PMD functional and electrical behavior for Energy Efficient Ethernet

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Overview

- Functional and electrical requirements for “quiescent” mode
  - tx_mode = QUIET, ALERT, RF_ALERT
  - rx_mode = QUIET
- No requirements for “fast wake” mode (normal operation)
  - tx_mode = FW
- 10GBASE-KR requirements modified for multi-lane interface
- Reorganize signal detect functions
  - One instance of Training state diagram and “energy_detect” per lane
  - Global PMD signal detect function combines lane-by-lane indications
  - Map to SIGNAL_OK parameter of PMD:IS_SIGNAL.indication

93.7.2 PMD Transmit function

The PMD transmit function shall convert the four bit streams requested by the PMD service interface messages PMD:IS_UNITDATA_0.request to PMD:IS_UNITDATA_3.request into four separate electrical streams. The four electrical signal streams shall then be delivered to the MDI, all according to the transmit electrical specifications in 93.8.1. A positive output voltage of SL*i*<p> minus SL*i*<n> (differential voltage) shall correspond to tx_bit = one.

If the optional EEE capability is supported, the PMD transmit function shall transmit a periodic sequence, where each period of the sequence consists of 8 ones followed by 8 zeros, on each lane when tx_mode is set to ALERT. In addition, when tx_mode is set to ALERT, the transmit equalizer coefficients are set to the preset values (see 93.7.12 and 93.8.1.6). When tx_mode is not set to ALERT, the transmit equalizer coefficients set to the values determined via the start-up protocol (see 93.7.12).

93.7.4 Global PMD signal detect function

Replace the contents of 93.7.4 with the following:

The variable Global_PMD_signal_detect is the logical AND of the values of PMD_signal_detect_*i* for *i*=0 to 3.

When the MDIO is implemented, this function maps the variable Global_PMD_signal_detect to the register and bit defined in 93.6.

93.2 Physical Medium Dependent (PMD) service interface

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The 100GBASE-KR4 PMD has four parallel bit streams, hence *i* = 0 to 3. The PMA (or the PMD) continuously sends four parallel bit streams to the PMD (or the PMA), one per lane, each at a nominal signaling rate of 25.78125 GBd.

~~The SIGNAL_OK parameter of the PMD:IS_SIGNAL.indication primitive is assigned the value of SIGNAL_DETECT as defined in 93.7.4. When SIGNAL_OK is FAIL, the PMD:IS_UNITDATA_i.indication parameters are undefined.~~ The SIGNAL_OK parameter of the PMD:IS_SIGNAL.indication primitive corresponds to the variable Global_PMD_signal_detect as defined in 93.7.4. When Global_PMD_signal_detect is one, SIGNAL_OK shall be assigned the value OK. When Global_PMD_signal_detect is zero, SIGNAL_OK shall be assigned the value FAIL. When SIGNAL_OK is FAIL, the PMD:IS_UNITDATA_*i*.indication parameters are undefined.

If the optional EEE capability is supported, then the PMD service interface includes two additional primitives as follows:

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93.7.5 PMD lane-by-lane signal detect function

Replace the contents of 93.7.5 with the following:

The PMD lane-by-lane signal detect function is used by the 100GBASE-KR4 PMD to indicate the successful completion of the start-up protocol by the PMD control function (see 93.7.12). PMD_signal_detect_*i* (where *i* represents the lane number in the range 0 to 3) is set to zero when the value of the variable signal_detect is set to false by the Training state diagram for lane *i* (see Figure 72-5). PMD_signal_detect_*i* is set to one when the value of signal_detect for lane *i* is set to true.

If training is disabled by management, PMD_signal_detect_*i* shall be set to one for *i*=0 to 3.

If the optional EEE capability is supported, the following requirements apply. The value of PMD_signal_detect_*i* (for *i*=0 to 3) is set to zero when rx_mode is first set to QUIET. While rx_mode is set to QUIET, PMD_signal_detect_*i* shall be set to one within 500 ns following the application of the output of a channel meeting the requirements of 93.9, driven by the ALERT pattern defined in 93.7.2 with a peak-to-peak differential output amplitude of 720 mV, to the receiver of lane *i*.

When the MDIO is implemented, this function maps the variables to registers and bits as defined in 93.6.

