

IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for 100 Mb/s Operation over a Single Balanced Twisted Pair Cable (100BASE-T1)

IEEE Computer Society

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LAN/MAN Standards Committee

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USA

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(Amendment to
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**LAN/MAN Standards Committee
of the
IEEE Computer Society**

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Abstract: The 100BASE-T1 Physical Layer (PHY) specifications and management parameters for point-to-point full duplex 100 Mb/s operation over single twisted pair balanced cabling is defined in this amendment.

This specification provides fully functional and electrical specifications for the type 100BASE-T1 PHY. This specification also specifies the baseband medium used with 100BASE-T1.

Keywords: 100BASE-T1; copper; Ethernet; IEEE 802.3bw™; MASTER-SLAVE; Medium Dependent Interface; Physical Coding Sublayer; physical layer; Physical Medium Attachment

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Introduction

This introduction is not part of IEEE Std 802.3bw™-2015, IEEE Standard for Ethernet—Amendment 1: Physical Layer Specifications and Management Parameters for 100 Mb/s Operation over a Single Balanced Twisted Pair

IEEE Std 802.3™ was first published in 1985. Since the initial publication, many projects have added functionality or provided maintenance updates to the specifications and text included in the standard. Each IEEE 802.3 project/amendment is identified with a suffix (e.g., IEEE Std 802.3ba™-2010).

The half duplex Media Access Control (MAC) protocol specified in IEEE Std 802.3-1985 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was key to the experimental Ethernet developed at Xerox Palo Alto Research Center, which had a 2.94 Mb/s data rate. Ethernet at 10 Mb/s was jointly released as a public specification by Digital Equipment Corporation (DEC), Intel and Xerox in 1980. Ethernet at 10 Mb/s was approved as an IEEE standard by the IEEE Standards Board in 1983 and subsequently published in 1985 as IEEE Std 802.3-1985. Since 1985, new media options, new speeds of operation, and new capabilities have been added to IEEE Std 802.3. A full duplex MAC protocol was added in 1997.

Some of the major additions to IEEE Std 802.3 are identified in the marketplace with their project number. This is most common for projects adding higher speeds of operation or new protocols. For example, IEEE Std 802.3u™ added 100 Mb/s operation (also called Fast Ethernet), IEEE Std 802.3z added 1000 Mb/s operation (also called Gigabit Ethernet), IEEE Std 802.3ae added 10 Gb/s operation (also called 10 Gigabit Ethernet), IEEE Std 802.3ah™ specified access network Ethernet (also called Ethernet in the First Mile) and IEEE Std 802.3ba added 40 Gb/s operation (also called 40 Gigabit Ethernet) and 100 Gb/s operation (also called 100 Gigabit Ethernet). These major additions are all now included in and are superseded by IEEE Std 802.3-2012 and are not maintained as separate documents.

At the date of IEEE Std 802.3-2015 publication, IEEE Std 802.3 is composed of the following documents:

IEEE Std 802.3-2012

Section One—Includes Clause 1 through Clause 20 and Annex A through Annex H and Annex 4A. Section One includes the specifications for 10 Mb/s operation and the MAC, frame formats and service interfaces used for all speeds of operation.

Section Two—Includes Clause 21 through Clause 33 and Annex 22A through Annex 33E. Section Two includes management attributes for multiple protocols and speed of operation as well as specifications for providing power over twisted pair cabling for multiple operational speeds. It also includes general information on 100 Mb/s operation as well as most of the 100 Mb/s Physical Layer specifications.

Section Three—Includes Clause 34 through Clause 43 and Annex 36A through Annex 43C. Section Three includes general information on 1000 Mb/s operation as well as most of the 1000 Mb/s Physical Layer specifications.

Section Four—Includes Clause 44 through Clause 55 and Annex 44A through Annex 55B. Section Four includes general information on 10 Gb/s operation as well as most of the 10 Gb/s Physical Layer specifications.

Section Five—Includes Clause 56 through Clause 77 and Annex 57A through Annex 76A. Clause 56 through Clause 67 and Clause 75 through Clause 77, as well as associated annexes, specify subscriber access and other Physical Layers and sublayers for operation from 512 kb/s to 10 Gb/s, and defines

services and protocol elements that enable the exchange of IEEE Std 802.3 format frames between stations in a subscriber access network. Clause 68 specifies a 10 Gb/s Physical Layer specification. Clause 69 through Clause 74 and associated annexes specify Ethernet operation over electrical backplanes at speeds of 1000 Mb/s and 10 Gb/s.

