

Support – Service Document



Manufacturer: EKS Fiber Optic Systems

Subject: Power over Ethernet, PoE

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Power over Ethernet or PoE describes any of several standard or ad-hoc systems which pass electric power along with data on twisted pair Ethernet cabling. This allows a single cable to provide both data connection and electric power to devices such as wireless access points, IP cameras, and VoIP phones.

There are several common techniques for transmitting power over Ethernet cabling. Two of them have been standardized by IEEE 802.3 since 2003. These standards are known as **Alternative A** and **Alternative B**. For 10BASE-T and 100BASE-TX, only two of the four signal pairs in typical Cat 5 cable are used. Alternative B separates the data and the power conductors, making troubleshooting easier. It also makes full use of all four twisted pairs in a typical Cat 5 cable. The positive voltage runs along pins 4 and 5, and the negative along pins 7 and 8.

Alternative A transports power on the same wires as data for 10 and 100 Mbit/s Ethernet variants. This is similar to the phantom power technique commonly used for powering condenser microphones. Power is transmitted on the data conductors by applying a common voltage to each pair. Because twisted-pair Ethernet uses differential signaling, this does not interfere with data transmission. The common-mode voltage is easily extracted using the center tap of the standard Ethernet pulse transformer. For Gigabit Ethernet and faster, all four pairs are used for data transmission, so both Alternatives A and B transport power on wire pairs also used for data.

In addition to standardizing existing practice for spare-pair (**Alternative B**) and common-mode data pair power (Alternative A) transmission, the IEEE PoE standards provide for signaling between the power sourcing equipment (PSE) and powered device (PD). This signaling allows the presence of a conformant device to be detected by the power source, and allows the device and source to negotiate the amount of power required or available.

The original IEEE 802.3af-2003 PoE standard provides up to 15.4 W of DC power (minimum 44 V DC and 350 mA) on each port. Only 12.95 W is assured to be available at the powered device as some power dissipates in the cable. The updated IEEE 802.3at-2009 PoE standard also known as PoE+ or PoE plus, provides up to 25.5 W of power for "Type 2" devices. The 2009 standard prohibits a powered device from using all four pairs for power. Both of these standards have since been incorporated into the IEEE 802.3-2012 publication.

The IEEE 802.3bu amendment introduced PoDL single-pair power delivery for the single-pair Ethernet standard 100BASE-T1 intended for automotive and industrial applications. On the two-pair or four-pair standards power is transmitted only between pairs, so that within each pair there is no other voltage present than that representing the transmitted data. With single-pair Ethernet, power is transmitted in parallel to the data. PoDL defines 10 power classes, ranging from .5 to 50 W (at PD).

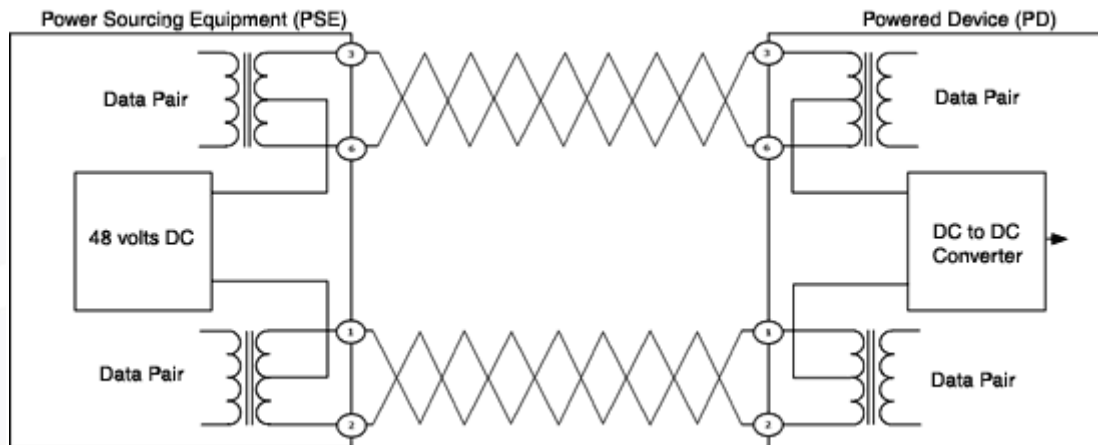
The IEEE is currently looking at ways of increasing the amount of power transmitted. The upcoming IEEE 802.3bt standard slated for early 2018 will introduce two additional power types: up to 55 W (Type 3) and up to 90-100 W (Type 4). Each pair of twisted pairs will need to handle a current of up to 600 mA (Type 3) or 960 mA (Type 4). Additionally, support for 2.5GBASE-T, 5GBASE-T and 10GBASE-T is planned. This development opens the door to new applications and expands the use of applications such as high-performance wireless access points and surveillance cameras.

