The PMA couples messages from the PMA service interface specified in 168.3.1 onto the 10BASE-T1M physical medium. The PMA provides half duplex communications to and from the medium. The interface between PMA and the baseband medium is the Medium Dependent Interface (MDI), which is specified in 168.8.

168.4.1 PMA Reset function

The PMA Reset function shall be executed whenever one of the two following conditions occur:

— Power on (see 36.2.5.1.3).
— The receipt of a request for reset from the management entity.

The PMA Reset function carries out the following tasks:

— PMA Transmit output is set to high-impedance state.
— PMA_UNITDATA.indication is cleared.

168.4.2 PMA Transmit function

During transmission, PMA_UNITDATA.request conveys the tx_sym variable to the PMA. The value of the tx_sym variable is sent over the single balanced pair of conductors, BI_DA.

The tx_sym variable is a 5B symbol, to be encoded LSB first, using DME rules defined below:

If the tx_sym parameter value is the special 5B symbol 'I', the PMA shall, in the following order:

a) Transmit an additional DME encoded 0 if the previous value of the tx_sym parameter was anything but the 5B symbol 'I'.
b) Present the minimum impedance described in 168.8.2 at the MDI. This shall happen within 40 ns after the additional DME encoded 0 has been transmitted.

Editor's Note (to be removed before Working Group Ballot):

This specification either needs to be changed to reflect maintaining the TCI RL specification approach, or a minimum impedance at the PMA port needs to be added to 168.8.

If tx_sym value is anything other than 'I', the following rules apply:

— A "clock transition" shall always be generated at the start of each bit.
— A "data transition" in the middle of a nominal bit period shall be generated if the bit to be transmitted is a logical '1'. Otherwise, no transition shall be generated until the next bit.

168.5.4.4.1 Upper PSD

$$\text{UpperPSD}(f) = \begin{Bmatrix} -61 & 0.3 \le f < 15 \\ -40 - 1.4f & 15 \le f < 25 \\ -75 & 25 \le f \le 40 \end{Bmatrix} \text{ dBm/Hz} \quad (168\text{–}1)$$

where

f is the frequency in MHz; $0.3 \le f \le 40$

Lower PSD

$$\text{LowerPSD}(f) = \begin{Bmatrix} -87 + 2f & 5 \le f < 10 \\ -47 - 2f & 10 \le f \le 15 \end{Bmatrix} \text{ dBm/Hz} \quad (168\text{–}2)$$

where

f is the frequency in MHz; $5 \le f \le 15$

168.5.4.4.2 PSD mask

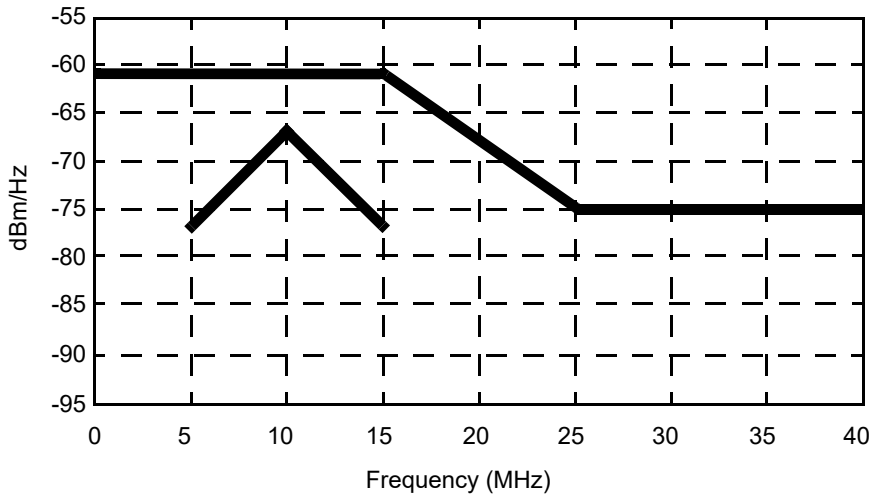

Figure 168–15—PSD upper and lower limits

168.5.4.5 Transmitter high impedance mode

Editor's Note (to be removed at draft 0.6):

This was changed from 'shall present the minimum' in clause 147 to "shall present at least the minimum" for clarity. No change in requirement was meant.

In test mode 4, a transmitter shall present at least the minimum parallel impedance across the MDI attachment points as specified in 168.8.2.

