Reyec
by Ruijie

Redefine your easy network

PoE Technology Reference

V1.0

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1 What is PoE

PoE (Power over Ethernet) is the name of a number of methods that allow for powering network devices through UTP/FTP cables. This way it is possible to power devices such as cameras, phones, switches, access points, etc. In 2003, the IEEE established 802.3af PoE standard, upgraded to 802.3at in 2009. 802.3at distinguishes between the first type (prior 802.3af) and the second type with maximum transmitted power of 30 W, nearly two times higher. The second type is suitable to power cameras with high-power IR illuminators, IP telephones, small network printers etc.

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2　Comparison of 802.3af and 802.3at

Feature/standard	802.3af (802.3at type 1)	802.3at type 2 (POE+)
Output power of power supply [W]	15.40	30.00*
Minimum power available for the powered device [W]	12.95	25.5*
Output voltage of power supply [V]	44...57	50...57
Supplying voltage available at the powered device [V]	37...57	42.5...57
Max current [mA]	350	600
Ethernet compatibility	10BASE-T, 100BASE-TX and 1000BASE-T	10BASE-T, 100BASE-TX and 1000BASE-T
Range [m]	100	100
Cabling	UTP/FTP min. cat. 3	UTP/FTP min. cat. 5

*Some companies developed solutions that transmit power over all 4 pairs of UTP/FTP cables. They allow power supplies with output power up to 60 W(HPoE), and the power consumption of the powered devices can reach 51 W.

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3   Topology

Depending on the location in the transmission path where the power supply is combined with the data, the power-injection devices can be divided into 2 groups: PoE switches (endspam) and PoE adapters (midspam).
Depending on the transmitted power and data rates, the 802.3at standard encompasses 2 versions:

- type 1 - for devices compliant with 802.3af and with power transmission employing 2 pairs of min. Cat.3 cable, with max output power of 12.95 W

- type 2 - with max output power of 30 W, transmitted via min. Cat.5 cable

The standard also defines two types of PoE implementation:

- Option A - power is sent together with the data on pairs 1/2 and 3/6

- Option B - power is sent on pairs 4/5 and 7/8 (unused in Fast Ethernet networks, in the case of Gigabit Ethernet the pairs are used both for data and power transmission).

The power supply unit may implement both or just one of the PoE types, while remaining compliant with the standard. So, the powered device must therefore support both modes, however, as it turns out in practice, not all end devices are fully compliant with the standard. This may be the reason for the lack of compatibility with some PoE power supplies.
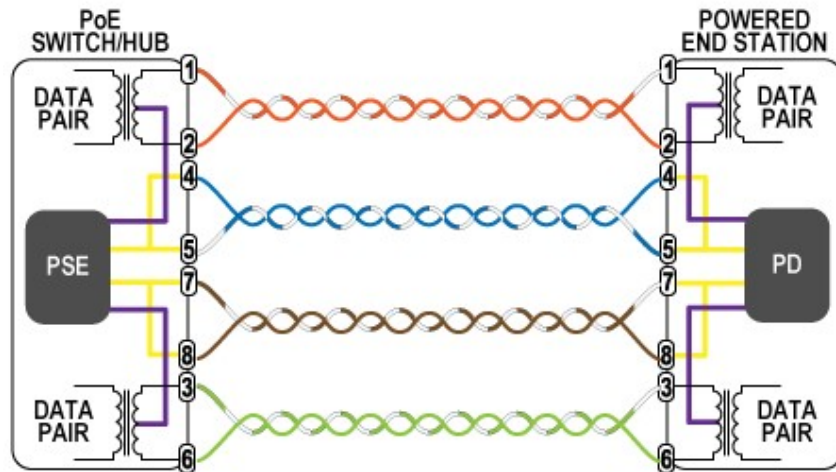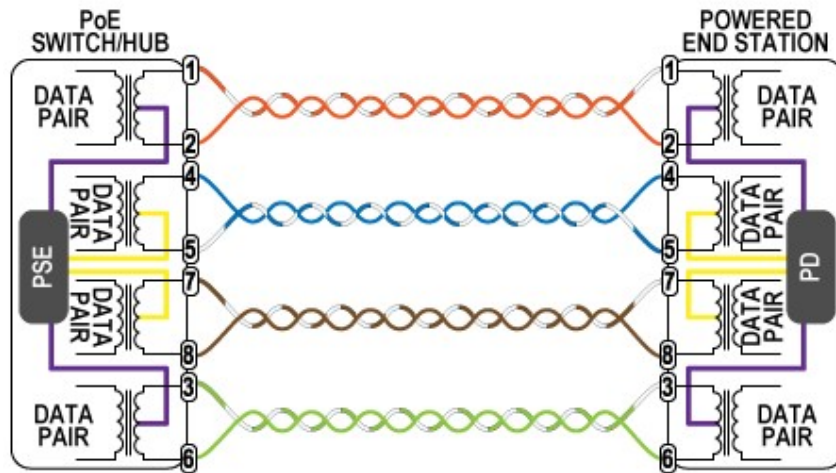