Section Six—Includes Clause 78 through Clause 95 and Annex 83A through Annex 93C. Clause 78 specifies Energy-Efficient Ethernet. Clause 79 specifies IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements. Clause 80 through Clause 95 and associated annexes includes general information on 40 Gb/s and 100 Gb/s operation as well the 40 Gb/s and 100 Gb/s Physical Layer specifications. Clause 90 specifies Ethernet support for time synchronization protocols.

A companion document IEEE Std 802.3.1 describes Ethernet management information base (MIB) modules for use with the Simple Network Management Protocol (SNMP). IEEE Std 802.3.1 is updated to add management capability for enhancements to IEEE Std 802.3 after approval of the enhancements.

IEEE Std 802.3 will continue to evolve. New Ethernet capabilities are anticipated to be added within the next few years as amendments to this standard.

IEEE Std 802.3bw™-2015

This amendment includes changes to IEEE Std 802.3-2015 and adds Clause 96. This amendment adds 100 Mb/s Physical Layer (PHY) specifications and management parameters for operation on a single balanced twisted-pair copper cable.

A companion document IEEE Std 802.3.1 describes Ethernet management information base (MIB) modules for use with the Simple Network Management Protocol (SNMP). IEEE Std 802.3.1 is updated to add management capability for enhancements to IEEE Std 802.3 after approval of the enhancements.

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IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for 100 Mb/s Operation over a Single Balanced Twisted Pair Cable (100BASE-T1)

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NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.¹

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~striketrough~~ (to remove old material) and underline (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Deletions and insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.

Cross references that refer to clauses, tables, equations, or figures not covered by this amendment are highlighted in **green**.

¹Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

1. Introduction

1.3 Normative references

Insert the following references in alphanumerical order:

ASTM D4728, Standard Test Method for Random Vibration Testing of Shipping Containers.²

CISPR 25 Edition 3.0 2008-03, Vehicles, boats and internal combustion engines—Radio disturbance characteristics—Limits and methods of measurement for the protection of on-board receivers.³

IEC 60068-2-1/27/30/38/52/64/78, Environmental testing.⁴

IEC 61000-4-2, Electromagnetic compatibility (EMC)—Part 4-2: Testing and measurement techniques—Electrostatic discharge immunity test.

IEC 61000-4-3, Electromagnetic compatibility (EMC)—Part 4-3: Testing and measurement techniques—Radiated, radio-frequency, electromagnetic field immunity test.

IEC 61000-4-21, Electromagnetic compatibility (EMC)—Part 4-21: Testing and measurement techniques—Reverberation chamber test methods.

IEC 61967-1, Integrated circuits—Measurement of electromagnetic emissions, 150 kHz to 1 GHz—Part 1 : General conditions and definitions.

IEC 61967-4, Integrated circuits—Measurement of electromagnetic emissions, 150 kHz to 1 GHz—Part 4: Measurement of conducted emissions—1 Ω /150 Ω direct coupling method.

IEC 62132-1, Integrated circuits—Measurement of electromagnetic immunity, 150 kHz to 1 GHz—Part 1: General conditions and definitions.

IEC 62132-4, Integrated circuits—Measurements of electromagnetic immunity 150 kHz to 1 GHz—Part 4: Direct RF power injection method.

IEC 62215-3, Integrated circuits—Measurement of impulse immunity—Part 3: Non-synchronous transient injection method.

ISO 7637-2:2008, Road vehicles—Electrical disturbances from conduction and coupling—Part 2: Electrical transient conduction along supply lines only.

ISO 7637-3:2007, Road vehicles—Electrical disturbances from conduction and coupling—Part 3: Electrical transient transmission by capacitive and inductive coupling via lines other than supply lines.

ISO 8820-1:2014, Road vehicles—Fuse-links - Part 1: Definitions and general test requirements.

ISO 10605:2008, Road vehicles—Test methods for electrical disturbances from electrostatic discharge.

²ASTM publications are available from the American Society for Testing and Materials (<http://www.astm.org/>).

³CISPR documents are available from the International Electrotechnical Commission (<http://www.iec.ch/>). They are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

⁴IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch/>). IEC publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org/>).

