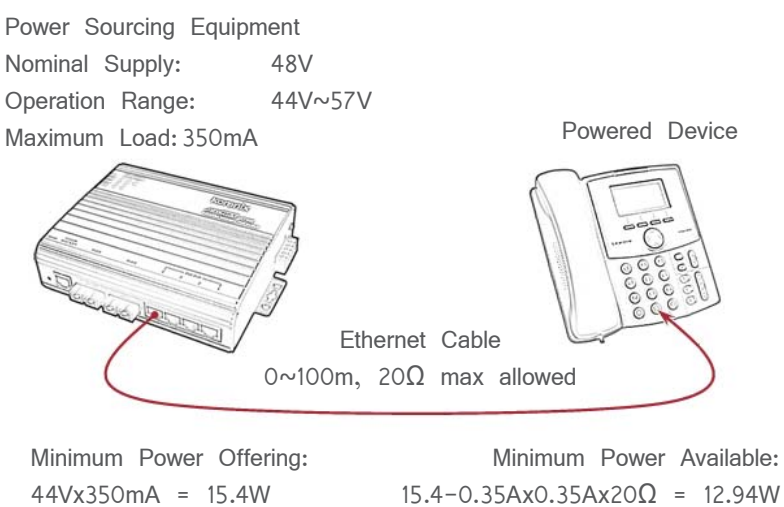


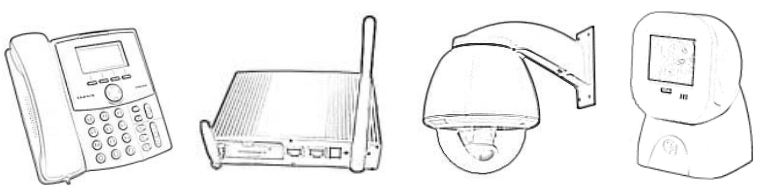
Figure 1. Typical PoE Installation

Overview of The PoE Technology

Power over Ethernet (PoE), referred to IEEE802.3af "*Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specification. Amendment: Data Terminal Equipment (DTE) Power via Media Dependent Interface*", is an extension to existing Ethernet standard and was approved in June 2003. It defines how to integrate power into a data cable while keeping data integrity and ensuring safety of the network.

As shown in Figure 1, a typical PoE installation involves two major components, the Power Sourcing Equipment (PSE) and the Powered Device (PD). All PoE devices are compatible in one of these two components when connected through a standard CAT5 cabling.

Normally, the power applied by PoE is at 48V with a maximum current of 350mA which would supply 13W of power to drive various kinds of devices, such as VoIP phones, wireless AP, IP security cameras, bar code readers and so on.



VoIP Phone Wireless AP IP Camera Bar Code Reader

Figure 2. Examples of Powered Device

How Power Delivered through The Cable

PoE transmits data and delivers power on Ethernet cable at the same time.

There are four unshielded twisted pairs (UTP) in a CAT5 Ethernet cable. Only two of the pairs are used in 10BASE-T and 100BASE-T environment. To integrate power and data over the cable, IEEE802.3af defines two options for different circumstances.

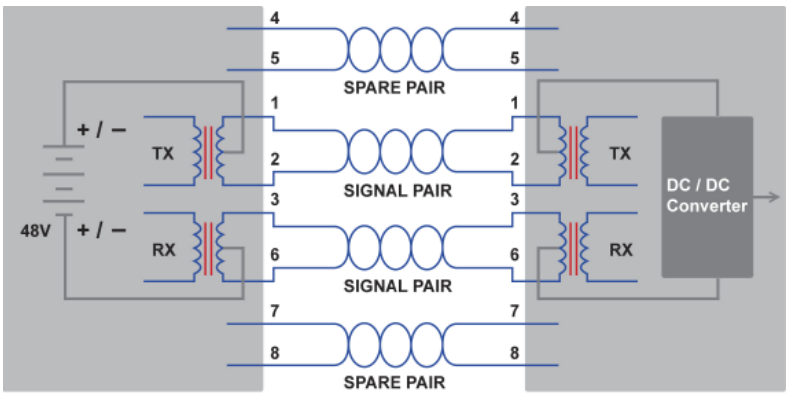
Figure 3 illustrates these two options, which are referred to as alternative A and B.

