55.4.2.5.4 Next transmitter settings

Next transmitter setting (1 octet). Represented by the octet Oct6{Valid<7>, PBO<6:4>, Reserved<3:0>} and shown in Figure 55–22. Used to announce the next programmable PBO setting during PMA_PBO_Exch that will take effect upon entering PMA_Coeff_Exch state. For every other state this octet is set to zero and ignored by the link partner. The bit Valid will be set to one if the corresponding octet information is valid and will be set to zero if it the octet information is not valid. If Valid is set to zero the octet is ignored by the link partner.

55.4.2.5.5 Requested transmitter settings

Requested remote transmitter setting (1 octet). Represented by the octet Oct7{Valid<7>, PBO<6:4>, Reserved<3:0>} and shown in Figure 55–22. Used to request the remote transmitter programmable PBO setting during PMA_PBO_Exch that will take effect upon entering PMA_Coeff_Exch state. For every other state this octet is set to zero and ignored by the link partner. The bit Valid will be set to one if the corresponding octet information is valid and will be set to zero if it the octet information is not valid. If Valid is set to zero the octet is ignored by the link partner.

55.4.2.5.6 Message Field

Message Field (1 octet). For the MASTER, this field is represented by the octet Oct8{Reserved<7:6>, loc_rcvr_status<5>, en_slave_tx<4>, trans_to_Coeff_Exch<3>, Coeff_exchange<2>, trans_to_Fine_Adjust<1>, trans_to_PCS_Test<0>}. For the SLAVE, this field is represented by the octet Oct8{Reserved<7:6>, loc_rcvr_status<5>, timing_lock_OK<4>, trans_to_Coeff_Exch<3>, Coeff_exchange<2>, trans_to_Fine_Adjust<1>, trans_to_PCS_Test<0>}.

All possible Message Field settings are listed in Table 55–4 for the MASTER and Table 55–5 for the SLAVE. Any other value shall not be transmitted and shall be ignored at the receiver. When loc_rcvr_status=OK the InfoField variable is set to loc_rcvr_status<5>=1 and set to 0 otherwise.

Table 55–4—InfoField message field valid MASTER settings

Reserved<7:6>	loc_rcvr_ status	en_slave_tx	trans_to_ Coeff_Exch	Coeff_ exchange	trans_to_ Fine_Adjust	trans_to_ PCS_test
00	0	0	0	0	0	0
00	0/1	1	0	0	0	0
00	0	1	1	0	0	0
00	0	1	0	1	0	0
00	0	1	0	0	1	0
00	1	1	0	0	0	1

Table 55–5—InfoField message field valid SLAVE settings

Reserved<7:6>	loc_rcvr_ status	timing_lock _OK	trans_to_ Coeff_Exch	Coeff_ exchange	trans_to_ Fine_Adjust	trans_to_ PCS_test
00	0/1	0/1	0	0	0	0
00	0	1	1	0	0	0
00	0	1	0	1	0	0
00	0	1	0	0	1	0
00	1	1	0	0	0	1

55.4.2.5.7 SNR Margin

SNR Margin (4 bits). Represented by the half octet Oct9<7:4>, which reports received decision point SNR Margin in 1/2 dB steps. The SNRmargin<7:4> 4 bit values, 0010, 0011, 0100, 0101, 0110, 0111, 1000, 1001, 1010, 1011, 1100, 1101, 1110 shall indicate the decision point SNR margin values of -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 dB respectively. The value 0001 shall indicate a margin of -2 dB or less, and the value 1111 shall indicate 5 dB or more. Finally the value 0000 shall indicate that the SNR margin value is unknown.

55.4.2.5.8 Transition counter

Transition counter (10 bits). Represented by the 1.25 octets [Oct9<1:0>, Oct10<7:0>]. When configured as Transition counter (Coeff_exchange<2>=0 and a transition is announced to PMA_Coeff_Exch, PMA_Fine_Adjust or PCS_Test) this field is used as a 10 bit counter that counts the number of remaining frames until the next transition (PMA_Coeff_Exch, PMA_Fine_Adjust, PCS_Test).

55.4.2.5.9 Coefficient exchange handshake

Coefficient exchange handshake (12 bits). Represented by the 1.5 octets [Oct9<3:0>, Oct10<7:0>]. If Coeff_exchange<2>=1 this field is configured as a Coefficient exchange handshake and is used as a handshake control channel during programmable THP coefficient exchange. The details of the coefficient exchange are described in 55.4.2.5.14.