ISO 11452, Road vehicles—Component test methods for electrical disturbances from narrowband radiated electromagnetic energy.

ISO 12103-1:1997, Road vehicles—Test dust for filter evaluation—Part 1: Arizona test dust.

ISO 16750-1:2006, Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 1: General.

ISO 16750-2:2012, Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 2: Electrical loads.

ISO 16750-3:2012, Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 3: Mechanical loads.

ISO 16750-4:2010, Road vehicles—Environmental conditions and testing for electrical and electronic equipment—Part 4: Climatic loads.

ISO 16750-5: 2010, Road vehicles—Environmental conditions and testing for electrical and electronic equipment - Part 5: Chemical loads.

ISO 20653:2013, Road vehicles—Degrees of protection (IP code)—Protection of electrical equipment against foreign objects, water and access.

ISO 26262, Road vehicles—Functional safety.

1.4 Definitions

Change the following existing definitions:

1.4.150 code-group: For IEEE 802.3, a set of encoded symbols representing encoded data or control information. For 100BASE-T4, a set of six ternary symbols that, when representing data, conveys an octet. For 100BASE-TX and 100BASE-FX, a set of five code-bits that, when representing data, conveys a nibble. For 100BASE-T2, a pair of PAM5×5 symbols that, when representing data, conveys a nibble. For 1000BASE-X, a set of ten bits that, when representing data, conveys an octet. For 1000BASE-T, a vector of four 8B1Q4 coded quinary symbols that, when representing data, conveys an octet. For 100BASE-T1, a set of ternary symbols that, when representing data, conveys three bits, as defined in 96.3. (See IEEE Std 802.3, [Clause 23](#), [Clause 24](#), [Clause 32](#), [Clause 36](#), ~~and Clause 40~~, [and Clause 96](#).)

1.4.166 Control mode: In 1000BASE-T, the period of operation in which the PHY is transmitting code-groups that represent control information. The end of a frame is accompanied by a transition to the Control mode, which immediately follows the Data mode and precedes the Idle mode. This occurs when the GMII signal TX_EN is set FALSE. During this time, several control fields are transmitted as code-groups to complete a stream. These include two convolutional encoder reset code-groups, two End-of-Stream delimiter (ESD) code-groups and, possibly, carrier extend code-groups. In 100BASE-T1, the period of operation in which the PHY is transmitting code-groups that represent control information. The end of a frame is accompanied by a transition to the Control mode, which immediately follows the Data mode and precedes the Idle mode. This occurs when the MII signal TX_EN is set FALSE. During this time, several control fields are transmitted as code-groups to complete a stream. (See IEEE Std 802.3, [Clause 40](#) [and Clause 96](#).)

1.4.172 Data mode: In 1000BASE-T, the period of operation in which the PHY is transmitting code-groups that represent data. This mode is preceded by a start of a frame during which the GMII signal TX_EN is set TRUE for data transmission. This mode begins with transmission of two Start-of-Stream delimiter code-groups followed by code-groups encoded from the data octets arriving on TXD<7:0> via the GMII. In

100BASE-T1, the period of operation in which the PHY is transmitting code-groups that represent data. This mode is preceded by a start of a frame during which the MII signal TX_EN is set TRUE for data transmission. This mode begins with transmission of three Start-of-Stream delimiter code-groups followed by code-groups encoded from the data nibbles arriving on TXD<3:0> via the MII. (See IEEE Std 802.3, Clause 40 and Clause 96.)

1.4.193 End-of-Stream Delimiter (ESD): Within IEEE 802.3, a code-group pattern used to terminate a normal data transmission. For 100BASE-T4, the ESD is indicated by the transmission of five predefined ternary code-groups named eop1-5. For 100BASE-X, the ESD is indicated by the transmission of the code-group/T/R. For 100BASE-T2, the ESD is indicated by two consecutive pairs of predefined PAM5×5 symbols (see Table 32–15), which are generated using unique Start-of-Stream Delimiter (SSD)/ESD coding rules. For 100BASE-T, the ESD is indicated by two consecutive vectors of four quinary symbols as specified in Table 40–1. For 100BASE-T1, the ESD consists of three code-groups as defined in 96.3.3.3.5. (See IEEE Std 802.3, Clause 22, Clause 23, Clause 32, ~~and Clause 40,~~ and Clause 96.)