- Alternative A

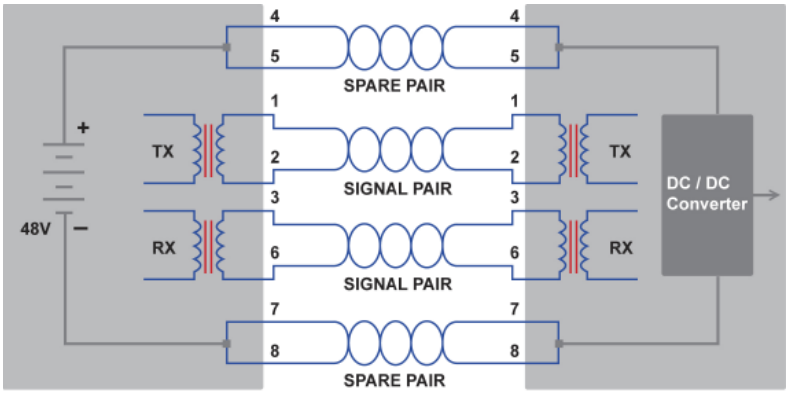
Also known as phantom powering, a PSE feeds power along the data pairs on pin 1/2 and 3/6 to without disturbing data transfer.

- Alternative B

The power is delivered through the idle pairs, pin 4 and 5 form the positive supply and ping 7 and 8 are negative supply.



Alternative A



Alternative B

Figure 3. Power and Data Arrangement on The Cable

According to the standard, PSE can be designed to apply power by alternative A or alternative B, but not both at the same time. As a result, a powered device must be capable of receiving power from both options while the source may apply power in either way.

Power Sourcing Equipment

Power Sourcing Equipment (PSE) is an equipment that supplies power to the powered device. A PoE capable switch is a most common example of PSE. Acting as a power transmitter, the PSE has three main jobs:

- detect a PD and determine the PD's power level
- supply adequate power according to the power level
- monitor and stop power supply

Two types of PSE are defined in the standard, the endspan and the midspan. An endspan PSE is a PoE capable port that carries both data and power on the link, while a midspan PSE stands between a common Ethernet port and a PD to help injecting power. Midspan offers a solution when adding PoE to an existing network infrastructure without changing its original configuration.

Powered Device and PD Classes

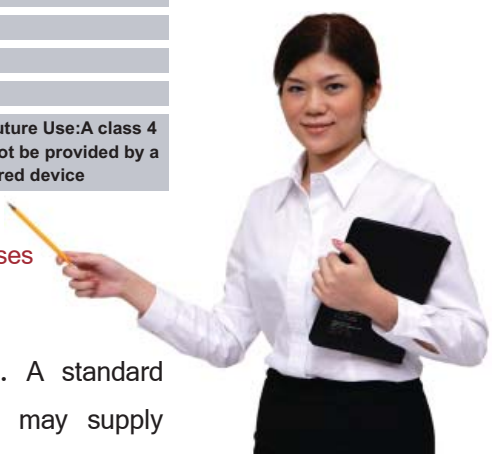
Powered Device (PD) is a device that receives power from PSE. More and more network attachments today, such as IP phones, wireless LAN access points, and IP cameras, are designed as a PD.

Due to different power ranges are needed by various PDs, IEEE802.3af defines an option to classify PD into classes according to their power consumption. Following the process of classification, a PD informs the PSE its power range so that the PSE can apply power more efficiently.

Table 1 details the class and the corresponding power level delivered from PSE and received at PD.

Class	Usage	Minimum Power Levels Output at PSE	Power Ranges Received by PD
0	Default	15.4W	0.44 to 12.95W
1	Optional	4.0W	0.44 to 3.84W
2	Optional	7.0W	3.84 to 6.49W
3	Optional	15.4W	6.49 to 12.95W
4	Reserved for Future Use	Treat as Class 0	Reserved for Future Use:A class 4 Signature cannot be provided by a complian powered device

Table 1. Power Ranges and the PD Classes



As can be seen, Class 0 is the default setting. A standard PSE which can recognize the class of the PD may supply power at the proper level to minimize the power usage and save the energy to another port. This not only cuts down power costs, but helps to save the need of a cooling system.

Power on Procedure

To comply with both PoE capable devices and non PoE capable devices, IEEE802.3af defines a method to prevent damaging an appliance because of improper power injecting. According the method, a PSE shall not apply power to a link until a PD is detected and requesting power. In addition, the PSE can supply power on different levels to meet the class which the PD belongs to. This power on process involves signature detection and classification:

- Signature Detection:

In this phase, PSE tests for a connection to see if a PD is connected. It applies two small current-limited DC volts across the cable and measure the impedance to determine whether a valid PD (with 25K Ohm resister) is present. When a PD is detected, power will be applied. The PSE may further enter the optional classification phase to read the power level of the PD.