55.4.2.5.10 Reserved Fields

All InfoField fields denoted Reserved in Figure 55–19, Figure 55–20 and Figure 55–21 are reserved for future use. This includes octets Oct11 and Oct12 when Coeff_exchange<2>=0, Oct9<3:2> when transition counter is announced and [Oct9<3:0>, Oct10<7:0>] when no transition is announced and no coefficients are exchanged.

55.4.2.5.11 Vendor Specific Field

If Coeff_exchange<2>=0 octets Oct13 and Oct14 are vendor specific fields. If during Auto-Negotiation both transceivers agree on the use of the two vendor specific octets they may be used as a PHY communication channel, otherwise they are set to zero and ignored by the link partner. Represented by the 2 octets [Oct13<7:0>, Oct14<7:0>].

55.4.2.5.12 Coefficient Field

Coefficient Field (4 octets). When Coeff_exchange<2>=1, this field is used to exchange programmable THP coefficients. It transmits four 8 bit THP coefficients out of the total of 64 (16 coefficients over each of the 4 pairs). The order is pair A, coefficients 0:3, followed by coefficients 4:7, followed by 8:11 and 12:15. The same coefficient order is followed to transmit the coefficients for pair B, followed by pair C and finally pair D. The details of the coefficient exchange are described in 55.4.2.5.14.

55.4.2.5.13 CRC16

CRC16 (2 octets). Shall implement the CRC16 polynomial (x+1)(x^15+x+1) of the previous 10 octets, Oct5<7:0>, Oct6<7:0>, Oct7<7:0>, Oct8<7:0>, Oct9<7:0>, Oct10<7:0>, Oct11<7:0>, Oct12<7:0>, Oct13<7:0> and Oct14<7:0>. The CRC16 shall produce the same result as the implementation shown in Figure 55–23. In Figure 55–23 the 16 delay elements S0,..., S15, shall be initialized to zero. Afterwards Oct5 through Oct14 are used to compute the CRC16 with the switch connected, which is setting CRCgen in Figure 55–23. After all the 10 octets have been processed, the switch is disconnected (setting CRCout) and the 16 values stored in the delay elements are transmitted in the order illustrated, first S15, followed by S14, and so on, until the final value S0.

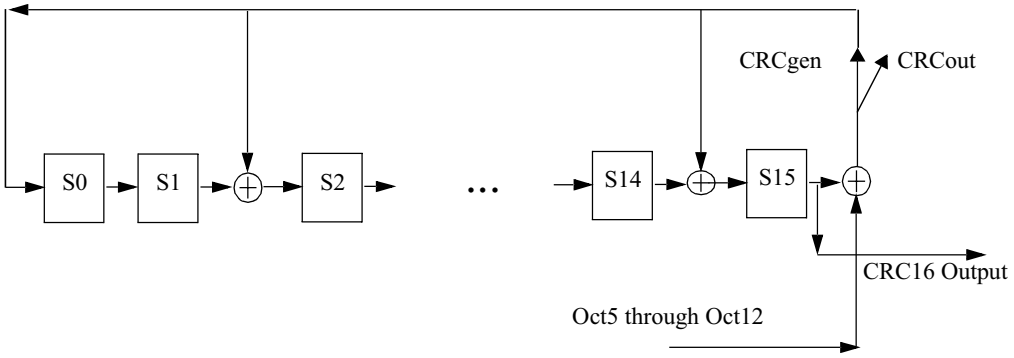

Figure 55–23—CRC16

55.4.2.5.14 Startup Sequence

The startup sequence shall comply with the state diagram description given in Figure 55–24 and the transition counter state diagrams Figure 55–25 and Figure 55–26.

During Auto-Negotiation PHY Control is in the DISABLE_10GBASE-T_TRANSMITTER state and the transmitters are disabled.

When the Auto-Negotiation process asserts link_control=ENABLE, PHY Control enters the INIT_MAXWAIT_TIMER state. Upon entering this state, the maxwait_timer is started and PHY Control enters the SILENT state which starts the minwait_timer and forces transmission of zeros by setting tx_mode=SEND_Z.