1.4.326 Physical Coding Sublayer (PCS): Within IEEE 802.3, a sublayer used in certain port types to couple the Media Independent Interface (MII), Gigabit Media Independent Interface (GMII) or 10 Gigabit Media Independent Interface (XGMII) and the Physical Medium Attachment (PMA). The PCS contains the functions to encode data bits for transmission via the PMA and to decode the received conditioned signal from the PMA. There are several PCS structures. (For example, See IEEE Std 802.3, Clause 23, Clause 24, Clause 32, Clause 36, Clause 40, Clause 48, Clause 49, ~~and Clause 82,~~ and Clause 96.)

1.4.327 Physical Layer entity (PHY): Within IEEE 802.3, the portion of the Physical Layer between the Medium Dependent Interface (MDI) and the Media Independent Interface (MII), Gigabit Media Independent Interface (GMII) or 10 Gigabit Media Independent Interface (XGMII), consisting of the Physical Coding Sublayer (PCS), the Physical Medium Attachment (PMA), and, if present, the WAN Interface Sublayer (WIS) and Physical Medium Dependent (PMD) sublayers. The PHY contains the functions that transmit, receive, and manage the encoded signals that are impressed on and recovered from the physical medium. (For example, See Clauses 23 to 26, Clause 32, Clause 36, Clause 40, Clauses 48 to 54, Clauses 58 to 63, Clause 65, Clause 66, ~~and Clauses 82 to 89,~~ and Clause 96.)

1.4.328 Physical Medium Attachment (PMA) sublayer: Within 802.3, that portion of the Physical Layer that contains the functions for transmission, reception, and (depending on the PHY) collision detection, clock recovery and skew alignment. (For example, See IEEE Std 802.3, Clauses 7, 12, 14, 16, 17, 18, 23, 24, 32, 36, 40, 51, 62, 63, 66, ~~and 83,~~ and Clause 96.)

1.4.353 receiver training: Within IEEE 802.3, a start-up routine in 100BASE-T2, ~~and 100BASE-T,~~ and 100BASE-T1 used to acquire receiver parameters and synchronize the scramblers of two connected Physical Layers (PHYs).

1.4.363 retraining: Within IEEE 802.3, the process of re-acquiring receiver parameters and synchronizing the scramblers of two connected 100BASE-T2, ~~PHYs or 100BASE-T,~~ or 100BASE-T1 PHYs. See: **receiver training, blind mode.**

1.4.390 Start-of-Stream Delimiter (SSD): Within IEEE 802.3, a pattern of defined codewords used to delineate the boundary of a data transmission sequence on the Physical Layer stream. The SSD is unique in that it may be recognized independent of previously defined code-group boundaries and it defines subsequent code-group boundaries for the stream it delimits. For 100BASE-T4, SSD is a pattern of three predefined sosb code-groups (one per wire pair) indicating the positions of the first data code-group on each wire pair. For 100BASE-X, SSD consists of the code-group sequence /J/K/. For 100BASE-T2, the SSD is indicated by two consecutive pairs of predefined PAM5×5 symbols (± 2 , ± 2) (± 2 , 0) which are generated using unique SSD/ESD coding rules. For 100BASE-T, the SSD is indicated by two consecutive vectors of four quinary symbols as specified in Table 40–1. For 100BASE-T1, the SSD consists of three code-groups, as defined in 96.3.3.3.5.

1.4.393 symbol: Within IEEE 802.3, the smallest unit of data transmission on the medium. Symbols are unique to the coding system employed. For example, 100BASE-T4 and 100BASE-T1 use ternary symbols; 10BASE-T uses Manchester symbols; 100BASE-X uses binary symbols or code-bits; 100BASE-T2 and 1000BASE-T uses quinary symbols. For 1000BASE-X PMDs operating at 1.25 GBd, a symbol corresponds to a code-bit after the 8B/10B encoding operation i.e. has the duration of 0.8 ns. For 10GBASE-R PMDs operating at 10.3125 GBd, a symbol corresponds to a code-bit after the 64B/66B encoding operation i.e. has the duration of approximately 0.097 ns.

1.4.394 symbol period: In 1000BASE-T, the time interval for transmission of one code-group. This is equivalent to 8 ns. In 100BASE-T1, this is equivalent to 15 ns with a code-group of 30 ns. (See IEEE Std 802.3, [Clause 40](#) and [Clause 96](#).)