93.7.6 Global PMD transmit disable function

The Global PMD transmit disable function is optional. When implemented, it allows all of the transmitters to be disabled with a single variable.

a) When Global_PMD_transmit_disable variable is set to one, this function shall turn off all of the transmitters such that each transmitter drives a constant level (i.e., no transitions) and does not exceed the maximum differential peak-to-peak output voltage in Table 93–4.

b) If a ~~PMD_fault~~PMD fault (93.7.9) is detected, then the PMD may turn off the electrical transmitter in all lanes.

c) Loopback, as defined in 93.7.8, shall not be affected by Global_PMD_transmit_disable.

d) The following additional requirements apply when the optionl EEE capability is supported. The Global PMD transmit disable function shall turn off all of the transmitters as specified in 93.8.1.3 when tx_mode transitions to QUIET from any other value. The Global PMD transmit disable function shall turn on all of the transmitters as specified in 93.8.1.3 when tx_mode transitions from QUIET to any other value.

93.8.1.3 Signal levels

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The DC common-mode output voltage shall be between 0 V and 1.9 V with respect to signal ground. The AC common-mode output voltage shall be less than or equal to 12 mV RMS with respect to signal ground. Common-mode output voltage requirements shall be met regardless of the transmit equalizer setting.

If the optional EEE capability is supported the following requirements also apply. The peak-to-peak differential output voltage shall be less than 30 mV within 500 ns of the transmitter being disabled. When the transmitter is disabled, the peak-to-peak differential output voltage shall be greater than 720 mV within 500 ns of the transmitter being enabled and shall meet the requirements of 93.8.1 within TBD ns of the transmitter being enabled. When the transmitter is disabled, the DC common-mode output voltage shall be maintained to within +/-150 mV of the value for the enabled transmitter.

Differential and common-mode signal levels are measured with a PRBS9 test pattern.

Conclusions

- PMD functional and electrical requirements for EEE proposed for Clause 93

- Also applicable to Clause 92

Addendum: Differences for Clause 94 EEE

94.3.6.2 PMD Transmit function

<existing text>

The PMD transmit function shall convert the four bit streams requested by the PMD service interface messages PMD:IS_UNITDATA_0.request to PMD:IS_UNITDATA_3.request into four separate electrical streams. The four electrical signal streams shall then be delivered to the MDI, all according to the transmit electrical specifications in 94.3.12. A positive output voltage of SLi<p> minus SLi<n> (differential voltage) shall correspond to a positive tx_symbol value.

<existing text>

<new text>

If the optional EEE capability is supported, the PMD transmit function shall transmit a periodic sequence, where each period of the sequence is an ALERT frame (see 94.3.11.1) when tx_mode is set to ALERT. When tx_mode is DATA or ALERT the transmit equalizer coefficients shall be set to the values determined via the start-up protocol (see 94.3.10).

<new text>

94.3.6.5 PMD lane-by-lane signal detect function

Replace the contents of 94.3.6.5 with the following:

The PMD lane-by-lane signal detect function is used by the 100GBASE-KR4 PMD to indicate the successful completion of the start-up protocol by the PMD control function (see 94.3.10). PMD_signal_detect_*i* (where *i* represents the lane number in the range 0 to 3) is set to zero when the value of the variable signal_detect is set to false by the Training state diagram for lane *i* (see Figure 72-5). PMD_signal_detect_*i* is set to one when the value of signal_detect for lane *i* is set to true.

If training is disabled by management, PMD_signal_detect_*i* shall be set to one for *i*=0 to 3.

If the optional EEE capability is supported, the following requirements apply. The value of PMD_signal_detect_*i* (for *i*=0 to 3) is set to zero when rx_mode is first set to QUIET. While rx_mode is set to QUIET, PMD_signal_detect_*i* shall be set to one within 500 ns following the application of the output of a channel meeting the requirements of 94.4, driven by the ALERT pattern defined in 94.3.6.2 and meeting the EEE transmit enable amplitude requirement of 94.3.12.3.

When the MDIO is implemented, this function maps the variables to registers and bits as defined in 94.3.5.

94.3.12.3 Signal levels

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The common-mode DC output voltage shall be between 0 V and 1.9 V with respect to signal ground. The common-mode AC output voltage shall be less than or equal to 30 mV RMS with respect to signal ground. Common-mode output voltage requirements shall be met regardless of the transmit equalizer setting.

If the optional EEE capability is supported the following requirements also apply. The peak-to-peak differential output voltage shall be less than 35 mV within 500 ns of the transmitter being disabled.

When the transmitter transitions from disabled to enabled: (a) The amplitude of the frame marker of the third complete alert frame (see 94.3.11.1) after the transmitter is enabled shall be greater than 90% of the steady state value (see 94.3.12.6.1), and (b) the transmitter output shall meet the requirements of 94.3.12 within 1 us of the transmitter being enabled.

When the transmitter is disabled, the DC common-mode output voltage shall be maintained to within +/-150 mV of the value for the enabled transmitter.

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