In MASTER mode, after expiration of the minwait_timer, PHY Control transitions to the PMA_Training_Init_M state.

Upon entering the PMA_Training_Init_M and PMA_Training_Init_S states, the PHY Control forces transmission into the training mode by asserting tx_mode=SEND_T which includes the transmission of InfoFields.

Upon entering state PMA_Training_Init_M, the MASTER starts transmission with a fixed transmit power level, PBO=4 (corresponding to a power backoff of 8 dB). The PBO variable is communicated to the link partner via the current transmitter octet of the InfoField.

Initially the MASTER will not be ready for the SLAVE to respond and sets en_slave_tx=0 which is communicated to the link partner via the InfoField. After the MASTER has sufficiently converged the necessary circuitry the MASTER must set en_slave_tx=1 to allow the SLAVE to transition to PMA_Training_Init_S.

In SLAVE mode, PHY Control transitions to the PMA_Training_Init_S state only after the SLAVE PHY acquires timing, converges its equalizers, acquires its descrambler state and sets loc_SNR_margin=OK. The SLAVE shall respond using the fixed PBO transmit power level, PBO=4 (corresponding to a power backoff of 8 dB).

While in states PMA_Training_Init_S, PMA_PBO_Exch or PMA_Coeff_Exch, whenever a SLAVE operating in loop timing mode loses the MASTER timing reference (for example after transmit power level transitions) it sets timing_lock_OK=0 which is communicated to the link partner via the InfoField. Otherwise timing_lock_OK is set to one.

In MASTER mode, PHY Control enters the PMA_PBO_Exch state after loc_SNR_margin=OK and in SLAVE mode PHY Control enters the PMA_PBO_Exch state after the loc_SNR_margin=OK and minwait_timer expires. In the PMA_PBO_Exch state, after the MASTER has computed the final desired programmable PBO level, it will request a PBO change using the requested transmitter setting in the InfoField (octet 7). In SLAVE mode, after the MASTER has requested the desired PBO level, the SLAVE will request a desired PBO level that is within two levels (within 4dB) of the requested MASTER PBO level.

Following PBO exchange for both transceivers, each PHY will announce the next PBO setting using the next transmitter setting (octet 6) and will announce a transition to the PMA_Coeff_Exch state (trans_to_Coeff_Exch=1) and start the Transition Counter as described in 55.4.5.1. After the counters time out, the PHYs will enter the PMA_Coeff_Exch state and enable the requested PBO.

While both MASTER and SLAVE are in state PMA_Coeff_Exch, when either end has computed the programmable THP settings, the programmable THP coefficient exchange process can begin, using the 1.5 octet Coefficient exchange handshake and the 4 octet Coefficient Field as follows:

a) During PMA_Coeff_Exch each PHY will begin a coefficient exchange by setting the Coeff_Exchange flag to 1 in the Message Field.
b) During coefficient exchange, the Transition Counter bits are used as the Coefficient Exchange Handshake
    1) Oct9{Reserved<3:0>}: unused
    2) Coefficient Pair Received, Oct10<7:6>: 01 for local transmitter pair A, 10 for B, 11 for C and 00 for D (default). This is the handshake to tell the remote unit the last coefficients received.
    3) Coefficient Group Received, Oct10<5:4>: 01 for coefficients 0:3, 10 for 4:7, 11 for 8:11 and 00 for 12:15 (default). This is the handshake to tell the remote unit the last coefficients received.
    4) Coefficient Pair Sent, Oct10<3:2>: 01 for remote transmitter pair A, 10 for B, 11 for C and 00 for D (default). This is the handshake to tell the remote unit the current coefficients being sent.
    5) Coefficient Group Sent, Oct10<1:0>: 01 for 0:3, 10 for 4:7, 11 for 8:11 and 00 for 12:15 (default). This is the handshake to tell the remote unit the current coefficients being sent.
c) The Reserved Field will be used to send 4 8-bit coefficients in each frame designated by the Coefficient Pair Sent and Coefficient Group Sent bits.