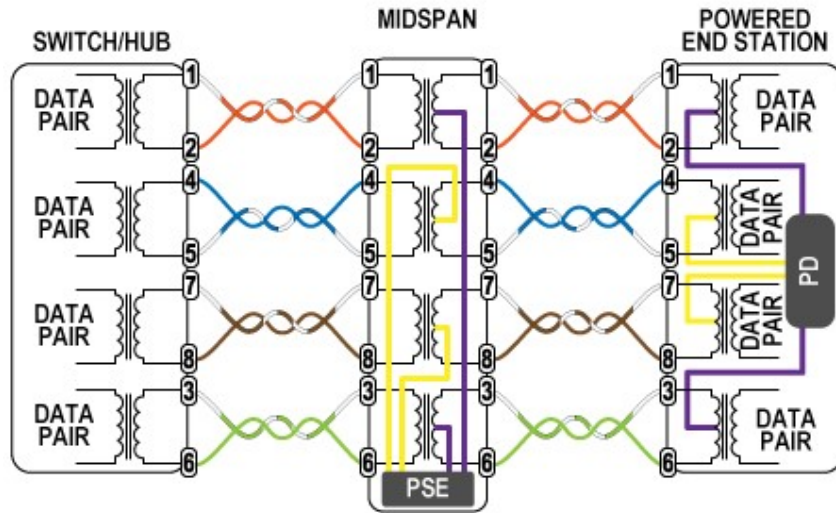*Wiring diagram for a PoE switch (endspan) and an 802.3af (802.3at type 1) powered device.*
Option A - violet color, option B - yellow color.

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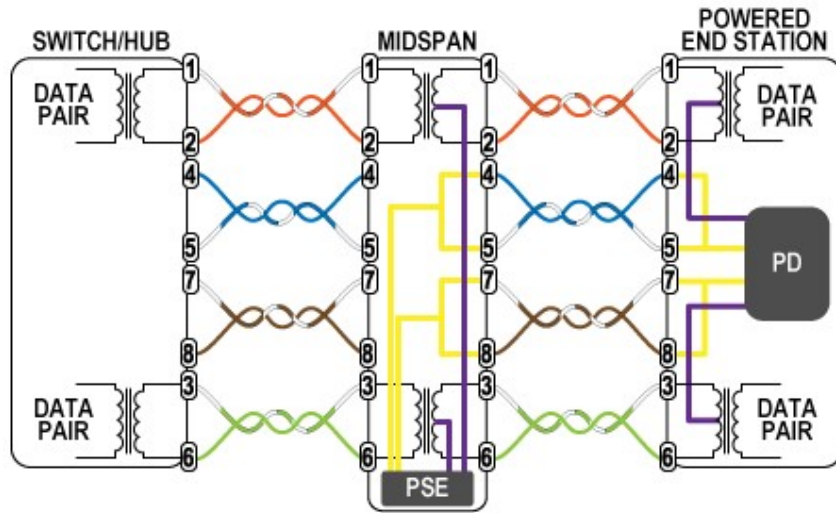
Wiring diagram for a PoE injector (midspan) and an 802.3af (802.3at type 1) powered device.

Option A - violet color, option B - yellow color.

Wiring diagram for a PoE switch (endspan) and an 802.3at type 2 (PoE+) powered device.

Option A - violet color, option B - yellow color.

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Wiring diagram for a PoE injector (midspan) and an 802.3at type 2 (PoE+) powered device.

Option A - violet color, option B - yellow color.

4   Long distance PoE (250 Meter PoE)

250-meter power supply does change the port rate to **10Mbps**, but at the same time, it uses 8-core intelligent power supply technology. The voltage drop on the network cable is small and the loss is small. In addition, the voltage amplitude of the RJ45 port of the PoE switch is increased from 0.98V to 2.2V, which can drive the signal and power transmission to 250 meters, and there is no phenomenon that the video picture is stuck. **Of course, if you really want HD or Ultra HD, don't choose this.** This feature requires Cat6 or higher quality UTP cable.

# 5   Testing procedures and classes of powered devices (PD)

PoE standard has been optimized for safety. In addition to a safe voltage range, the devices must communicate according to established procedures. Before providing the supplying voltage, the PoE power supply unit tests the connection. The current is limited to milliamperes and is applied to determine the actual type of the PoE implemented in the powered device (with the help of characteristic resistance of about 25 kΩ used for this purpose in the device). In addition, this procedure allows for checking the continuity of the line.