168.6 Management interface

10BASE-T1M uses the management interface as specified in ~~Clause 45~~Clause 45. The ~~Clause 45~~Clause 45 MDIO electrical interface is optional. Where no physical embodiment of the MDIO exists, provision of an equivalent mechanism to access the registers is recommended.

168.7 Mixing segment characteristics

10BASE-T1M PHYs are designed to operate over media that meet the requirements specified in this subclause. The 10BASE-T1M mixing segment (1.4.331) is a single balanced pair of conductors that may have more than two MDIs attached.

~~Figure 168–18 shows an example mixing segment with reference points. The mixing segment specificationsin 168.7 are referenced to these designated points and are to be met without the MDI or other loads attached. The mixing segment specifications are based on a trunk-stub configuration. Other configurations may be possible, provided they meet the electrical parameters in this 168.7. The example configuration assumes that the trunk comprises TBD m of 1.02 mm (18 AWG) 100 Ω cabling and the stubs are 100 Ω balanced pairs of conductors up to 30 cm long. The trunk is terminated at each end into 100 Ù, at a point designated the 'edge termination'. One end of the stub is designated the trunk connection (TC) and the other designated the 'MDI attachment point'.~~

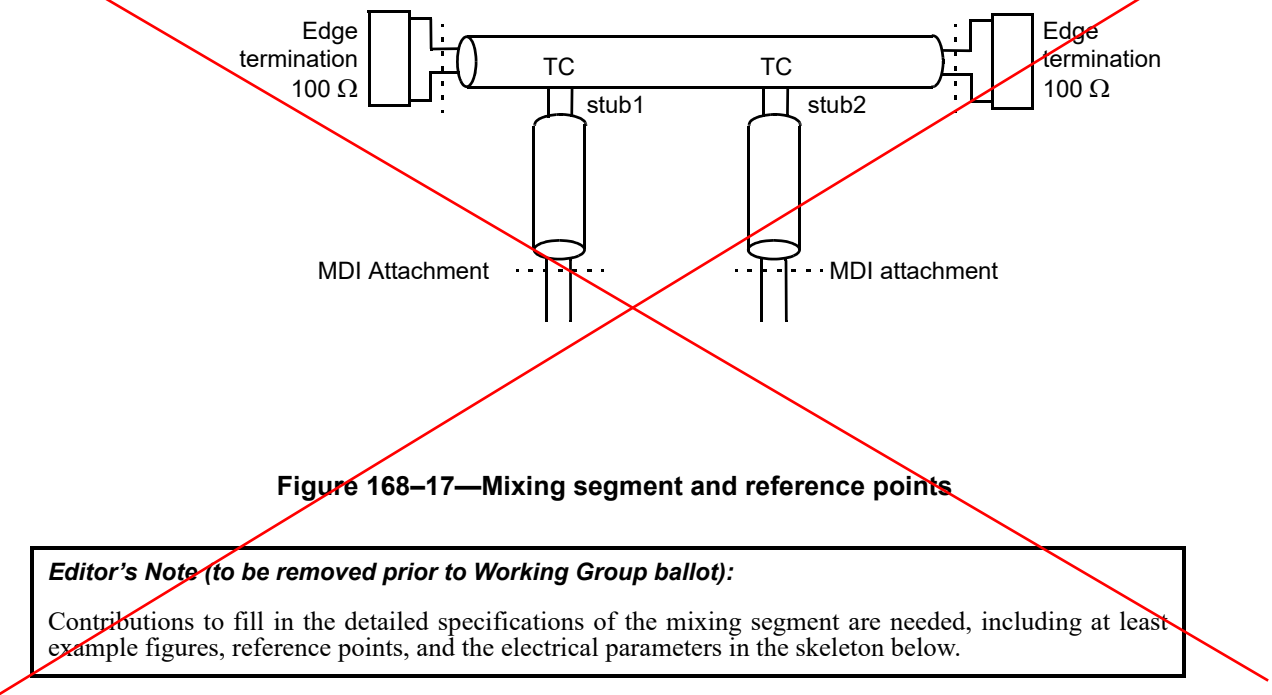

Figure 168–17—Mixing segment and reference points

Editor's Note (to be removed prior to Working Group ballot):

Contributions to fill in the detailed specifications of the mixing segment are needed, including at least example figures, reference points, and the electrical parameters in the skeleton below.