d) Each PHY begins the exchange by sending pair A coefficients 0:3 with Coefficient Pair Sent=01 and Coefficient Group Sent=01.
e) The remote unit will acknowledge by setting Coefficient Pair Received =01 and Coefficient Group Received =01.
f) Following each acknowledgement, the PHY will increment through the Coefficient Group and then Coefficient Pair settings until Coefficient Pair Sent=00 and Coefficient Group Sent=00 and Coefficient Pair Received =00 and Coefficient Group Received =00. At this time, coefficient exchange is done and both PHYs will set Coeff_Exchange=0 and trans_to_Fine_Adjust =1 and start the Transition Counter.
g) Coefficient Format
    1) 8 bits per coefficient. Use one octet per coefficient in twos complement notation
    2) Coefficient range is -2.0 to 1.984375 in steps of 0.015625

Following coefficient exchange for both transceivers, each PHY will announce a transition to the PMA_Fine_Adjust state (trans_to_Fine_Adjust=1) and start the Transition Counter as described in 55.4.5.1. After the counters time out, the PHYs will enter the PMA_Fine_Adjust state and enable the THP precoders with the requested coefficients. At the closure of the THP feedback loop, the initial state of the THP feedback filters shall be the last 16 symbols from the state PMA_Coeff_Exch.

The THP coefficients and PBO setting may not be changed during PMA_Fine_Adjust. The final convergence of the adaptive filter parameters is completed in the PMA_Fine_Adjust state.

After the PHY completes successful training and establishes proper receiver operations, PCS Transmit conveys this information to the link partner via transmission of the parameter InfoField value loc_rcvr_status. The link partner's value for loc_rcvr_status is stored in the local device parameter rem_rcvr status. When the condition loc_rcvr_status=OK and rem_rcvr_status=OK is satisfied, each PHY will announce a transition to the PCS_Test state (trans_to_PCS_Test=1) and start the Transition Counter as described in 55.4.5.1.

The normal mode of operation corresponds to the PCS_Data state, where PHY Control asserts tx_mode=SEND_N and transmission of data over the link can take place.

PHY Control may force the transmit scrambler state to be initialized to an arbitrary value by requesting the execution of the PCS Reset function defined in 55.3.2.1.

55.4.2.6 Link Monitor function

Link Monitor determines the status of the underlying receive channel and communicates it via the variable link_status. Failure of the underlying receive channel typically causes the PMA's clients to suspend normal operation.

The Link Monitor function shall comply with the state diagram of Figure 55–27.

Upon power on, reset, or release from power down, the Auto-Negotiation algorithm sets link_control=SCAN_FOR_CARRIER and, during this period, sends fast link pulses to signal its presence to a remote station. If the presence of a remote station is sensed through reception of fast link pulses, the Auto-Negotiation algorithm sets link_control=DISABLE and exchanges Auto-Negotiation information with the remote station. During this period, link_status=FAIL is asserted. If the presence of a remote 10GBASE-T station is established, the Auto-Negotiation algorithm permits full operation by setting link_control=ENABLE. As soon as reliable transmission is achieved, the variable link_status=OK is asserted, upon which further PHY operations can take place.

55.4.2.7 Clock Recovery function

The Clock Recovery function couples to all four receive pairs. It may provide independent clock phases for sampling the signals on each of the four pairs.

The Clock Recovery function shall provide clocks suitable for signal sampling on each line so that the LDPC FER indicated in 55.4.2.4 is achieved. The received clock signal should be stable and ready for use when training has been completed (loc_rcvr_status=OK). The received clock signal is supplied to the PMA Transmit function by received_clock.

55.4.3 MDI

Communication through the MDI is summarized in 55.4.3.1 and 55.4.3.2.

55.4.3.1 MDI signals transmitted by the PHY

The symbols to be transmitted by the PMA on the four pairs BI_DA, BI_DB, BI_DC, and BI_DD are denoted by tx_symb_vector[BI_DA], tx_symb_vector[BI_DB], tx_symb_vector[BI_DC], and tx_symb_vector[BI_DD], respectively. The modulation scheme used over each pair is 1DSQ128. PMA Transmit generates a pulse-amplitude modulated signal on each pair in the following form:

$$b_i = M(a_i + \sum_{k=1}^{16} b_{i-k} c_k) \quad (55\text{–}4)$$

$$s(t) = \sum_{k=0}^{\infty} b_k h_1(t - kT) \quad (55\text{–}5)$$

where 'M(x) = (x + 16) mod32 - 16' of a real number x, is defined as a value in the interval $-16 \le x < 16$ such that 'M(x) = x + 32m', for some integer m. In equations 55-4 and 55-5, a_i represents the 1DSQ128 symbol from the set {-15, -13, -11, -9, -7, -5, -3, -1, 1, 3, 5, 7, 9, 11, 13, 15} to be transmitted at time iT, c_k denotes the THP coefficients, and $h_1(t)$ denotes the system impulse response at the MDI. There are 16 THP coefficients per pair, and each coefficient is represented as an 8-bit value as described in 55.4.2.5. The values of the programmable THP coefficients are exchanged in the InfoField during startup. The THP filter coefficients shall be fixed after startup.

