

145.1 Overview

Info: not part of baseline

This introductory (informative) text creates a link between the PoE system described in Clause 33 and the one described here in Clause 145.

This clause defines the functional and electrical characteristics for providing an [enhancement of the](#) Power over Ethernet (PoE) system [defined in Clause 33](#) for deployment over balanced twisted-pair cabling. [This includes the capability to provide power over 4 pairs while maintaining compatibility with equipment designed in accordance to Clause 33.](#) The system consists of two optional power (non-data) entities, a Powered Device (PD) and Power Sourcing Equipment (PSE), for use with the MAU defined in Clause 14 and the PHYs defined in Clause 25, Clause 40, Clause 55, and Clause 126. These entities allow devices to draw/supply power using the same generic cabling as is used for data transmission.

Info: not part of baseline

Introduction of PSE and PD types needs to be moved here from 145.1.3

[PSEs and PDs are categorized by Type.](#) This Clause specifies Type 3 and Type 4 devices and their interaction with Type 1 and Type 2 devices. References [in this clause](#) to PSEs and PDs without a Type qualifier refer exclusively to Type 3 and Type 4 devices. See Clause 33 for the specification of Type 1 and Type 2 devices.

Info: not part of baseline

Lennart's proposal: we need at the beginning of Clause 145 (and possible in Clause 33 as well) something like (right after the second paragraph):

Type 1, Type 2, Type 3, and Type 4 PSEs fully interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE, they can then optionally operate in a reduced power mode.

My comment:

- We also need the symmetrical sentence for the PDs

Sentence to be introduced in the PSE section when describing PSE Types:

Type 1, Type 2, Type 3, and Type 4 PSEs interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE. The PD may then operate in a reduced power mode.

A symmetrical sentence will be introduced in the PD section when describing PD Types

This clause uses several terms defined in 1.4.

Info: not part of baseline

Power over Ethernet replaces DTE powering

PSE replaces power source

Power over Ethernet ~~DTE powering~~ is intended to provide a 10BASE-T, 100BASE-TX, 1000BASE-T, 2.5GBASE-T, 5GBASE-T, or 10GBASE-T device with a single interface to both the data it requires and the power to process this data.

This clause specifies the following:

- a) A ~~power source~~PSE to add power to the 100 Ω ~~balanced~~ cabling system
- b) The characteristics of a PD's load on the ~~power source~~PSE and the structured cabling
- c) A protocol allowing the detection of a PD that requests power from a PSE
- d) Methods to classify PDs based on their power needs
- e) A method for PDs and PSEs to dynamically negotiate and allocate power
- f) A method for scaling supplied power back to the detect level when power is no longer requested or required

The importance of item c) above should not be overlooked. Given the large number of legacy devices (both IEEE 802.3 and other types of devices) that could be connected to a 100 Ω balanced cabling system, and the possible consequences of applying power to such devices, the protocol to distinguish compatible devices and non-compatible devices is important to prevent damage to non-compatible devices.

The detection and powering algorithms are likely to be compromised by cabling that is not point-to-point, resulting in unpredictable performance and possibly damaged equipment.

This clause differentiates between the two ends of the powered portion of the link, defining the PSE and the PD as separate but related devices.

145.1.1 Compatibility considerations

All implementations of PD and PSE systems shall be compatible at their respective Power Interfaces (PIs) when used in accordance with the restrictions of Clause 145 where appropriate. Designers are free to implement circuitry within the PD and PSE in an application-dependent manner provided that the respective PI specifications are satisfied.

Info: not part of baseline

A power system can be made of PSEs and PD of any type, including Type 1 and Type2, so it needs to be stated here.

The sentence *PSEs and PDs are categorized by Type* was moved to 145.1.

145.1.3 System parameters

A power system consists of a single PSE, a single PD, and the link section connecting them. PSEs and PDs may be of a Type defined in Clause 33, Clause 145, or a combination of both. ~~PSEs and PDs are categorized by Type.~~ The power system has certain basic parameters defined according to Table 145–1. These parameters define not only certain performance characteristics of the system, but are also used in calculating the various electrical characteristics of PSEs and PDs as described in 145.2 and 145.3.

145.2 Power sourcing equipment (PSE)

The PSE is the portion of the end station or midspan equipment that provides the power to a single PD. The PSE's main functions are as follows:

- to search the link section for a PD
- to supply power to the detected PD through the link section
- to monitor the power on the link section
- to remove power when no longer requested or required, returning to the searching state.

An unplugged link section is one instance when power is no longer required.

In addition, power classification mechanisms exist to provide the PSE with detailed information regarding the power needs of the PD.

A PSE is electrically specified at the point of the physical connection to the cabling.

Info: not part of baseline

PSE Type description is not complete without an informative reference to Type1 and Type2 PSE. The subsequent text addresses interoperability between PSEs and PDs of any Type.

145.2.1 PSE Type descriptions

PSEs can be categorized as ~~either Type 1, Type 2,~~ Type 3, or Type 4 PSEs. See 33.2 for the specification of Type 1 and Type 2 PSEs.

Type 1, Type 2, Type 3, and Type 4 PSEs interoperate with Type 1, Type 2, Type 3, and Type 4 PDs. The only limitation being that some PDs may not receive their requested amount of power when connected to a lower Type PSE. The PD may then operate in a reduced power mode.

| |
|---|
| Info: not part of baseline |
| Type1 and Type 2 PSEs are also permissible, just not described in this clause, so the table needs to be renamed |

Table 145–2 summarizes the permissible PSE Types along with supported parameters.

