104.1 Overview

This clause specifies the following:

a) The characteristics of a power source to add power to the 100 Ω single balanced twisted-pair cabling system.
b) The characteristics of a PD's load on the power source and the cabling.
c) Certain electrical parameters of the medium dependent interface which may be different from that specified in the PHY clause when power is simultaneously transmitted with data.
d) Physical Layer protocols allowing the detection of a fast start-up device that requests power from a PSE ~~and classification of the device based on its power needs~~.
e) Classification protocols of a plug-and-play device that requests power based on its needs.
f) A method for powered devices and power sourcing equipment to negotiate and allocate power.
g) A method for scaling supplied voltage back to the sleep level when operating voltage is no longer requested or required.

[Insert at end of 104.1]

PSEs and PDs fall into one of two System configurations, Fast Startup Systems (FSS) and Plug-and-Play Systems (PPS). These two system configurations are not interoperable by definition in order to allow FSS to dispense with classification routines. A FSS PSE will not power a PPS PD. Likewise, a PPS PSE will not power a FSS PD. This ensures PDs will not be damaged when inserted into an incompatible System configuration.

FSSs are intended for use in engineered applications with PSE and PD class symmetry defined at the system level. For example, the system designer will assure that a 48V Type A, Class 9 PSE will be connected with only 48V Type A, Class 9 or Class 8 PDs as the application may require.

FSS PSEs and PDs perform detection but do not perform classification.

FSSs benefit from optimized detection and lower power up latencies, allowing system vendors to minimize startup delays.

PPSs are intended for use in plug and play systems with Type and Class discoverable during classification. In such systems, the PSE interrogates PD Type and Class using the Serial Communication Classification Protocols (SCCP). A PSE can use the classification result to determine if the PSE can power the PD based on Type and Class.

PPS PSEs and PDs do not perform detection and do perform classification.

104.1.1 Compatibility considerations

Compliant implementations of a PPS PD and PSE ~~systems~~ are defined as compatible at their respective Power Interfaces (PIs) when used in accordance with the restrictions of this clause. Compliant implementations of FSS PD and PSE are only compatible at their respective PIs when the PSE and PD are in the same power class. Table 104-1 outlines the detection and classification requirements for FSS and PPS PSEs and PDs.

Table 104-1-Detection and classification requirements matrix for FSS and PPS PSE and PDs

PSE and PD System	Detection Allowed?	PD Detection Signature	Classification Allowed?	Classification Required?
FSS	Yes	Valid	No	No
PPS	No	Invalid	Yes	Yes

104.1.2 Relationship of Single-Pair PoDL to the IEEE 802.3 architecture

Single-Pair PoDL is an optional power entity to be used in conjunction with supported Ethernet Physical Layers. Data which is out of band to normal Ethernet traffic ~~may be~~ is transmitted and received between ~~the~~ a PPS PSE and a PPS PD prior to the application of power and subsequent to the removal of full operating voltage via the MDI using the Serial Communication Classification Protocol (SCCP) which is described in 104.7.

104.4 Power sourcing equipment (PSE)

~~The PSE provides power to the PD. The PSE's main functions are as follows:~~

~~a) To search the link segment for a PD~~
~~b) To supply power to the detected PD through the link segment~~
~~c) To monitor the power on the link segment~~
~~d) To remove the operating voltage when no longer required or when transitioning to the SLEEP state~~

A PPS PSE provides power to a PD after performing classification. An FSS PSE provides power to a PD after performing physical detection.

A PPS PSE's main functions are as follows:

a) To search the link segment for a PD using SCCP
b) To supply the required power to a classified PD through the link segment
c) To monitor the power on the link segment
d) To remove the operating voltage when no longer required or when transitioning to the SLEEP state

Voltage and power classification mechanisms exist via SCCP to provide a PPS PSE with detailed information regarding the requirements of a~~n~~ PPS PD and vice versa.

An FSS PSE's main functions are as follows:

a) To search the link segment for a PD using the detection protocol described in 104.4.4.
b) To supply power based on predetermined requirements to a detected PD through the link segment
c) To monitor the power on the link segment
d) To remove the operating voltage when no longer required or when transitioning to the SLEEP state

A PSE is specified by its electrical and logical behavior as seen at the PI.

104.4.3 PSE state diagram

The PSE shall implement the behavior of the state diagram shown in Figure 104–4

104.4.3.1 Overview

Prior to application of operating voltage at the PI, a FSS PSE performs detection in order to verify that a valid PD is present. A PPS PSE communicates with the PD using SCCP prior to the application of operating voltage ~~using SCCP~~. A PSE shall perform either detection or classification prior to the application of operating voltage.