The nominal power (denoted Ptx) and the impulse response of the PMA Transmit signal $s(t)$, shall comply with the electrical specifications given in 55.5. When the link segment does not experience the maximum IL, each transceiver indicates to the link partner that the link partner PMA Transmit signal shall be reduced in increments of 2 dB. The minimum power backoff levels are described in the power backoff schedule in Table 55–6. If a given receiver has sufficient decision point SNR margin it may choose to request from the link partner larger power backoff than shown in Table 55–6 up to 14 dB. The PMA transmit shall be capable of 8 power backoff settings in approximately 2 dB steps. The difference between each consecutive power setting shall be 2 +/- 0.25 dB, and each step shall be centered at 2 × n dB (n=0 to 7) reduction from nominal, with a maximum error of +/- 1 dB.

The received signal power at the MDI, *P* (dBm), in Table 55–6, should be the estimate of the average received power across all four pairs from the remote transmitter when the link partner PMA transmit is at nominal power (after accounting for local transmitter power). If the remote transmitter is not at nominal power during the measurement, the estimate of the received power should be incremented by the amount of power backoff of the link partner transmitter during the measurement. Nominal power refers to the transmit power without any power backoff and is specified in 55.5.3.4. The estimate of the received signal power is stored in registers 1.141-1.144 as described in 45.2.1. The values in the Length (m) column in Table 55–6

are for reference only (not required for power backoff evaluation) and have been computed using the scaled insertion loss equation in 55.7

Table 55–6—Power backoff schedule

Received signal power at MDI, *P* (dBm)	Length(m) (reference)	Minimum power backoff (dB)
-1.1 <P	0 to 35	10
-2.3 < P <= -1.1	35 to 45	8
-3.3 < P <= -2.3	45 to 55	6
-4.2 < P <= -3.3	55 to 65	4
-5.0 < P <= -4.2	65 to 75	2
P<= -5.0	> 75	0

55.4.3.2 Signals received at the MDI

Signals received at the MDI can be expressed for each pair as pulse-amplitude modulated signals that are corrupted by noise as follows:

$$r(t) = \sum_{k=0}^{\infty} a_{k,\,agmt} h_2(t - kT) + w(t) \qquad (55\text{–}6)$$

In this equation $a_{k,agmt}$ represents the augmented DSQ128 constellation elements by the transmit M(x) function described in 55.4.3.1, $h_2(t)$ denotes the impulse response of the overall channel between the transmit symbol source and the receive MDI and $w(t)$ is a term that represents the contribution of various noise sources. The four signals received on pairs BI_DA, BI_DB, BI_DC, and BI_DD will be processed within the PMA Receive function to yield the received symbols rx_symb_vector.

55.4.4 Automatic MDI/MDI-X Configuration

Automatic MDI/MDI-X Configuration is intended to eliminate the need for crossover cables between similar devices. Automatic MDI/MDI-X configuration is required for 10GBASE-T devices and shall comply with 40.4.4.1 and 40.4.4.2.

Having established MDI/MDI-X configuration, the receiver shall detect and correct for several configurations of pair swaps and crossovers and arbitrary polarity swaps. The receiver pairs BI_DA, BI_DB, BI_DC and BI_DD might be connected to the corresponding transmit pairs in any of the following ways with arbitrary polarity:

a) No crossover
b) A/B crossover only
c) C/D crossover only
d) A/B crossover and C/D crossover

55.4.5 State variables

55.4.5.1 State diagram variables

coeff_exchange_done
: This variable reports that both transceivers have received the corresponding coefficients from the link partner.
Values: TRUE: The coefficient exchange has completed.
FALSE: The coefficient exchange has not completed.