- Classification:

The PSE tries to classify a PD by presenting another voltage on the connection. The PD makes a response with a load current corresponding to its classification. The PSE can then identify the power requirement and optimize its power supply.

Question:
I want my system work more effectively, but my PD does not support classification. Any workaround?
See "Forced Powering" on page 27.

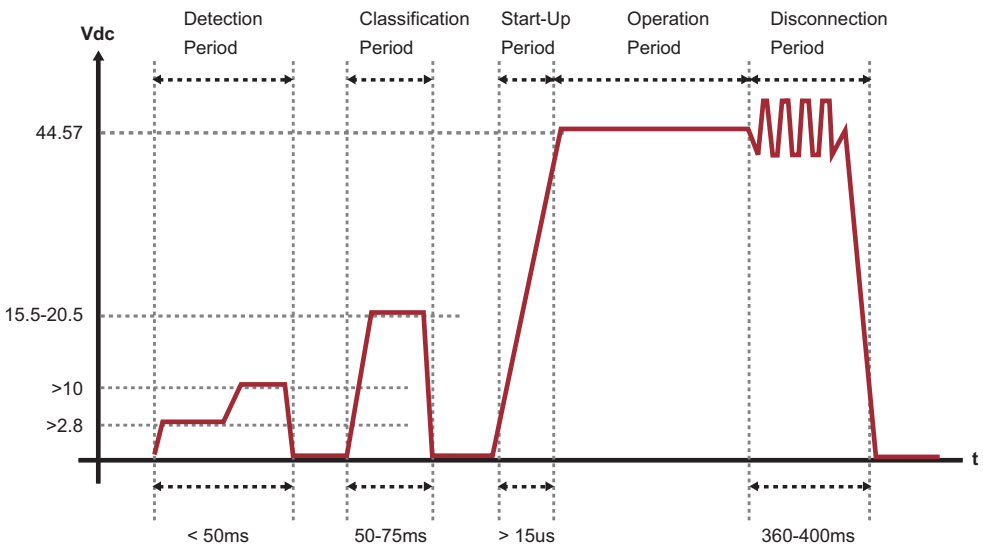


Figure 4. PoE Power on Process

After the "Power On" process, PSE raises the power level to fit the need of PD and moves into the ON state.

Note !

Signature detection and classification processes are carried out by small voltages. This procedure is sensitive to environmental disturbances. To prevent faults during detecting and classifing, make sure your PoE device is well connected to ground.

Disconnect Protection

Once power delivered, PSE continuously monitors the PD current draw for operational safety. If the draw drops below a minimum values or user swaps a powered cable to a non-PoE device, the PSE will stop supplying power to avoid damage. According to the standard, the PSE should cut the power once it loses the power signature from the PD in a very short time.

There are two detection schemes defined in standard: DC and AC Disconnect. DC Disconnect method removes power when PD current falls below a given threshold (5 to 10 mA) for a given time (300 mSec to 400 mSec). AC Disconnect superimposed a probing AC voltage on the power and measures the impedance. AC Disconnect method removes power when the impedance is larger than 27k ohm or 1980k ohm and the AC voltage is found for a given time (300 mSec to 400 mSec).

PoE Plus

As the rapid growth and adoption of the PoE technology strengthens, the needs have driven IEEE to formulate a new group, IEEE802.3at, in 2004. The group, commonly known as Power over Ethernet Plus, is to research the next generation of PoE. The main goal of the new standard is to increase the maximum power rating to 30 watt to fit the needs of greater power consumption applications, such as WiMax base stations, notebooks, video phones, and motorized cameras. The standard is expected to be ratified in 2008.