The mixing segment shall be a linear topology, with DTE attached at a TCI, where the TCI has two connections, one facing the direction of each edge termination. The Trunk Connection Interface (TCI) connects the left and right sides of the mixing segment together and has a third port to attach the PMA at the MDI attachment point (see 168.7). The TCI is part of the mixing segment, and the requirements of 168.7 are met with TCIs in place with or without attached MDIs as specified for the particular specification.

A TCI may be a "T" type connector to provide a means of connecting the segments of balanced conductors and attaching the PMA of a DTE to the trunk. The connection is specified so as not to disturb the transmission line characteristics of the trunk conductor significantly, except for the increased insertion loss

when loaded with a PMA. TCIs with compensation are expected to be matched to a particular DTE/PMA implementation, including any associated stub or service loop.

Figure 168–18 shows an example mixing segment with reference points. The mixing segment specifications in 168.7 are referenced to these designated points and are to be met without the MDI or other loads attached. The mixing segment specifications provide for a trunk-stub configuration, extended from the TCI. The electrical parameters in 168.7 include any trunk connection interface (TCI) connecting the left and right sides of the mixing segment, but do not include any external connection such as a stub or service loop from the TCI to the DTE hardware. The example trunk comprises TBD m of 1.02 mm (18 AWG) 100 Ω cabling, with a TCI at each location that a DTE may attach. The TCI is part of the mixing segment, and the requirements of 168.7 are met with TCIs in place with or without attached DTEs as specified for the particular specification. See 168.8 for further definition and description of the TCI. The trunk is terminated at each end into 100 Ω, at the point designated the 'edge termination'.

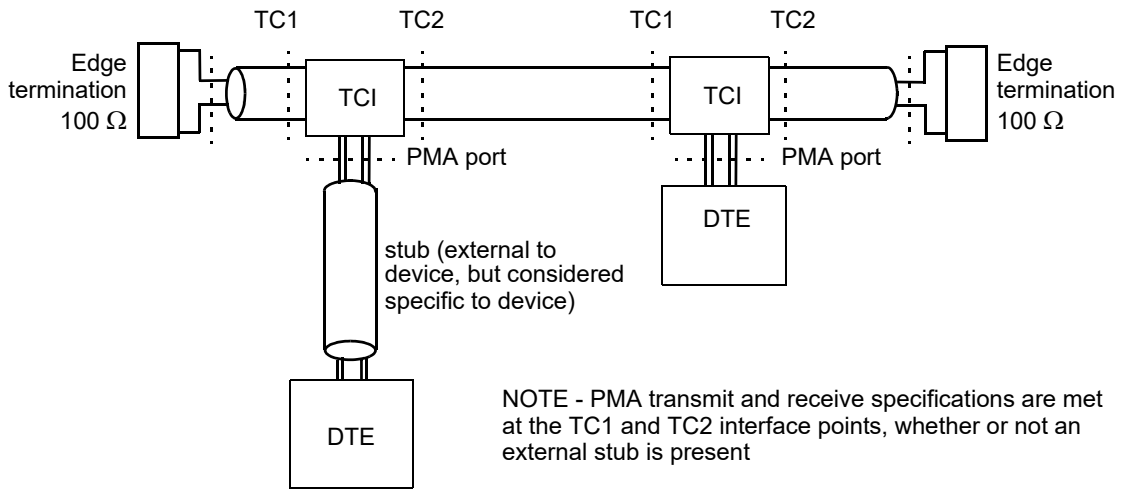

Figure 168–18—Mixing segment and reference points

Editor's Note (to be removed prior to Working Group ballot):

Contributions to fill in the detailed specifications of the mixing segment are needed, including at least the electrical parameters in the skeleton below.

168.7.1 Insertion ~~loss and delay~~loss

~~The mixing segment insertion loss is specified by independently meeting the requirements specified in this section for trunks and stubs. The stub time delay is specified to limit reflective resonances.~~

The mixing segment insertion loss is specified including any through-path insertion loss for the TCIs. See 168.8.2 for specification of the insertion loss and return loss (reflections) at the TCI interfaces.

The mixing segment insertion loss, without ~~the MDI~~ any PMAs or other loads attached, shall meet the values determined using Equation (168–3) between edge termination attachment points. The reference impedance is 100 Ω.

$$IL(f) \leq TBD \text{ dB}, \quad 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz} \qquad (168–3)$$

..

Editor's Note (to be removed prior to Working Group ballot):

Consider insertion loss equation (147-3) as a starting point.