config
: The PMA shall generate this variable continuously and pass it to the PCS via the PMA_CONFIG.indication primitive.
Values: MASTER or SLAVE

link_control
: This variable is defined in 28.2.6.2.

link_status
: The link_status parameter set by PMA Link Monitor and passed to the PCS via the PMA_LINK.indication primitive.
Values: OK or FAIL

loc_rcvr_status
: Variable set by the PMA Receive function to indicate correct or incorrect operation of the receive link for the local PHY.
Values: OK: The receive link for the local PHY is operating reliably.
NOT_OK: Operation of the receive link for the local PHY is unreliable.

loc_SNR_margin
: This variable reports whether the local device has sufficient SNR margin to continue to the next state. The criterion for setting the parameter loc_SNR_margin is left to the implementor.
Values: OK: The local device has sufficient SNR margin.
NOT_OK: The local device does not have sufficient SNR margin.

master_transition_counter
: This variable reports the current value of the MASTER's transition counter reported in the InfoField defined in 55.4.2.5.
Values: 0 to 2^{10} - 1

MessageField_IF
: This variable reports that a receiver has successfully received and decoded the InfoField from the remote device. This variable takes on the value contained in the Message Field. If the Message Field cannot be decoded or no explicit action is outstanding the value Null is returned.
Values: trans_to_Fine_Adjust, trans_to_PCS_Test or Null

PBO
: PBO is a variable that can take any integer value from 0 to 7 and indicates the power backoff level. Denoting Ptx as the maximum nominal power, the PBO values are:
Values: 0, 1, 2, 3, 4, 5, 6, 7, which correspond to transmit power levels of *Ptx*, *Ptx*-2 dB, *Ptx*-4 dB, *Ptx*-6 dB, *Ptx*-8 dB, *Ptx*-10 dB, *Ptx*-12 dB, *Ptx*-14 dB respectively

PBO_next

PBO_next is a variable that can take any integer value from 0 to 7 and indicates the next power backoff level to be used at the local transmitter. The value is taken from the fixed set of values during PMA_Training_Init_M and PMA_Training_Init_S as described in 55.4.2.5. The value is taken from the decoded value of the link partner InfoField during PMA_PBO_Exch

Values: 0, 1, 2, 3, 4, 5, 6, 7, which correspond to transmit power levels of *Ptx*, *Ptx*-2 dB, *Ptx*-4 dB, *Ptx*-6 dB, *Ptx*-8 dB, *Ptx*-10 dB, *Ptx*-12 dB, *Ptx*-14 dB respectively

PBO_tx

PBO_tx is a variable that can take any integer value from 0 to 7 and indicates the power backoff level currently used at the local transmitter.

Values: 0, 1, 2, 3, 4, 5, 6, 7, which correspond to transmit power levels of *Ptx*, *Ptx*-2 dB, *Ptx*-4 dB, *Ptx*-6 dB, *Ptx*-8 dB, *Ptx*-10 dB, *Ptx*-12 dB, *Ptx*-14 dB respectively

PBO_exchange_done

This variable reports that both transceivers have received the corresponding PBO levels from the link partner.

Values: TRUE: The PBO exchange has completed.
FALSE: The PBO exchange has not completed.

rem_rcvr_status

Variable set by the PCS Receive function to indicate whether correct operation of the receive link for the remote PHY is detected or not.

Values: OK: The receive link for the remote PHY is operating reliably.
NOT_OK: Reliable operation of the receive link for the remote PHY is not detected.

THP_next

THP is a variable that contains sixteen 8 bit values and describes the next transmitter setting of the THP coefficients. It refers to the programmable THP coefficients selected during coefficient exchange described in 55.4.2.5.

Values: 16 coefficients of 8 bit values each. Range is -2.0 to 1.984375 in steps of 0.015625

THP_tx

THP is a variable that contains sixteen 8 bit values and describes the current transmitter setting of the THP coefficients. It refers to the programmable THP coefficients selected during coefficient exchange described in 55.4.2.5.

Values: 16 coefficients of 8 bit values each. Range is -2.0 to 1.984375 in steps of 0.015625

trans_to_Coeff_Exch

Message field variable defined in 55.4.2.5 that flags a transition by the local device to the PMA_Coeff_Exch state.