After operating voltage has been applied, the PSE monitors the PI for a valid Maintain Full Voltage Signature (MFVS) from the PD. In the event a valid MFVS is not present, the PSE reduces the voltage at the PI to the range of V_{Sleep}. If an external wakeup request is received or if a valid wakeup current signature is detected at the PI, the PSE shall ~~confirm that a valid PD is present by re~~perform~~ing~~ either detection or classification as appropriate before re-applying operating voltage to the PI.

104.4.3.3 Variables

~~mr_sccp_enabled~~

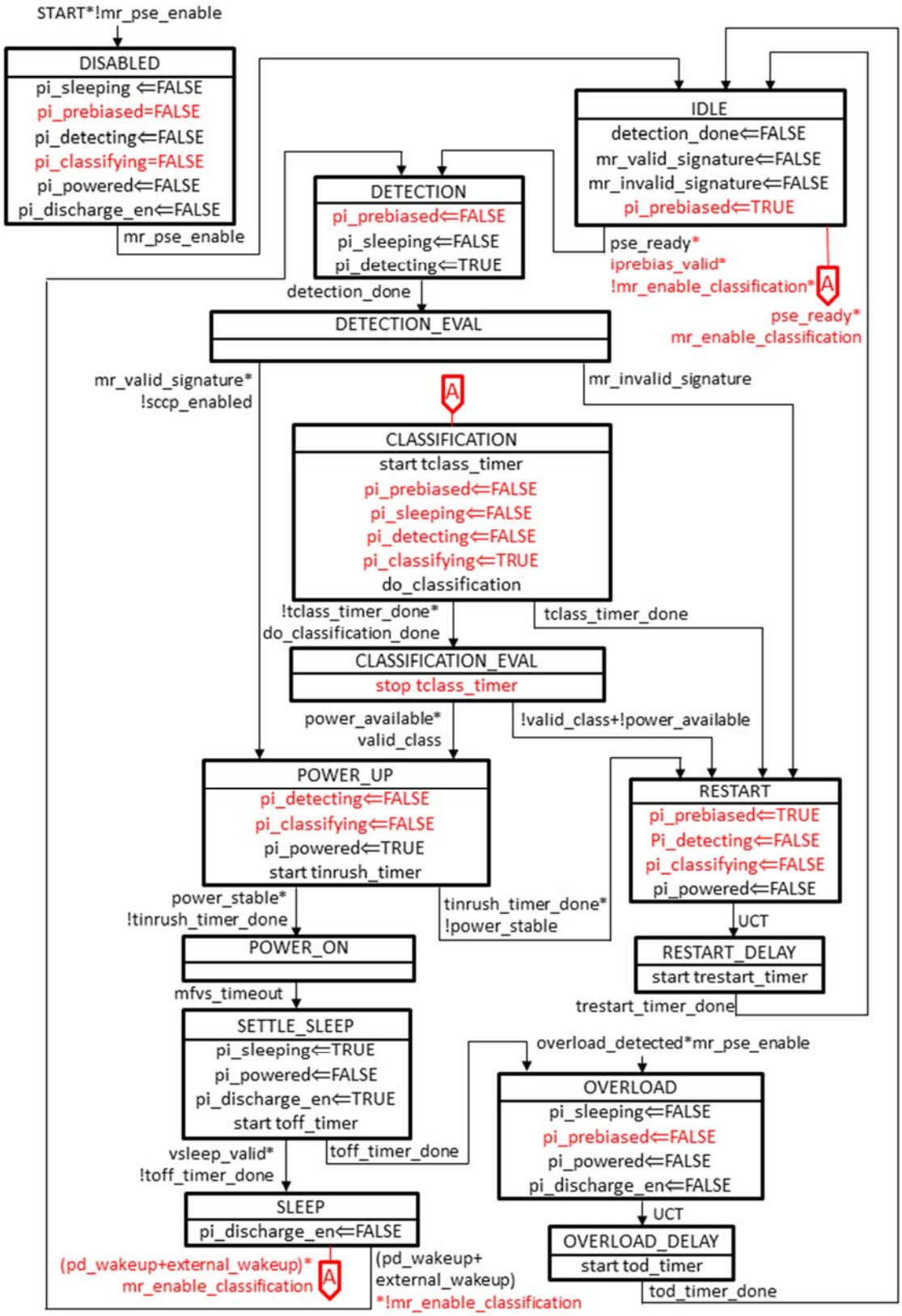
~~TRUE: SCCP is enabled (see 104.7).~~

~~FALSE: SCCP is not enabled (see 104.7).~~

mr_enable_classification

TRUE: enable operation of the PSE do_classification function and disable detection
FALSE: disable operation of the PSE do_classification function and enable detection

104.4.3.6 PSE State Diagram



104.4.4 PSE detection of a PD

FSS PSEs shall perform detection. FSS PDs support detection.

