Annex 25A Energy Efficient Ethernet for the 100BASE-TX PMD

(normative)

25A.1 Introduction

100BASE-TX supports optional capability of Energy Efficient Ethernet as described in Clause 78. A 100BASE-TX PMD with support for Energy Efficient Ethernet is exactly a 100BASE-TX PMD as defined in Clause 25, with the additions and changes described in this annex. The way to implement this feature is through the Low Power Idle. Two new service primitives PMD_RXQUIET.request(rx_quiet) (see 24A.8.1.1) and PMD_TXQUIET.request(tx_quiet) (see 24A.8.1.2) are generated to pass the energy saving requests from the PCS. An additional service primitive PMA_RXLPI.request (rx_lpi) (see 24A.7.1.2) is provided by the PCS to modify the signal detect behavior while in Low Power Idle.

25A.2 Specific requirements

25A.2.1 Jitter

In addition to the requirements stated in 25.4.6, the following requirements apply when using Energy Efficient Ethernet with the 100BASE-TX PMD.

During Low Power operation, jitter shall be measured using scrambled SLEEP code groups transmitted during the TX_SLEEP state. Total transmit jitter with respect to a continuous unjittered reference shall not exceed 1.4 ns peak-to-peak with the exception that the jitter contributions from the clock transitions occurring during TX_QUIET and the first 5 usec of TX_SLEEP are ignored. The jitter measurement time period shall be not less than 100 msec and not greater than 1 second.

25A.2.2 Energy Efficient Ethernet capability

TP-PMD does not have an option to support Energy Efficient Ethernet. In order to add this capability to existing TP-PMD specification, TP-PMD 7.1.2, 7.2.2, 10.1.2, 10.1.3, and Table 4 are modified to incorporate the Low Power Idle function. These modifications take effect only if the option of low power idle is implemented.

25A.2.2.1 Change to TP-PMD 7.1.2 “Encoder”

The Encoder receives the scrambled NRZ data stream from the Scrambler and encodes the stream into MLT3 code for presentation to the Driver. MLT3 coding is similar to NRZI coding, but three instead of two levels are transmitted. The Encoder can be deactivated during the low power transmit state.

The PMD in low power idle mode shall implement the Encoder as depicted in Figure 25A–1

25A.2.2.1.1 State Variables

25A.2.2.1.1.1 Variables

encoder_input

Indicates the value of each scrambled NRZ bit to be encoded.

Values: ZERO; the nrz bit from Scrambler process (TP-PMD 7.1.1) has a logical value 0

ONE; the nrz bit from Scrambler process (TP-PMD 7.1.1) has a logical value 1

encoder_output

Indicates the value from the encoder for each MLT-3 encoded bit.

Values: POSITIVE_VOLTAGE; the output indicates a positive value of voltage to TP-TMD Driver (TP-PMD 7.1.3)
ZERO_VOLTAGE; the output indicates a zero value of voltage to TP-TMD Driver (TP-PMD 7.1.3)
NEGATIVE_VOLTAGE; the output indicates a negative value of voltage to TP-TMD Driver (TP-PMD 7.1.3)

link_status

The link_status parameter as communicated by the PMA_LINK.indicate primitive.

Values: FAIL; the receive channel is not intact
READY; the receive channel is intact and ready to be enabled by Auto-Negotiation
OK; the receive channel is intact and enabled for reception

tx_quiet

The tx_quiet parameter as communicated by the PMD_TXQUIET.request (tx_quiet) primitive. This variable is from the Transmit process of PCS to control the power saving function of local transmitter. It is also used to set the initial state of Encoder state diagram.

Values: TRUE; The local transmitter is in Quiet state
FALSE; The local transmitter is not in Quiet state

le_flag

A Boolean set by the Encoder process to indicate whether the last non-zero value of encoder_output was POSITIVE_VOLTAGE. The flag le_flag is set upon entry to PLUS_V state and is cleared upon entry to MINUS_V state.

Values: ONE; The encoder is in PLUS_V state
ZERO; The encoder is in MINUS_V state

25A.2.2.1.1.2 Messages

gotNRZbit.indicate

A signal sent to the Encoder process by the Scrambler process after a scrambled nrz text bit has been generated using recursive linear function by the scrambler from plaintext bit stream and is ready to transmit.

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25A.2.2.2 Change to TP-PMD 7.2.2 “Decoder”

The Decoder receives the MLT3 encoded bit stream from the Receiver, and decodes it into a NRZ encoded bit stream for presentation to the Descrambler. The Decoder can be deactivated during the low power receive state.