	IEEE 802.3f PoE	IEEE 802.3at PoE Plus	Note
Release	Ratified June 2003	Expected in 2008	
Max Power	15.4W	30W	
Voltage Range	44~57V	50~57V	
Max Current	350mA	720mA	
Power Delivery	2 pairs	2 pairs	
Classification	Layer 1	Layer 1 Layer 2 LLDP	IEEE 802.3at PD should embed micro processor
Class ID	0~3, 4 as 0	Layer 1 class 4 only Layer 2 upto 1023 classes	
PSE Type	Ethernet Switch Power Hub	Ethernet Switch	Power Hub not applicable to IEEE802.3at
Installation	Endspan Midspan	Endspan only	Midspan cannot do Layer 2 classification

Table 2. Comparison of PoE and PoE-Plus

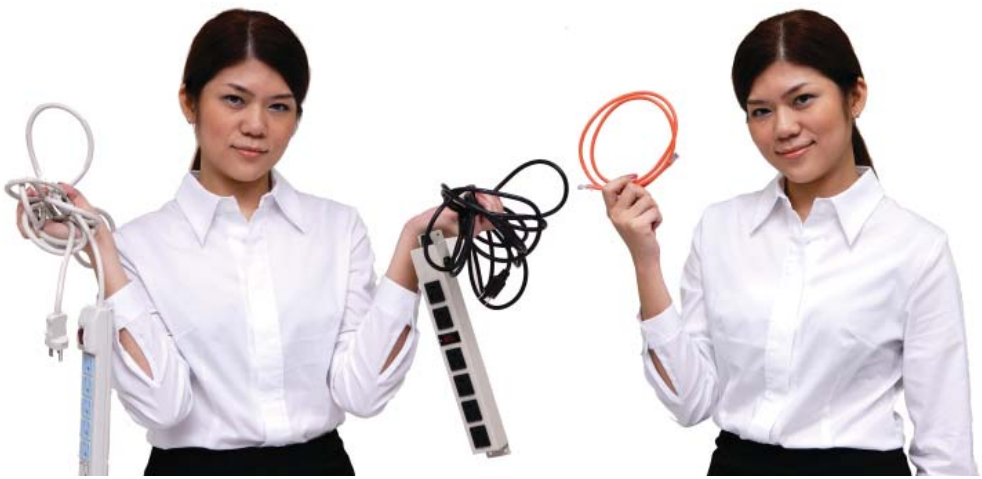
Question:
My PD needs more power to be turned on. How can I do with it?
See "PoE-Plus Capability" on page 27.

What PoE Benefits You

The benefits brought by the PoE technology are more than just eliminating the power cords. They can include:

Cost Effectiveness

Both time and money could be saved. Without the traditional electrical circuit, not only the costs for creating and maintaining the power infrastructure such as cords, outlets, conduits, but also the costs for expensive electricians are saved. The time spent in installing the power system is also eliminated.



PoE integrates power delivery and data transmission into one single cable, which saves cost and management effort greatly.

Simple Deployment

Only one set of wires to bring to the appliance. Both manufacturers and users benefit from the PoE technology. No specific accessories for different countries' power systems are needed anymore.

Mobility and Flexibility

The location to deploy a device is no longer restricted within the short distance from the AC outlets. Thus, systems like IP cameras and wireless access points can be easily located in remote places, such as ceiling, for security and performance.

Reliability

By managing the PSE to a UPS, the power supply can be guaranteed even when mains power failure.

Enhanced Management

Centralized power and data management, SNMP for example, allows IT staff to remotely monitor and manage access point and IP camera or other PD.

Question:
Besides UPS, are there any solution to make my system more reliable?
See "Redundant Power Supply" on page 29.

Industrial PoE Challenges

Rather than using commercial PoE apparatus to deploy PoE in industrial environments, various kinds of challenges need to be considered. Any carelessness may result in system failure, device damage or economical loss. A number of issues are highlighted below when adopting PoE in an industrial environments.

Reliability

Reliability is a necessity for industrial usages. It is critical for industrial applications remains running. Any single point failure may need to be recovered in a short time. Aside from the network reliability, which is discussed in Ethernet environment, the demand for stability and reliability to supply power is raising because of power and data integration into a single infrastructure. The reliability of supplying power can be further explained below:

- PSE Reliability:

Acting as a power source, a PSE applies power to one or more PDs. A single PSE failure may lead to a number of PDs shut down. As a result, both the reliability of PSE itself and its power input become two critical points to which must be given thought. Basically, the PSE should stay stable under its most unfavorable operating condition, such as temperature, humidity, vibration, shock, and so on. A stronger PSE may further equip with self protection mechanisms for

undetected system failure. As to the power input, it can be enhanced by supplying through an UPS system or by other means to avoid from sudden disconnection.