Values: 1: The local device will transition to the PMA_Coeff_Exch state.
0: The local device will not transition to the PMA_Coeff_Exch state.

trans_to_Fine_Adjust

Message field variable defined in 55.4.2.5 that flags a transition by the local device to the PMA_Fine_Adjust state.

Values: 1: The local device will transition to the PMA_Fine_Adjust state.
0: The local device will not transition to the PMA_Fine_Adjust state.

trans_to_PCS_Test

Message field variable defined in 55.4.2.5 that flags a transition by the local device to the PCS_test state.

Values: 1: The local device will transition to the PCS_test state.
0: The local device will not transition to the PCS_test state.

transition_count

This variable reports the value of the transition counter contained in the InfoField sent to the remote device. Transition_count must comply with the state diagram description given in 55.4.6.2. When the message field contains a flag for a state transition, the transition counter will denote the remaining number of InfoField until the next state transition. The MASTER initiates the transition to PMA_Coeff_Exch count with the "trans_to_Coeff_Exch" flag and a counter value of 2^9 (10 ms). The SLAVE responds prior to the counter reaching 2^6 (1 ms) with the same flag and a count value matching the MASTER. Then both PHY's will transition to PMA_Coeff_Exch within one PMA frame. The same sequence is performed in the transition to PMA_Fine_Adjust state and PCS_Test state using the "trans_to_Fine_Adjust" and "trans_to_PCS_Test" flags respectively.
When the message field does not contain a flag for a state transition, the transition counter will be set to zero and ignored by the receiver.
Values: 0 to 2^{10}-1

tx_mode

PCS Transmit sends code-groups according to the value assumed by this variable.
Values: SEND_N: This value is continuously asserted when transmission of sequences of code-groups representing a XGMII data stream take place.

SEND_T: This value is continuously asserted when transmission of sequences of code-groups representing the sequences of code-groups (TAn, TBn, TCn, TDn) defined in 55.3.4.2 is to take place.

SEND_Z: This value is asserted when transmission of zero code-groups is to take place.

55.4.5.2 Timers

All timers operate in the manner described in 14.2.3.2.

maxwait_timer

A timer used to limit the amount of time during which a receiver dwells in the SILENT and TRAINING states. The timer shall expire 2000 ms ± 10 ms after being started. This timer is used jointly in the PHY Control and Link Monitor state diagrams. The maxwait_timer is tested by the Link Monitor to force link_status to be set to FAIL if the timer expires and loc_rcvr_status is NOT_OK. See Figure 55–24 and Figure 55–27.

minwait_timer

A timer used to determine the minimum amount of time the PHY Control stays in the SILENT, PMA_Training_Init_S, PCS_Test and PCS_Data states. The timer shall expire 1 ms ± 0.1 ms after being started.

55.4.5.3 Functions

Exchange_Final_PBO

This function transmits and receives the final PBO settings using the InfoField as described in 55.4.2.5.

Exchange_THP_Coefficients

This function compiles and sends to the link partner and receives from the link partner the desired programmable THP coefficients using the InfoField as described in 55.4.2.5.