~~The insertion loss of each stub, between MDI attachment point and trunk connection point (TC), shall meet the values determined using Equation (168–4). The reference impedance is 100 Ω.~~

$$~~IL(f) \leq 0.15 \text{ dB}, \quad 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz}~~ \tag{168–4}$$

~~The time delay of each stub, between MDI attachment point and trunk connection point (TC), shall meet the values determined using Equation (168–5) at a frequency of 10 MHz. The reference impedance is 100 Ω.~~

$$~~\text{time delay} \leq 1.6 \text{ ns}~~ \tag{168–5}$$

168.7.2 Return loss

The mixing segment at ~~any MDI attachment point~~each TCI PMA port, without ~~the MDI~~ a PMA or other loads attached, shall meet the return loss values determined using Equation (168–6). The reference impedance is 50 Ω.

$$RL(f) \geq TBD \text{ dB}, \quad 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz} \tag{168–6}$$

The mixing segment edge terminations, without ~~the MDI~~ a PMA or other loads attached, shall meet the return loss values determined using Equation (168–7). The reference impedance is 100 Ω.

$$RL(f) \geq TBD \text{ dB}, \quad 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz} \tag{168–7}$$

.

Editor's Note (to be removed prior to Working Group ballot):

Consider 147.7.2 return loss equation(147-4) as starting point.

168.7.3 Mode conversion loss

TBD

Editor's Note (to be removed prior to Working Group ballot):

This section requires contributions to specify which mode conversion measurements (e.g., TCL, TCTL, ELTCTL) are made at which points - at or between MDI attachment points, and at or between edge connections. Example text which might be improved may be found in IEEE Std 802.3-2022 at 147.8.3. Contributions are solicited, and may also consider 146.7.1.4 through 146.7.1.6, 97.6.1.4, and IEEE Std 802.3ck-2022.

168.7.4 Coupling attenuation

Editor's Note (to be removed prior to Working Group ballot):

Contributions are encouraged to explore the ramifications of using shielded cabling on multidrop mixing segments.

The coupling attenuation requirement applies to shielded mixing segments and depends on the electromagnetic noise environment. The requirements in Table 168–3 shall be met based on the local environment as described by the electromagnetic classifications given in Table 146–7, E1, E2, or E3.

Table 168–3—Coupling attenuation

Frequency (MHz)	(dB)		
	E_1	E_2	E_3
TBD to **TBD**	≥ **TBD**	≥ **TBD**	≥ **TBD**

168.8 ~~MDI~~ TCI specification

~~***Editor's Note (to be removed prior to Working Group ballot):***~~

~~Contributions and baselines are needed to fill out the MDI connector and the electrical specification in the subclauses here. See 802.3cg clause 147 for example text.~~

Editor's Note (to be removed prior to Working Group ballot):

Contributions and baselines are needed to fill out the TCI electrical specification in the subclauses here.

~~168.8.1 MDI connectors~~

The interface of the Clause 168 PHY to the mixing segment is called the Trunk Connection Interface (TCI). While technically it aligns with the definition of an MDI in 1.4.395, the fact that the TCI has two ports to the medium and plays a role in mixing segment specifications by connecting the left and right sides of the linear mixing segment mandates it has a unique role beyond what is normally considered in an MDI.

Each TCI has two interfaces and a four-wire interface connecting to the DTE (and any associated stub or service loop) at the TCI's PMA port. as shown in Figure 168–19.