The PMD in low power idle mode shall implement the Decoder as depicted in Figure 25A–2.

25A.2.2.2.1 State Variables

25A.2.2.2.1.1 Variables

decoder_input

Indicates the value of the MLT-3 encoded bit from the Receiver.

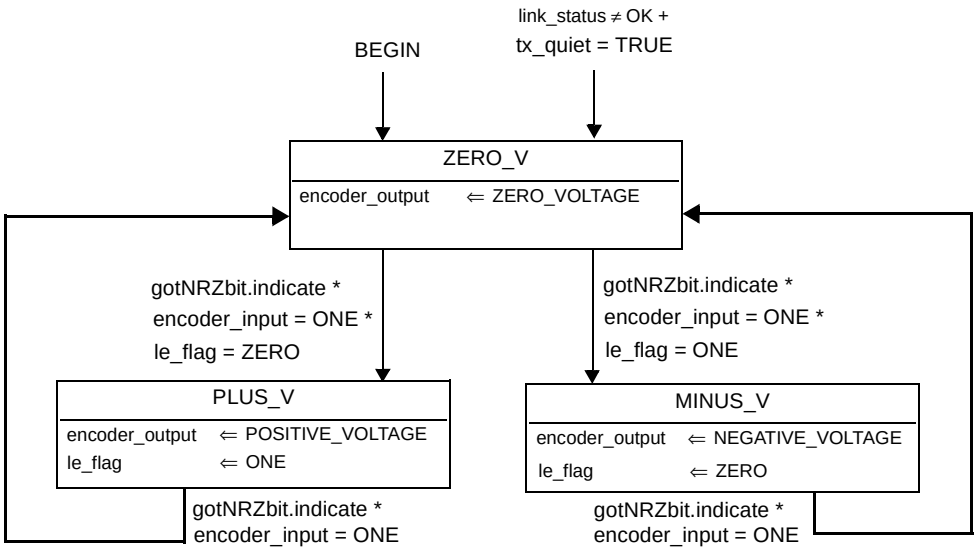

Figure 25A–1—Encoder state diagram

Values: ZERO; the MLT3 bit from Receiver process (TP-PMD 7.2.1) has a logical value 0
NONZERO; the MLT3 bit from Receiver process (TP-PMD 7.2.1) has a non-zero logical value

decoder_output

Indicates the value of the NRZ encoded bit.

Values: ZERO; the output indicates a logical value of 0 to TP-PMD Descrambler process
ONE; the output indicates a logical value of 1 to TP-PMD Descrambler process

link_status

The link_status parameter as communicated by the PMA_LINK.indicate primitive.

Values: FAIL; the receive channel is not intact
READY; the receive channel is intact and ready to be enabled by Auto-Negotiation
OK; the receive channel is intact and enabled for reception

rx_quiet

The rx_quiet parameter as communicated by the PMD_RXQUIET.request (rx_quiet) primitive. This variable is from the Receive process of PCS to control the power saving function of local receiver. It is also used to set the initial state of Decoder state diagram.

Values: TRUE; The local receiver is in Quiet state
FALSE; The local receiver is not in Quiet state

prev_data

Indicates whether the last value of decoder_input was ZERO or NONZERO.

Values: ZERO; the last value of MLT3 bit of decoder_input has a logical value 0
NONZERO; the last value of MLT3 bit of decoder_input has a non-zero logical value

25A.2.2.2.1.2 Messages

sentNRZbit.indicate

A signal sent to the Decoder process by the Descrambler process after an nrz bit from ciphertext

bit stream has been processed using recursive linear function and is ready to process the next bit from Decoder.

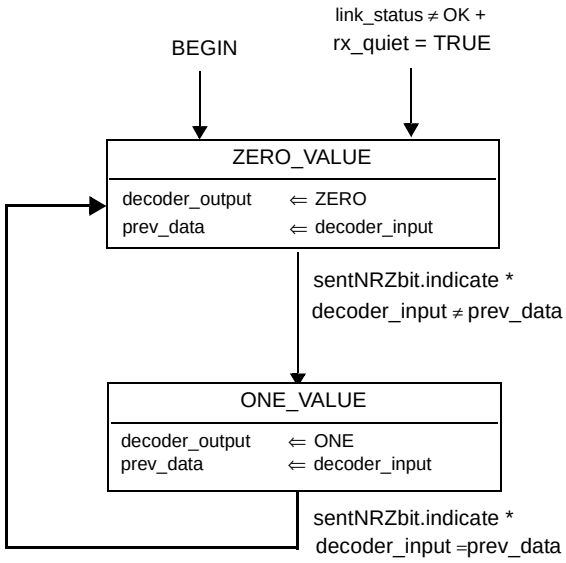

Figure 25A–2—Decoder state diagram

25A.2.2.3 Changes to 10.1.1.1 "Signal_Detect assertion threshold"