Comparison of PoE parameters

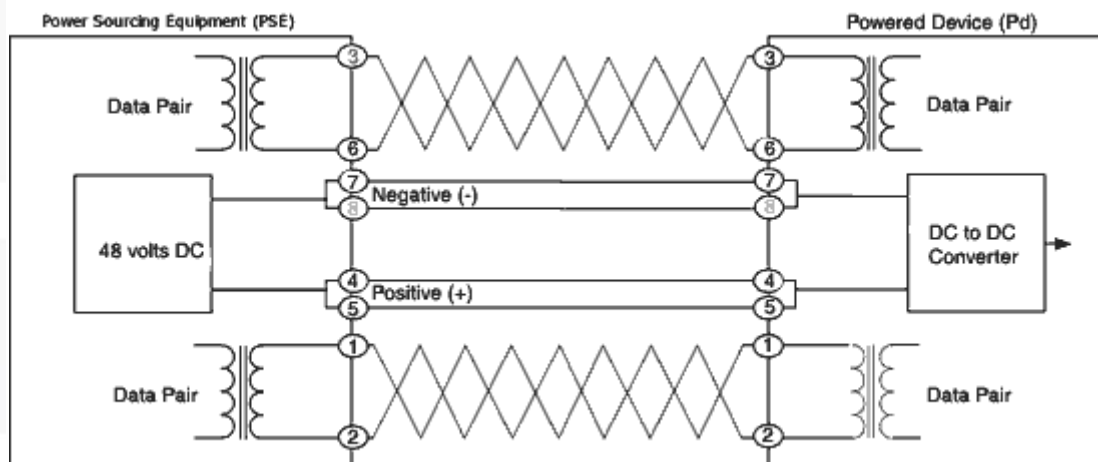
Property	802.3af (802.3at Type 1) "PoE"	802.3at Type 2 "PoE+"	802.3bt Type 3 "4PPoE"	802.3bt Type 4
Power available at PD	12.95 W	25.50 W	51 W	71 W
Maximum power delivered by PSE	15.40 W	30.0 W	60 W	100 W
Voltage range (at PSE)	44.0–57.0 V	50.0–57.0 V	50.0–57.0 V	52.0–57.0 V
Voltage range (at PD)	37.0–57.0 V	42.5–57.0 V	42.5–57.0 V	41.1–57.0 V
Maximum current I_{max}	350 mA	600 mA	600 mA per pair	960 mA per pair

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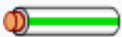










Alternative A implements a simplex, or 'phantom feeding' method for delivering power to the end device. Power is carried on the same conductors as data. CAT-5 cabling for standard 10BaseT and 100Base-TX Ethernet uses two data/signal pairs connected to pins 1 and 2 and pins 3 and 6 on RJ-45 connectors. Power sourcing equipment superimposes power onto these pins via the center tap of internal signal coupling transformers. In the powered device (PD) the power is derived from these lines using the reverse technique.



Alternative B carries power over spare wire pairs in the cable. The power sourcing equipment applies positive voltage to pins 4 and 5. Negative voltage is applied to pins 7 and 8.



Pinouts

802.3af Standards A and B from the power sourcing equipment perspective										
Pins at switch	T568A color	T568B color	10/100 mode B, DC on spares		10/100 mode A, mixed DC & data		1000 (1 gigabit) mode B, DC & bi-data		1000 (1 gigabit) mode A, DC & bi-data	
Pin 1	 White/green stripe	 White/orange stripe	Rx +		Rx +	DC +	TxRx A +		TxRx A +	DC +
Pin 2	 Green solid	 Orange solid	Rx -		Rx -	DC +	TxRx A -		TxRx A -	DC +
Pin 3	 White/orange stripe	 White/green stripe	Tx +		Tx +	DC -	TxRx B +		TxRx B +	DC -
Pin 4	 Blue solid	 Blue solid		DC +	Unused		TxRx C +	DC +	TxRx C +	
Pin 5	 White/blue stripe	 White/blue stripe		DC +	Unused		TxRx C -	DC +	TxRx C -	
Pin 6	 Orange solid	 Green solid	Tx -		Tx -	DC -	TxRx B -		TxRx B -	DC -
Pin 7	 White/brown stripe	 White/brown stripe		DC -	Unused		TxRx D +	DC -	TxRx D +	
Pin 8	 Brown solid	 Brown solid		DC -	Unused		TxRx D -	DC -	TxRx D -	

Bron: Wikipedia