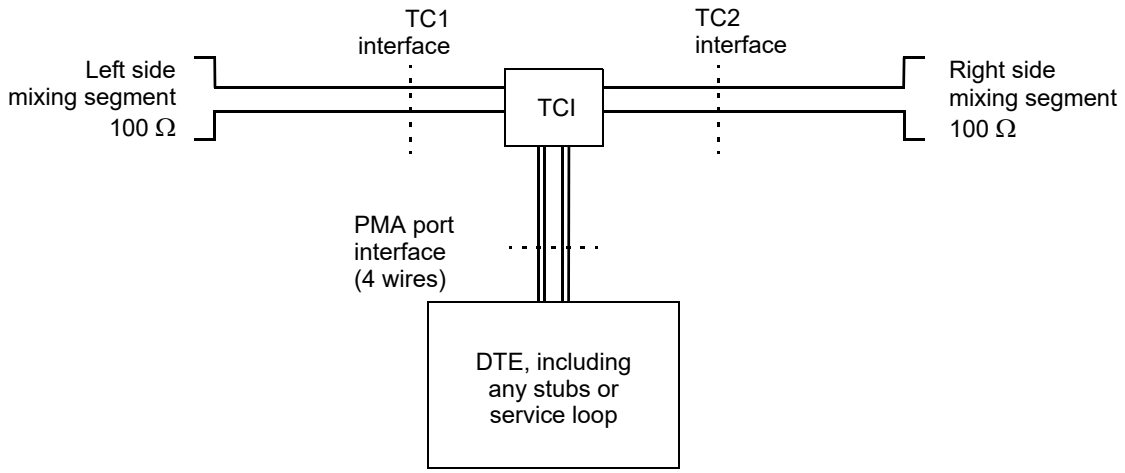

Figure 168–19—TCI ports and connections

The through connection from the left side to the right side of the mixing segment occurs through the TCI, but practically, when a DTE is connected this may be implemented by breaking the path at the TCI and completing the electrical path within the DTE. A TCI may be a "T" type connector to provide a means of connecting the segments of balanced conductors and attaching a PMA to the mixing segment.

The connections of the TCI are specified so as not to disturb the transmission line characteristics of the mixing segment conductor significantly, except for the increased insertion loss when loaded with a PMA. TCIs with compensation are expected to be matched to a particular PMA.

The TCI may be an adapter separate from the DTE's PMA assembly or the TCI and the PMA of the DTE may be located within a single assembly. The latter configuration presents a negligible stub length when the PMA attachment is open circuit. Either configuration may include compensation engaged when a PMA or PMA load is attached.

168.8.2 ~~MDI~~ TCI electrical specification

168.8.2.1 TCI Insertion Loss

Without a PMA or PMA loading present, the differential insertion loss of the TCI between ports TC1 and TC2 shall be less than TBD dB *(ed note - small number)* from 0.3 to 40 MHz, in each direction, measured into 100 Ω.

With the PMA (or PMA load specified for the TCI) present at the PMA port, the differential insertion loss of the TCI between the trunk ports shall be less than TBD dB *(ed note - allows for compensation and phy loading –may be an equation)* from 0.3 to 40 MHz, in each direction, measured into 100 Ω.

168.8.2.2 TCI Return Loss

Without a PMA (or PMA load specified for the TCI) present at the PMA port, the return loss of the TCI at ports TC1 and TC2 shall be greater than Equation (168–8) with the other trunk port terminated in 100 Ω. NOTE – this is to allow meeting the unloaded mixing segment RL specification at 168.7.2.

$$RL(f) \geq TBD \text{ dB}, \ 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz} \quad (168\text{–}8)$$

With a PMA or PMA load present at the TCI attachment, the return loss of the TCI at port TC1 and TC2 shall be greater than Equation (168–9) with the other trunk port terminated in 100 Ω. NOTE -this specification replaces the MDI return loss and is measured at the TCI.

$$RL(f) \geq TBD \text{ dB}, \ 0.3 \text{ MHz} \leq f \leq 40 \text{ MHz} \quad (168\text{–}9)$$

168.8.3 ~~MDI~~ TCI line powering voltage tolerance

The DTE shall withstand without damage the application of any voltages between 0 V dc and 60 V dc with the source current limited to 2000 mA, applied across the TCI's PMA port's BI_DA+ and BI_DA– in either polarity, under all operating conditions indefinitely.

168.8.4 ~~MDI~~ TCI fault tolerance

~~The wire~~ Each balanced pair of the ~~MDI~~ TCI shall withstand without damage the application of short circuits of any wire to the other wire of the same pair or ground potential, as per Table 168–4, under all operating conditions indefinitely. Normal operation shall resume after all short circuits have been removed.

Table 168–4—Fault conditions

BI_DA+	BI_DA–
BI_DA–	BI_DA+
Ground	No fault
No fault	Ground
Ground	Ground
+60 V dc	No fault
No fault	+60 V dc
+60 V dc	+60 V dc
Ground	+60 V dc
+60 V dc	Ground

168.9 Environmental specifications

Editor's Note (to be removed prior to Working Group Ballot):

Consider whether these specifications are aligned with the changes made in 802.3cr-2021, including Annex J.

168.9.1 General safety

All equipment subject to this clause is expected to conform to IEC 60950-1, IEC 62368-1, or IEC 61010-1. All equipment subject to this clause is expected to conform to all applicable local, state, national, and application-specific standards.