- PD Reliability:

The design of PD may be harden as described in PSE reliability to sustain harsh industrial conditions. However, a smart PSE may help to detect whether the PD is still alive. A detection of loss or failure event of PD can be reported to IT staffs by various management mechanisms, such as email, alarm, SNMP traps. The IT staffs then can take proper actions on the failure event. It is possible that a more advanced PSE, which provides a management option of resetting the power connection, could bring the PD back to alive in a timelier manner.

Diverse Output Voltage

Just like various control systems, such as Modbus, ProfitNet, DeviceNet, used in different industrial applications, the power voltage required by each industrial application may vary.

Take public transportation as an example, the power supply system is usually DC 24V, which does not fall in the range, from 44VDC to 57VDC, defined in the IEEE802.3af standard. In the circumstances, an additional voltage transformer may solve this problem. However, it may not meet the requirements for some particular reasons, such as

See "Wide Range Power Input/Output Voltage" on page 28.

costs, space limitation and so on.

Being able to feed a wider range of power voltage from the PSE would be a more direct solution. This becomes another challenge for the PSE manufacturers to achieve the needs for diverse industrial applications.

Ultra Power Demand and Max Power Limitation

Driven by the benefits and the evolution of the technology, more and more PDs consuming high power are coming to the market. WiMax base stations and PZT cameras are such kind of products already seen today.

While the demand of high power is considered when arrange to go to PoE technology, it should be note that the amount of power drawn by the PD must not cause any damages to the PSE, the cable, or the PD itself. Power delivery generates heat and bundling of the cables may exacerbate the heating problem. For safety concern, if either PSE or PD is not well designed to comply with the standard, the power delivery should be well controlled by some means to avoid overheating.

To protect your system, See "Manual Power Limitation" on page 29.

Potential Problem of DC Disconnect

There may be PD products designed to enter sleeping mode to save power if it has been on idle for a while. In power saving mode, the power consumption becomes low. However, there is a case that if the power draw goes below the DC disconnect threshold, the PSE judges the PD removal and will start DC disconnect process and stop delivering power. The PD is then turned off and can never be woken up by its event triggers.

The problem may not be limited to power saving mode. A PD designer should be aware of this potential problem, and it is also recommend that a PSE provides some mechanisms to prevent unexpected DC disconnect in order to ensure the stability and reliability for industrial PoE applications.

To avoid this potential problem, please see "AC Disconnect" on page 29.

Wide-Ranged Operation Temperature

Industrial devices are often located at outdoors or in control rooms, where could be extreme cold or hot, and humid. A well designed industrial grade PoE device should be able to operate under harsh conditions.

In particular, feeding power generates heat. The more power delivers, the higher the operation temperature of the PoE device raises. Surrounding with the ambient heat in the environment, the high temperature circumstances may get from bad to worse. The tolerance of high temperature and over-heat protection are two important points of industrial PoE.

Advanced Monitoring and Management

In industrial environments, it may not be enough to power on a PoE device and let it go by itself. Advanced monitoring and management on each PD, PSE or even on each port of a PSE are important to IT staffs for many system maintenance requirements.

For example, by polling the amount of real-time power delivering on each port of a PSE helps to monitor the current status and to have an idea of the trend of the PoE port. Abnormal conditions, such us power cut, over feeding or under supplying, can then be possibly observed in advance to prevent errors.

Error detection can be also achieved by event-trigger approach. By setting a certain circumstance of threshold, any irregular event exceeding the circumstance triggers a notification to IT staffs or results in a predefined action. Notifications can be in the form of alarm, email, SNMP trap or by other means. Accompanying with notifications, a predefined action can take place immediately for protecting or for recovering purposes before IT staff receives the notification and arrives for on-site service.

Further more, detailed power control over a PoE system can also be used for security or power saving issues. Scheduling power control is one of the examples to save power and meet the economic resource utilization.

Advanced monitoring and management which enhance the reliability, security and efficiency of a PoE system are essential parts for industrial environments.

Want a smart solution? See "PoE Port Schedule" on page 31.

Real-World Industrial PoE Applications

Along with the conveniences and advantages, more and more vendors recognize the applications which the PoE technology can be applied to. This section gives examples of how PoE solutions used in industrial environments and met the challenges.

PoE IP Surveillance on Bus

Security of public transportation is a rising concern for transportation companies to protect passengers or for government authority to confront terrorist attacks. One of the examples is to deploy IP surveillance system on bus.