1.4.395 symbol rate (SR): Within IEEE 802.3, the total number of symbols per second transferred to or from the Medium Dependent Interface (MDI) on a single wire pair. For 100BASE-T4, the symbol rate is 25 MBd; for 100BASE-X, the symbol rate is 125 MBd; for 100BASE-T2, the symbol rate is 25 MBd; for 1000BASE-T, the symbol rate is 125 MBd; for 100BASE-T1, the symbol rate is 66.666 MBd.

1.4.398 ternary symbol: In 100BASE-T4 and 100BASE-T1, a ternary data element. A ternary symbol can have one of three values: -1, 0, or +1. (See IEEE Std 802.3, [Clause 23](#) and [Clause 96](#).)

Insert the following new definition into the list after 1.4.16 100BASE-T:

1.4.16a 100BASE-T1: IEEE 802.3 Physical Layer specification for a 100 Mb/s Ethernet full duplex local area network over a single balanced twisted-pair. (See IEEE Std 802.3, [Clause 96](#).)

Insert the following new definition into the list after 1.4.87 2 Event classification:

1.4.87a 4B/3B: For IEEE 802.3, the data encoding technique used by 100BASE-T1 when converting 4-bit (4B) MII data with 25 MHz clock to 3-bit (3B) data with 33.333 MHz clock. (See IEEE Std 802.3, 96.3.3.1.2.)

Insert the following new definition into the list after 1.4.221 FOMAU:

1.4.221a FORCE mode: FORCE mode is a PHY initialization procedure used for manual configuration of MASTER-SLAVE assignment to achieve link acquisition between two link partners. (See IEEE Std 802.3, 96.4.4.)

1.5 Abbreviations

Insert the following new abbreviations into the list, in alphabetical order:

AFEXT	alien FEXT
ANEXT	alien NEXT
DPI	direct power injection
DUT	device under test
EMC	electromagnetic compatibility
LCL	longitudinal conversion loss Sdc11/Sdc22
LCTL	longitudinal conversion transmission loss Sdc12/Sdc21
PSAACRF	power sum alien attenuation to crosstalk ratio far-end
PSANEXT	power sum alien near-end crosstalk
RMS	root mean square

TCL	transverse conversion loss Scd11/Scd22
TCTL	transverse conversion transmission loss Scd12/Scd21
XTALK	crosstalk

30. Management

30.3 Layer management for DTEs

30.3.2 PHY devicePHY device managed object class

30.3.2.1 PHY device attributes

30.3.2.1.2 aPhyType

Insert the following new entry in APPROPRIATE SYNTAX after the entry for 100BASE-T2:

APPROPRIATE SYNTAX:

...
100BASE-T1 Clause 96 100 Mb/s PAM3

30.3.2.1.3 aPhyTypeList

Insert the following new entry in APPROPRIATE SYNTAX after the entry for 100BASE-T2:

APPROPRIATE SYNTAX:

...
100BASE-T1 Clause 96 100 Mb/s PAM3

30.5 Layer management for medium attachment units (MAUs)

30.5.1 MAU managed object class

30.5.1.1 MAU attributes

30.5.1.1.2 aMAUType

Insert the following new entry in APPROPRIATE SYNTAX after the entry for 100BASE-T2FD:

APPROPRIATE SYNTAX:

...
100BASE-T1 Single balanced twisted-pair copper cabling PHY as specified in Clause 96

30.5.1.1.4 aMediaAvailable

Insert into the third paragraph in BEHAVIOUR DEFINED AS section of 30.5.1.1.4 after the second sentence as follows:

BEHAVIOUR DEFINED AS:

For 100BASE-T1, a link_status of OK maps to the enumeration “available”. All other states of link_status map to the enumeration “not available”.

45. Management Data Input/Output (MDIO) Interface

45.2 MDIO Interface Registers

45.2.1 PMA/PMD registers

Replace the reserved row for 1.17 through 1.29 in Table 45–3 with the following three rows (unchanged rows not shown):

Table 45–3—PMA/PMD registers

Register address	Register name	Subclause
1.17	Reserved	
1.18	BASE-T1 PMA/PMD extended ability	45.2.1.14a
1.19 through 1.29	Reserved	

Change the identified reserved row in Table 45-3 and insert four new rows immediately above the changed row as follows (unchanged rows not shown):