Optional classification of equipment compliant with 802.3af standard provides useful information about its power requirements. It is based on the measurement of the current flowing when testing the connection. The equipment is classified as follows:

Class	Output power of power sourcing equipment (PSE) [W]	Power consumed by powered device (PD) [W]
0	15,4	0,44 -12,95
1	4,0	0,44 - 3,84
2	7,0	3,84 - 6,49
3	15,4	6,49 - 12,95
4	30	12,95 - 25,5

Devices compliant with 802.3at also communicate with one another using Layer-2 power management protocol for enhanced power allocation, LLDP-MED (extended version of the protocol for auto-detection of devices). With such communication it is possible to determine the actual power demand with accuracy to 1.11W. The power supply unit forwards the information on the demand for power at regular time periods.
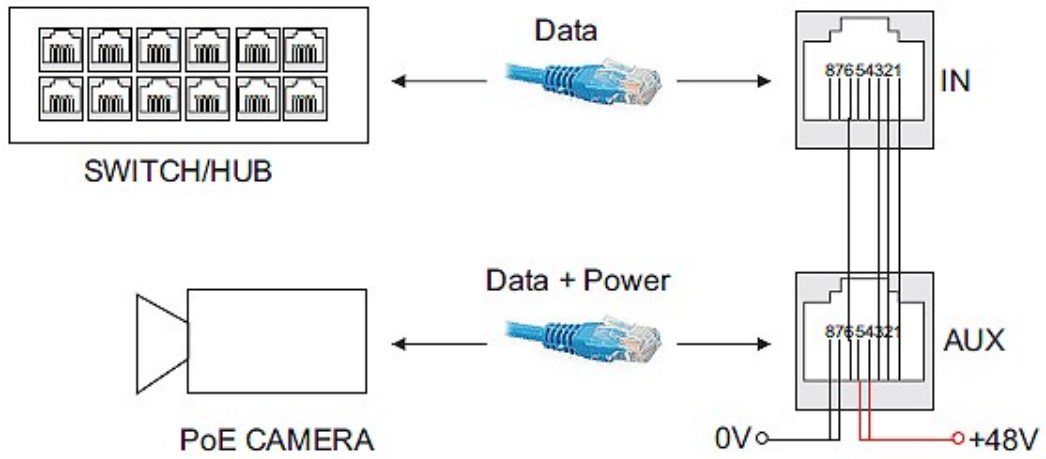
6 Passive PoE
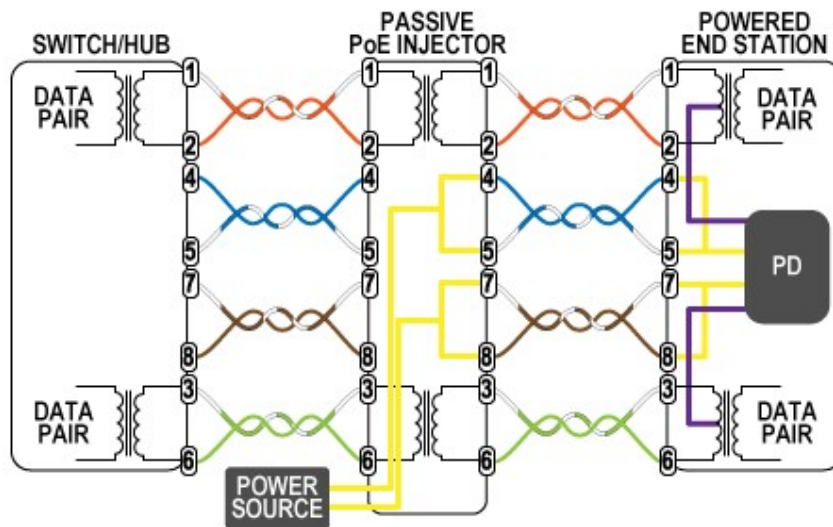
Wiring diagram of a passive PoE injector and powered device

Passive PoE transmits power through selected conductors of UTP/FTP cable. The supplying voltage can be connected directly to the powered device or converted by a special adapter. There is no communication between the power source and the powered device - the power is provided continuously. The wiring is usually made according to option B of IEEE 802.3af (use of free pairs 4/5 (+) and 7/8 (-) in 10/100 Mbps Ethernet networks).

There are power devices that can operate in Gigabit Ethernet networks. They use transformers that enable transmit power along with the data (like in 802.3af option A).

It should be noted that passive PoE solutions are not compatible with the 802.3at standard and are not recommended for use in professional networks.

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