By using the DC power from bus battery as power input, the PoE switch delivers power to the PoE IP video camera through the data cable. Without the additional power infrastructures and wiring, PoE is a better solution fitting into the limited storage space on a bus. However, due to the differences between the power system of bus battery and that of IP camera, a PSE switch may be required to adapt to distinct implementation situations.

An additional DC-to-DC converter inserted between the bus battery and the PSE switch to transform the voltage from 24V to 48V for the PSE switch, so that the PSE can apply suitable power level to IP camera. A more straightforward approach is to adopt a PSE switch which is capable of 24V DC input and forward power to a 24V DC PD. This requires the PSE to accept wider range of power input to provide simpler and more effective solution when implement PoE into most transportation systems.

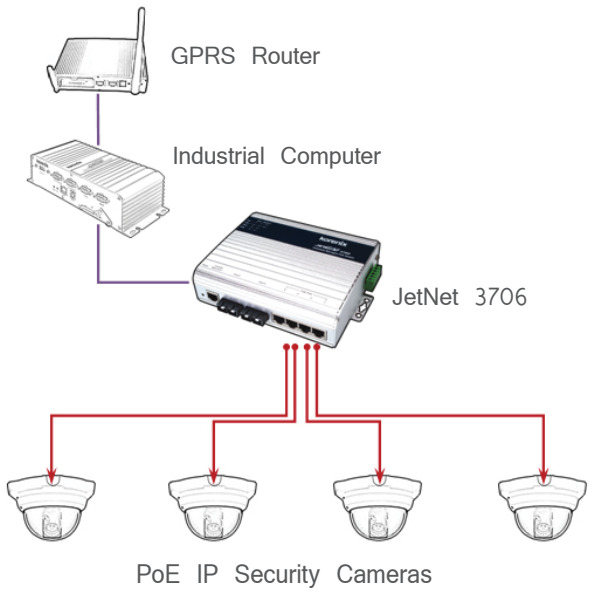


Figure 5. PoE IP Surveillance on Bus

PoE Broadband Data Communication on Trains

It is a trend to provide wireless broadband data communication services on trains and other public transportation systems. Passengers can simply use their laptop or PDA to browse the Internet, send and receive emails or connect to a corporate data service just from their seats on train. Train operators can also improve their service to customers. For instance, to provide journey progress maps and entertainment network for audio/video streaming or multiplayer games.

The data communication service is achieved on board the train by deploying WiFi adapter within each carriage, and placing WiMax transceivers at each end of the train. The WiFi and WiMax devices are powered by PoE switches in the carriage.

PoE technology brings both power and data transfer. Enabling wireless data services by PoE eliminates the need to install and maintain power wiring. It saves cost and improves reliability. More and more transportation companies evaluate the PoE technology upon deploying wireless data communications.

To provide seamless connection, the PoE switch should be reliable. In addition, the storage location for PoE devices is usually separated from passengers. The environment may be hot and humid because of no air conditioning. Therefore, the PoE device must be rugged, withstand the high temperature and equipped with anti-shock capability.

Forced High-Power PoE WiMax Network

WiMax is an evolving telecommunications technology aimed at providing high-speed wireless data communication over long distances. It enables the delivery of last mile wireless broadband access in a cost-effective, flexible manner. In practice, the infrastructure is further simplified by using PoE enabled WiMax devices.

Typically, a WiMax base station is composed of three base station units (BSU), and each unit has a high-gain directional antenna which points to different directions to increase the coverage and throughput. To assure the reliability and the long range communication, BSU demands higher power consumption, even up to 25W, and 48VDC power supply.

In this special case, a high-power capable PoE switch is used to link four BSUs to the backbone network for data communication. Particularly, for these BSUs do not support PD classification, each port connecting to the BSU is forced to deliver high power and limited to an upper bound to meet the ultra power consumption requirement as well as safety concerns.

Figure 6. Forced High-Power PoE WiMax Base Station

Superiority of Korenix's Industrial PoE Solutions

Korenix, the leader of industrial PoE market, provides solutions with powerful functionalities to fit and even exceed the challenges for industrial PoE. A number of superior features are highlighted below:

PoE-Plus Capability: 30W High Power

In addition to IEEE802.3af standard, Korenix also supports IEEE802.3at pre-standard High Power PSE solution for PDs which power requirement is greater than 15.4W. JetPoE switch series deliver up to 30W high power, which can satisfy more demanding applications.