Table 45–3—PMA/PMD registers

Register address	Register name	Subclause
1.1809 through 1.2099	Reserved	
1.2100	BASE-T1 PMA/PMD control	45.2.1.131
1.2101	Reserved	
1.2102	100BASE-T1 PMA/PMD test control	45.2.1.132
1.48092103 through 1.32767	Reserved	

45.2.1.6 PMA/PMD control 2 register (Register 1.7)

Replace indicated line in the 1.7.5:0 row of Table 45-7 with five new lines, as follows (unchanged lines not shown):

Table 45–7—PMA/PMD control 2 register bit definitions

Bit(s)	Name	Description	R/W ^a
1.7.5:0	PMA/PMD type selection	5 4 3 2 1 0 ~~1 1 x x x x = reserved for future use~~ ~~1 1 1 1 1 x = reserved for future use~~ ~~1 1 1 1 0 1 = 100BASE-T1 PMA/PMD~~ ~~1 1 1 1 0 0 = reserved for future use~~ ~~1 1 1 0 x x = reserved for future use~~ ~~1 1 0 x x x = reserved for future use~~	R/W

^aR/W = Read/Write

45.2.1.7.4 Transmit fault (1.8.11)

Insert the following row below the header row of Table 45-9 (unchanged rows not shown):

Table 45-9—Transmit fault description location

PMA/PMD	Description location
100BASE-T1	96.4.2

45.2.1.7.5 Receive fault (1.8.10)

Insert the following row below the header row of Table 45-10 (unchanged rows not shown):

Table 45-10—Receive fault description location

PMA/PMD	Description location
100BASE-T1	96.4.3

45.2.1.10 PMA/PMD extended ability register (Register 1.11)

Change the reserved row in Table 45-14 and insert a new row immediately below the changed row as follows (unchanged rows not shown):

Table 45-14—PMA/PMD extended ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.11.15:12	Reserved	Value always 0	RO
1.11.11	BASE-T1 extended abilities	1 = PMA/PMD has BASE-T1 extended abilities listed in register 1.18 0 = PMA/PMD does not have BASE-T1 extended abilities	RO

^aRO = Read only

Insert 45.2.1.10.a before 45.2.1.10.1 as follows:

45.2.1.10.a BASE-T1 extended abilities (1.11.11)

When read as a one, bit 1.11.11 indicates that the PMA/PMD has BASE-T1 extended abilities listed in register 1.18. When read as a zero, bit 1.11.11 indicates that the PMA/PMD does not have BASE-T1 extended abilities.

Insert 45.2.1.14a and Table 45-17a after 45.2.1.14 as follows:

45.2.1.14a BASE-T1 PMA/PMD extended ability register (1.18)

The assignment of bits in the BASE-T1 PMA/PMD extended ability register is shown in Table 45-17a. All of the bits in the PMA/PMD extended ability register are read only; a write to the PMA/PMD extended ability register shall have no effect.

Table 45-17a PMA/PMD extended ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.18.15:1	Reserved	Value always 0	RO
1.18.0	100BASE-T1 ability	1 = PMA/PMD is able to perform 100BASE-T1 0 = PMA/PMD is not able to perform 100BASE-T1	RO

^aRO = Read only

Insert the following new subclauses before 45.2.2:

45.2.1.131 BASE-T1 PMA/PMD control register (Register 1.2100)

The assignment of bits in the BASE-T1 PMA/PMD control register is shown in Table 45-98a.

Table 45-98a—BASE-T1 PMA/PMD control register bit definitions

Bit(s)	Name	Description	R/W ^a
1.2100.15	MASTER-SLAVE manual config enable	Value always 1	RO
1.2100.14	MASTER-SLAVE config value	1 = Configure PHY as MASTER 0 = Configure PHY as SLAVE	R/W
1.2100.13:4	Reserved	Value always 0	RO
1.2100.3:0	Type Selection	<u>3 2 1 0</u> 1 x x x = Reserved for future use 0 1 x x = Reserved for future use 0 0 1 x = Reserved for future use 0 0 0 1 = Reserved for future use 0 0 0 0 = 100BASE-T1	R/W

^aRO = Read only, R/W = Read/Write

45.2.1.131.1 BASE-T1 MASTER-SLAVE manual config enable (1.2100.15)

Bit 1.2100.15 returns a one to indicate that MASTER or SLAVE configuration is set manually.