55.4.6 State Diagrams

55.4.6.1 PHY Control state diagram

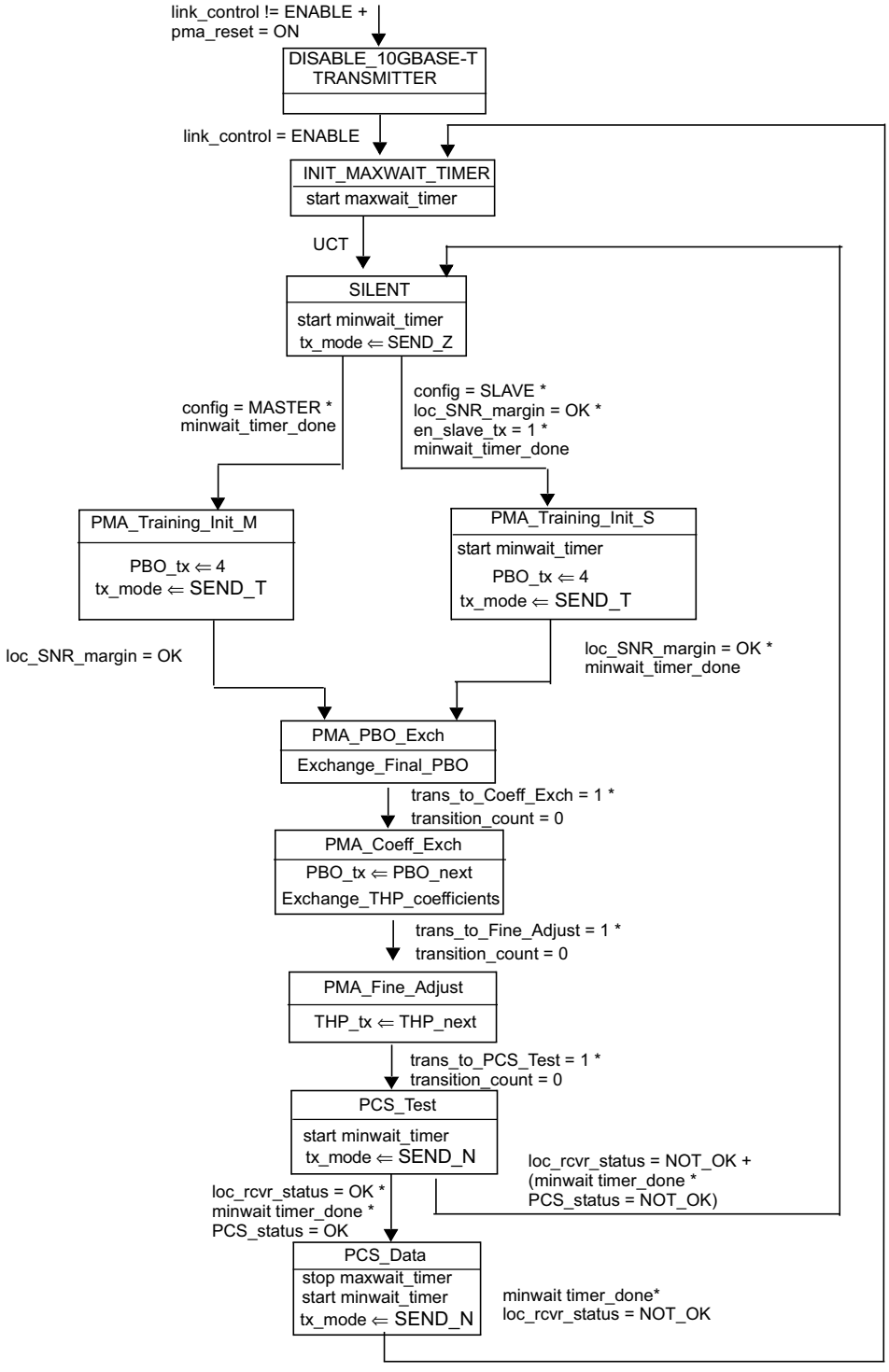

Figure 55–24—PHY Control state diagram

55.4.6.2 Transition Counter state diagrams

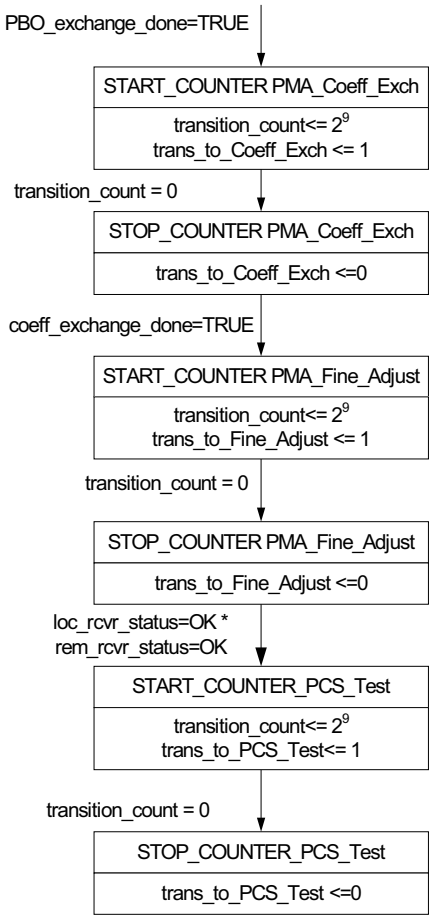

Figure 55–25—MASTER Transition counter state machine