Forced Powering

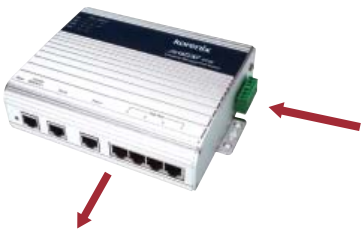
More than IEEE802.3af and high-power PoE, Korenix provides advanced Forced Powering control to deliver power to those nonstandard devices that cannot be detected as a valid PD.

Many early-days PoE products were released to the market before the standard ratified. Some of them may not comply with the standard and do not support PD detection and classification. The PoE system will not work and the PSE will not apply power to invalid PDs. The Forced Powering ability will solve this problem and enables your PDs to life.

Wide Range Power Input/Output Voltage

IEEE802.3af defines nominal power supply at 48V. As a result, most PSE receive 48V power input and then deliver power to PD at the operation range from 44V to 57V. However, for many industrial environments without 48V mains power system, this rule is not applicable. It is neither applicable to those nonstandard PDs that do not work within the standard operation range.

Korenix's PoE switch equips a mechanism that can accept wide range of power input voltages and deliver a correspondent level of power. This is especially useful, for example, to power a 24V nonstandard PD or to power existing non-PoE apparatus with an accessorial PoE splitter in the public transportation system that has 24V system only.



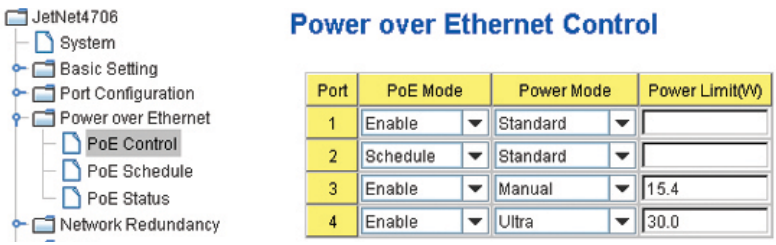
Redundant Power
DC 24~55V Range

Power Input DC 55V, PoE Output Up to 30W
Power Input DC 24V, PoE Output Up to 13.5W

Note !
To use this feature properly, please contact Korenix for nonstandard PD compatibilities.

Manual Power Limitation

Accompany with Forced Powering, Korenix allows user to manual configure the power limitation of the attached PD that does not support PD classification. This can be used to prevent over power drawing by a nonstandard PD or to provide over-heat protection in the case of great mount of power delivering.



Versatile control abilities of Korenix's industrial PoE solution enable standard PoE, nonstandard PoE, and even high-power PoE PDs efficiently while keeping the operation safe.

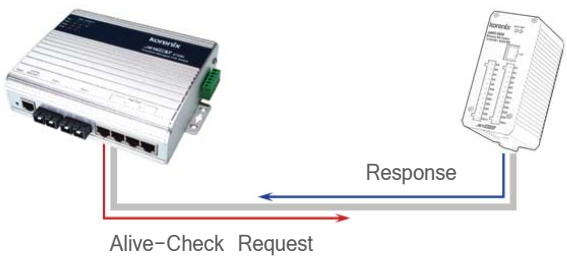
AC Disconnect

Korenix PoE switches take AC Disconnect approach to detect the removal of the PD and turn off power. While DC Disconnect is simpler, AC Disconnect provides superior mechanism to avoid mistakenly cutting the power for a PD which is in sleeping mode or whose current falls below the DC Disconnect threshold.

Smart Powered Device Alive-Check

Korenix PoE switches can be configured to check the real-time status of the connected PD. Once the PD fails, it will reset the PoE port to bring the PD back to working state. This greatly enhances the reliability and reduces the management burden.

Reset PoE port to bring the PD back to working state when the response from PD is lost continuously for three times.



Redundant Power Supply

Korenix supports power input redundancy on PSE solutions for those applications where a reliable power supply is critical. The backup power input will be enabled upon the main input fails.

Redundant power supply not only ensures reliability of the PSE itself but also enhances the availability of the PD.

PoE Port Schedule

Korenix provides an hourly/weekly scheduling mechanism for advanced power control. Each PoE port can be on and off by hourly basis. This feature meets economic power management, security, or customer-specific requirements.

Each PoE port can be managed according to the schedule on an hourly/weekly bases, and GUI schedule table makes configuration clear and easy.