PPS PSEs shall not perform detection. PPS PDs do not support detection.

The PSE performing detection shall probe the PI as described in 104.4.4.1. The PSE is connected to a PD through the PIs and a link segment.

104.4.5 PSE classification of a PD

The ability for the PSE to query the PD in order to determine the PD type and power class requirements of that PD is called classification. Classification ~~is optional, and~~ is performed using SCCP. ~~Implementation of SCCP by a PSE is also optional.~~

FSS PSEs shall not perform classification. FSS PDs do not support classification.

PPS PSEs shall perform classification. PPS PDs support classification.

A PSE with ~~SCCP~~ classification enabled shall complete classification ~~after detection and~~ prior to application of full operating voltage at the PI in a time less than T_{Class} as specified in Table 104-3. If classification is not completed before the T_{Class} timer expires, a new ~~detection~~ classification cycle shall be completed before any subsequent application of full operating voltage.

104.4.6.4 Inrush Time

The specification for T_{inrush} in Table 104–5 applies to the PSE power up time allowed for a PD after completion of either detection or classification, as appropriate. If full operating voltage is applied within T_{inrush} min, the PSE shall enter the POWER_ON state. If full operating voltage is not applied within T_{inrush} max, a new detection or classification cycle, as appropriate, shall be initiated after a delay of $T_{restart}$ before any subsequent application of full operating voltage. If full operating voltage is applied within the range of T_{inrush}, the PSE may enter the POWER_ON state or begin a new detection or classification cycle, as appropriate, after a delay of $T_{restart}$.

104.5 Powered Device (PD)

A PD is the portion of a device that is either drawing power or requesting power by participating in either the PD detection or the PD classification algorithm. A device that is capable of becoming a PD may or may not have the ability to draw power from an alternate power source and, if doing so, may or may not require power from the PI.

104.5.3.1 Overview

FSS PDs implement detection with the following requirements. A falling-edge of the FSS PD input voltage through V_{sig_enable} enables a constant voltage signature, as defined in 104.5.4. When the input voltage rises through ~~the~~ $V_{sig\_disable}$ the FSS PD disables its constant-voltage signature. A FSS PD requests detection and wakeup while the constant voltage signature is enabled by presenting a valid wakeup current signature.

~~SCCP may also be used for communication with the PD by the PSE when the constant-voltage signature is enabled.~~ PPS PDs use SCCP for communication with the PSE and do not provide the constant-voltage detection signature. A PPS PD requests classification and wakeup by presenting a valid wakeup current signature.

104.5.3.3 Variables

FSSys

TRUE: the PD is a FSS PD which implements detection but does not support classification

FALSE: the PD is a PPS PD which implements classification but does not support detection.

pd_sccp_enabled

TRUE: during ~~detection~~ WAIT_CLASSIFICATION or PD_SLEEP, a PSE reset pulse has been detected by the PD and a SCCP serial transaction is pending.

FALSE: during ~~detection~~ WAIT_CLASSIFICATION or PD_SLEEP, no PSE reset pulse has been detected by the PD.

sccp_reset_pulse

TRUE: during ~~detection~~ WAIT_CLASSIFICATION or PD_SLEEP, a SCCP reset pulse has been received by the PD.

FALSE: during ~~detection~~ WAIT_CLASSIFICATION or PD_SLEEP, a SCCP reset pulse has not been received by the PD.

104.5.3.5 PD Functions

do_sccp

This function returns the following variable to the PSE:

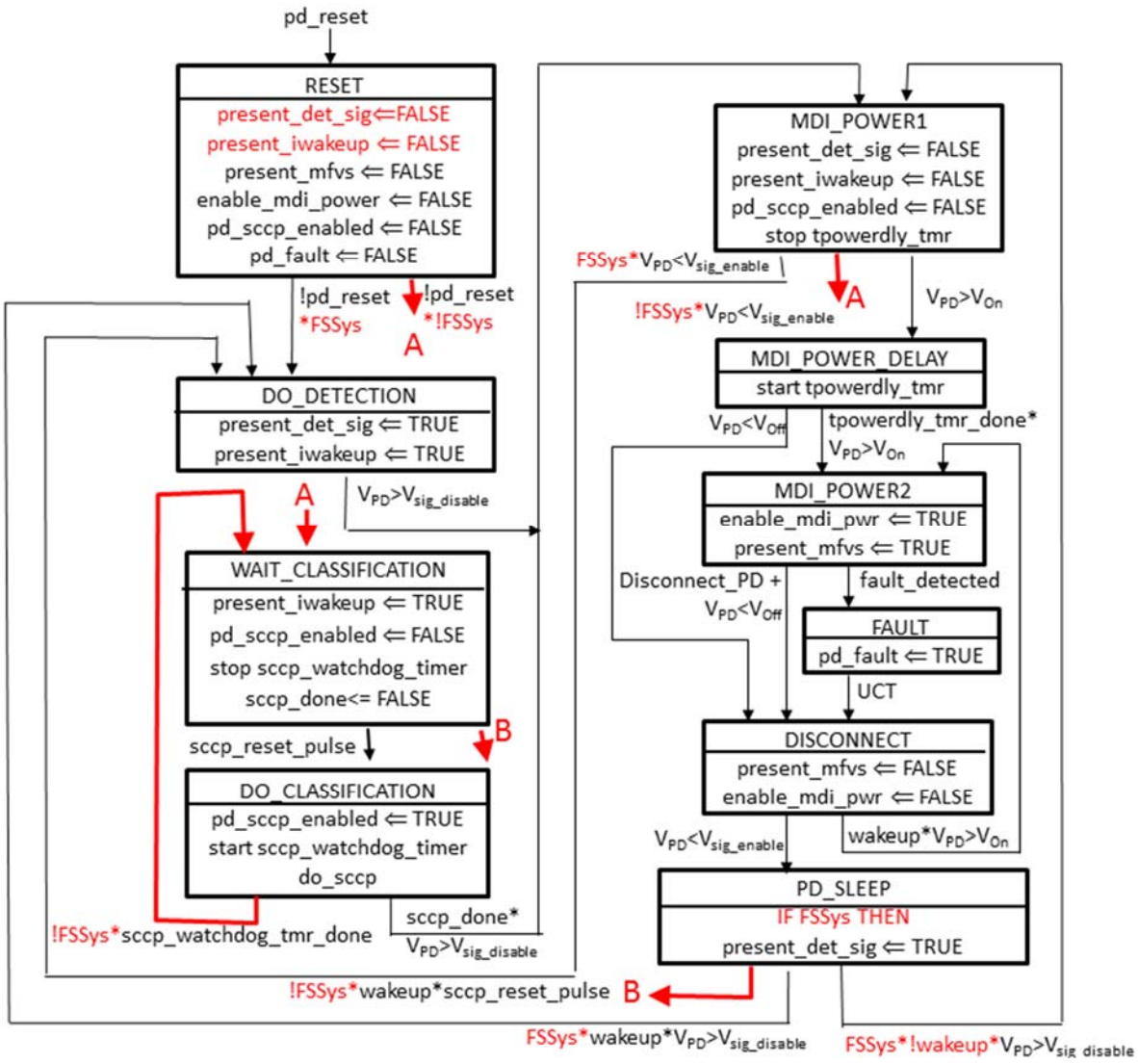
CLASS_TYPE_INFO register: refer to Table 104–8 for a description of the contents.

sccp_done:

TRUE: The do_sccp function has successfully completed transmission of CRC-8 to host

FALSE: The PD state diagram has entered the WAIT_CLASSIFICATION state

104.5.3.6 State Diagram



104.5.4 PD signature

A FSS PD shall ~~present~~ enable a valid detection signature as specified by Table 104-45 when V_{PD} is less than V_{sig_enable}. When V_{PD} is greater than $V_{sig\_disable}$ a FSS PD shall remove the current draw of the detection signature.

PPS PDs shall provide an invalid detection signature as specified by Table 104-~~5~~6.

104.5.5 PD classification and mutual identification between the PSE and PD

A PPS PD is classified by the PSE based on SCCP information provided by the PD.

PPS PDs shall support classification.

FSS PDs shall not support classification.

104.5.6.2 Input current

During operation in the DISCONNECT and PD_SLEEP states, the PD shall not draw current in excess of I_{Sleep_PD} as specified in Table 104–9. A PD that requires ~~detection and~~ power-up shall draw current in the range of I_{Wakeup_PD} for at least T_{Wakeup_PD} when V_{sleep_PD} min < V_{PD} < V_{sleep} max as specified in Table 104–5 and Table 104–9, respectively.

104.6.2 Fault tolerance

The ~~output~~ conductor pair of the PI shall meet the fault tolerance requirements of the appropriate specifying clause. (See clauses 96 and 97).

A FSS PD shall not be damaged when a Class 9 FSS PSE attempts to power it.

The PSE PI shall withstand without damage the application of short circuits between the wires within the cable for an indefinite period of time.

104.7 Serial communication classification protocol (SCCP)

~~Implementation of SCCP by the PSE and PD is optional.~~ PPS PSEs and PDs are required to perform SCCP. FSS PSEs and PDs are not allowed to perform SCCP. The PPS PSE acts as a master during the SCCP exchange, controlling the PPS PD that acts as the slave device.