Table 145–2—Permissible PSE Types supported parameters

| PSE Type | Supports 4-pair power | Range of maximum Class supported ^a | Short MPS support ^b | Physical Layer Classification ^a | Data Link Layer Classification ^a | Autoclass ^c |
|----------|-----------------------|---|--------------------------------|--|---|------------------------|
| Type 3 | Optional | Class 3 to 4 | Yes | Multiple-Event | Optional | Optional |
| Type 3 | Yes | Class 5 to 6 | Yes | Multiple-Event | Optional | Optional |
| Type 4 | Yes | Class 8 | Yes | Multiple-Event | Optional | Optional |

^aSee 145.2.7, Table 145–11
^bSee 145.2.10
^cSee 145.2.7.2 and 145.3.6.2

145.2.6.5 Rejection criteria

The PSE shall reject a pairset within a link section as having an invalid signature, when the pairset exhibits any of the following characteristics as specified in Table 145–10:

- a) Resistance less than or equal to R_{bad min}, or
- b) Resistance greater than or equal to R_{bad max}, or
- c) Capacitance greater than or equal to C_{bad min}.

| |
|--|
| Info: not part of baseline |
| Detection and rejection criteria are the same for PSEs of any Type. It was certainly true when the clause was one. With the clause split it is a precise choice which ensures interoperability. It deserves to be pointed out. |
| Heath’ comment: <i>(this note) does not give due attention to the new connection check requirements.</i> Better text is welcome. |

Note: Detection and rejection criteria for Clause 145 remain unchanged from Clause 33, therefore ensuring interoperability with Clause 33 devices (see also 145.2.6.4).

A PSE may accept or reject a signature resistance in the band between R_{good min} and R_{bad min}, and in the band between R_{good max} and R_{bad max}. A PSE may accept or reject a parallel signature capacitance in the band between C_{good max} and C_{bad min}. In instances where the resistance and capacitance meet the detection criteria, but one or both of the offsets are exceeded, the detection behavior of the PSE is undefined.

145.3 Powered devices (PDs)

A PD is the portion of a device that is either drawing power or requesting power by participating in the PD detection algorithm. A device that is capable of becoming a PD may have the ability to draw power from an alternate power source. A PD requiring power from the PI may simultaneously draw power from an alternate power source. PD capable devices that are neither drawing nor requesting power are also covered in this subclause. A PD is specified at the point of the physical connection to the cabling. Characteristics such as the losses due to voltage correction circuits, power supply inefficiencies, separation of internal circuits from external ground or other characteristics induced by circuits after the PI connector are not specified. Limits defined for the PD are specified at the PI, not at any point internal to the PD, unless specifically stated.

145.3.1 PD PI

PDs shall be capable of accepting power on either pairset and on both pairsets. The two pairsets are named Mode A and Mode B. In each four-wire connection, the two wires associated with a pair are at the same nominal average voltage. Figure 145–12 in conjunction with Table 145–18 illustrates the two power modes.

The PD shall be implemented to be insensitive to the polarity of the power supply. Single-signature PDs with a power demand lower or equal to Class 4 power shall be able to operate per the PD Mode A column and the PD Mode B column in Table 145–18. All other PDs may require being supplied over Mode A and Mode B simultaneously to operate at their nominal power level.

Info: not part of baseline

The following sentence is symmetrical to the one in 143.2 related to PSEs. Here PDs are the subject.

PDs interoperate with Type 1, Type 2, Type 3, and Type 4 PSEs. Depending on the PSE Type and powering capabilities, a PD may not receive its requested amount of power. The PD may operate in a reduced power mode in that case.

NOTE—PDs that implement only Mode A or Mode B are specifically not allowed by this standard. PDs that are sensitive to polarity, are specifically not allowed by this standard.

The PD shall not source power on its PI.

The PD shall withstand any voltage from 0 V to 57 V at the PI indefinitely without permanent damage.

Info: not part of baseline

Same as before for the PSE - Type1 and Type 2 PDs are also permissible, just not described in this clause, so the table needs to be renamed

145.3.2 PD Type descriptions

PDs can be categorized as either Type 1, Type 2, Type 3, or Type 4. See 33.3 for the specification of Type 1 and Type 2 PDs. PDs can be constructed as single-signature or dual-signature as defined in 1.4 and 145.3.5 and shown in Table 145–19. Table 145–19 shows the ~~permissible PD Types along with~~ supported parameters.

Table 145–19—~~Permissible PD Types~~ supported parameters

| PD Type | Single- or dual-signature | PD Class | 4-pair Capable | Short/Long MPS support | Physical Layer Classification | Data Link Layer Classification | Optional Capabilities |
|---------|---------------------------|----------|----------------|------------------------|-------------------------------|--------------------------------|-----------------------|
| Type 3 | Single | 1 to 3 | Mandatory | Both | Multiple-Event | Optional | Autoclass |
| | | 4 to 6 | Mandatory | Both | Multiple-Event | Mandatory | Autoclass |
| | Dual | 1 to 4 | Mandatory | Both | Multiple-Event | Mandatory | — |
| Type 4 | Single | 7 to 8 | Mandatory | Both | Multiple-Event | Mandatory | Autoclass |
| | Dual | 5 | Mandatory | Both | Multiple-Event | Mandatory | — |

NOTE—See Table 145–24 and Table 145–25 for the allowed PD power for each Type and Class.