Enhancement for Environmental Requirements

The PoE devices which used in industrial environment often locate in hot and humid location without conditioning. The products must be anti-shock and withstand high humidity, wide-range operation temperature. The award-winning mechanical design of Korenix PoE switch series fit the best for the industrial grade applications.

Summary

Power over Ethernet is an emerging technology that will change the way both network and non-network devices are used. With the rapid increasing deployment of PoE, residential, enterprise, and industrial users will benefit from its simplicity, reliability, flexibility as well as saving costs.

Industrial grade PoE devices face diverse challenges of different power systems, harsh operating environment, and management requirement. By providing flexible installation options and versatile management facilities, Korenix's JetPoE series overcomes practical deployment problems in industrial environment and brings the PoE technology into full play. It further enables standard, nonstandard, and even high-power PDs. By hardened design and construction, Korenix's JetPoE series undoubtedly the best choice for industrial PoE solutions.

Korenix Industrial PoE Switch Selection Guide

2007 Computex
Best Choice Winner


	JetNet 4706	JetNet 4706f
	Mamaged PoE Switch	
Number of Ports:10/100Base-TX	6	4
Number of Ports: PoE Injector	Port 1~4	Port 1~4
Number of Ports:100Base-FX		2
(Multi Mode Fiber)		JetNet 4706f-m
(Single Mode Fiber)		JetNet 4706f-s
PoE Wiring Pins	4,5,7,8	4,5,7,8
Power Terminal	DC24 / 48V*2	DC24 / 48V*2
PoE Power	up to 30w / port	up to 30w / port
Power Jack		
Fault Relay Output	●	●
1200VAC HIPOT	●	●
Rigid Aluminum Case	●	●
Case Protection	IP 31	IP 31
Dimensions (unit=mm)	174.8(W) x 46.5(H) x 136(D)	
Operating Temperature	-20~60°C	-10~60°C
DIN-Rail Kit	●	●
Web-based Configuration	●	●
Windows Utility (JetView)	●	●
Secured HTTPS,SSH	●	●
Super Ring, RSTP	●	●
Couple Ring, Dual Homing	●	●
IGMP Snooping & IGMP Query	●	●
Port - Based VLAN	●	●
Quality of Service	●	●
SNMP V1/V2C/V3	●	●
RMON1	●	●
SMTP(e-mail warning)	●	●
Syslog	●	●




JetNet 3706	JetNet 3706f	JetNet 3705	JetNet 3705f
Web-Managed PoE Switch		PoE Switch	
6	4	5	4
Port 1~4	Port 1~4	Port 1~4	Port 1~4
	2		1
	JetNet 3706f-m		JetNet 3705f-m
	JetNet 3706f-s		JetNet 3705f-s
4,5,7,8	4,5,7,8	4,5,7,8	4,5,7,8
DC24 / 48V*2	DC24 / 48V*2	DC48V*2	DC48V*2
up to 30w / port	up to 30w / port	15.4w x 4	15.4w x 4
		DC48V*1	DC48V*1
		●	●
●	●	●	●
●	●	●	●
IP 31	IP 31	IP 31	IP 31
174.8(W) x 46.5(H) x 136(D)		164.8(W) x 33.8(H) x 108(D)	
-20~60°C	-10~60°C	-20~70°C	-10~70°C
●	●	●	●
●	●		
●	●		
●	●		
●	●		

Glossary

10Base-T	Ethernet over twisted pair runs at 10 Mbps
100Base-T	Ethernet over twisted pair runs at 100 Mbps
BSU	Base Station Unit
CAT5	Category 5 Cable
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
IEEE802.3at	IEEE standard for Power Over Ethernet Plus
IEEE802.3af	IEEE standard for Power Over Ethernet
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IP31	Ingress Protection or International Protection rating 31
LLDP	Link Layer Discovery Protocol
PD	Powered Device
PoE	Power Over Ethernet
PoE-Plus	Power Over Ethernet Plus
PSE	Power Sourcing Equipment
RMON	Remote Network MONitoring
RSTP	Rapid Spanning Tree Protocol
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
STP	Shielded Twisted Pair
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VLAN	Virtual Local Area Network
VoIP	Voice Over IP

WiFi	Wireless Fidelity. A wireless technology brand promotes standards to improve the interoperability of IEEE802.11 wireless local area network products.
Wireless AP	Wireless Access Point
WiMax	Worldwide Interoperability for Microwave Access

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