The TP-PMD 10.1.1.1 is applicable during the normal operation. During the low power idle mode, when rx_lpi as communicated by the PMA_RXLPI.request primitive is asserted, Signal_Detect shall be asserted per 25A.2.2.5 for any valid peak to peak signal, VSDA, of greater than 400 mV.

Note: The requirement of signal detection time is different between normal operation mode and low power idle mode. In order to share one signal_detect, the timing characteristics are qualified by the LPI signal rx_lpi from PCS.

25A.2.2.4 Changes to 10.1.1.2 "Signal_Detect deassertion threshold"

The TP-PMD 10.1.1.2 is applicable during the normal operation. During the low power idle mode, when rx_lpi is deasserted, Signal_Detect shall be deasserted per 25A.2.2.6 for any valid peak to peak signal, VSDD, of smaller than 200 mV.

25A.2.2.5 Change to 10.1.2 "Signal_Detect timing requirements on assertion"

The TP-PMD 10.1.2 is applicable during the normal operation mode. When the Low Power Idle mode is implemented, the following paragraph is included:

During the low power idle mode, when rx_lpi is asserted, Signal_Detect output shall be asserted within 5 µs instead of 1000 µs under the same quality requirement of received signal as in normal operation. The new definition of conditional parameter AS_Max is inserted in TP-PMD Table 4 as depicted in Table 25A–1.

25A.2.2.6 Change to 10.1.3 "Signal_Detect timing requirements on deassertion"

The TP-PMD 10.1.3 is applicable during the normal operation mode. When the Low Power Idle mode is implemented, the following paragraph is included:

During the low power idle mode, when rx_lpi is asserted, Signal_Detect output shall be deasserted within 5 µs instead of 350 µs under the same quality requirement of received signal as in normal operation. The new definition of conditional parameter ANS_Max is inserted in TP-PMD Table 4 as depicted in Table 25A–1.

25A.2.2.7 Changes to TP-PMD 10.2 "Transmitter"

During the low power idle mode, when tx_quiet as communicated by PMD_TXQUIET.request primitive is deasserted, the transmitter output shall deliver a signal that exceeds Signal_Detect assertion threshold within 2 us, and at the same starting time, deliver a fully compliant 100BASE-TX signal within 5 us.

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Table 25A–1—Signal_Detect summary

Characteristic	Minimum	Maximum	Units
Assert time Normal operation mode		1000	us
Deassert time Normal operation mode		350	us
Assert time Low Power Idle mode		5	us
Deassert time Low Power Idle mode		5	us
Assert threshold VSDA 100 ohm balanced cable Normal operation mode		1000	mV peak to peak
Deassert threshold VSDD 100 ohm balanced cable Normal operation mode	200		mV peak to peak
Assert threshold VSDA 150 ohm balanced shielded cable Normal operation mode		1225	mV peak to peak
Deassert threshold VSDD 150 ohm balanced shielded cable Normal operation mode	245		mV peak to peak
Assert threshold VSDA Low Power Idle mode		400	mV peak to peak
Deassert threshold VSDD Low Power Idle mode	200		mV peak to peak

25A.3 Protocol implementation conformance statement (PICS) proforma for Annex 25A, Energy Efficient Ethernet for the 100BASE-TX PMD[1]

25A.3.1 Introduction

The supplier of a protocol implementation that is claimed to conform to Annex 25A, Energy Efficient Ethernet for the 100BASE-TX PMD, shall complete the following protocol implementation conformance statement (PICS) proforma.

A detailed description of the symbols used in the PICS proforma, along with instructions for completing the PICS proforma, can be found in Clause 21.

25A.3.2 Major capabilities/options

Item	Feature	Subclause	Status	Support	Value/Comment
*LPI	Supports LPI function	25A.2.2	O		

25A.3.3 PMD compliance

Item	Feature	Subclause	Status	Support	Value/Comment
PD6a	Jitter measurement during low power operation	25A.2.1	M		1.4 ns peak to peak

[1]*Copyright release for PICS proformas:* Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.