45.2.1.131.2 BASE-T1 MASTER-SLAVE config value (1.2100.14)

Bit 1.2100.14 is used to select MASTER or SLAVE operation when MASTER-SLAVE manual config enable bit 1.2100.15 is set to one. If bit 1.2100.14 is set to one the PHY shall operate as MASTER. If bit 1.2100.14 is set to zero the PHY shall operate as SLAVE.

45.2.1.131.3 BASE-T1 type selection (1.2100.3:0)

Bits 1.2100.3:0 are used to set the mode of operation. When these bits are set to 0000, the mode of operation is 100BASE-T1.

45.2.1.132 100BASE-T1 PMA/PMD test control register (Register 1.2102)

The assignment of bits in the 100BASE-T1 PMA/PMD test control register is shown in Table 45–98b.

Table 45–98b—100BASE-T1 PMA/PMD test control register bit definitions

Bit(s)	Name	Description	R/W ^a
1.2102.15:13	100BASE-T1 test mode control	15 14 13 1 1 1 = Reserved 1 1 0 = Reserved 1 0 1 = Test mode 5 1 0 0 = Test mode 4 0 1 1 = Reserved 0 1 0 = Test mode 2 0 0 1 = Test mode 1 0 0 0 = Normal operation	R/W
1.2102.12:0	Reserved	Value always 0	RO

^aRO = Read only, R/W = Read/Write

45.2.1.132.1 100BASE-T1 test mode control (1.2102.15:13)

100BASE-T1 test mode control operations are selected using bits 1.2102.15:13. The default value for bits 1.2102.15:13 is 000.

45.2.3 PCS registers

45.2.3.1 PCS control 1 register (Register 3.0)

45.2.3.1.2 Loopback (3.0.14)

Change 45.2.3.1.2 Loopback (3.0.14) as follows:

When the 100BASE-T1, 10GBASE-T₂ or the 10GBASE-R mode of operation is selected for the PCS using the PCS type selection field (3.7.1:0), the PCS shall be placed in a loopback mode of operation when bit 3.0.14 is set to a one. When bit 3.0.14 is set to a one, the 100BASE-T1, 10GBASE-R₂ or 10GBASE-T PCS shall accept data on the transmit path and return it on the receive path. The specific behavior of the 100BASE-T1 PCS during loopback is specified in 96.3.5. The specific behavior of the 10GBASE-R PCS during loopback is specified in 49.2. The specific behavior for the 10GBASE-T PCS during loopback is specified in 55.3.6.3. For all other port types, the PCS loopback functionality is not applicable and writes to this bit shall be ignored and reads from this bit shall return a value of zero.

45.5 Protocol implementation conformance statement (PICS) proforma for Clause 45, MDIO interface

45.5.3 PICS proforma tables for the Management Data Input Output (MDIO) interface

45.5.3.2 PMA/PMD MMD options

Insert the following row at the end of table 45.5.3.2 PMA/PMD MMD options:

Item	Feature	Subclause	Value/Comment	Status	Support
*BTC	Implementation of BASE-T1 PMA/PMD	45.2.1.131.2		PMA:O	Yes [] No [] N/A []

45.5.3.3 PMA/PMD management functions

Insert the following row at the end of table 45.5.3.3 PMA/PMD management functions:

Item	Feature	Subclause	Value/Comment	Status	Support
MM126	Writes to the BASE-T1 PMA/PMD extended ability register have no effect	45.2.1.14a		PMA:M	Yes [] N/A []
MM127	BASE-T1 MASTER config	45.2.1.131.2	PHY operates as MASTER when bit 1.2100.14 is set to one	BTC:M	Yes [] N/A []
MM128	BASE-T1 SLAVE config	45.2.1.131.2	PHY operates as SLAVE when bit 1.2100.14 is set to zero	BTC:M	Yes [] N/A []

45.5.3.7 PCS management functions

Change the identified rows in table 45.5.3.7 (unchanged rows not shown):

Item	Feature	Subclause	Value/Comment	Status	Support
RM15	Writes to loopback bit are ignored ~~when operating at 10 Gb/s~~ with port type selections other than <u>100BASE-T1</u> , 10GBASE-R _x or 10GBASE-T	45.2.3.1.2		PCS:M	Yes [] N/A []
RM16	Loopback bit returns zero ~~when operating at 10 Gb/s~~ with port type selections other than <u>100BASE-T1</u> , 10GBASE-R _x or 10GBASE-T	45.2.3.1.2		PCS:M	Yes [] N/A []