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## 188.5.3 PMA Receive function

**Table 188–2—DME timings** 1

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Parameter name** | **Description** | **Minimum value** | **Nominal value** | **Maximum value** | **Unit of measure** |
| T1 | Delay between transmissions | 480 | — | — | ns |
| T2 | Clock transition to clock transition | 80 - 100  ppm | 80 | 80 + 100  ppm | ns |
| T3 | Clock transition to data transition (data = 1) | 38 | 40 | 42 | ns |

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The 10BASE-T1M PMA Receive function comprises a single receiver (PMA Receive) for DME modulated 15

signals on a single balanced pair of conductors, BI\_DA. PMA Receive has the ability to translate the 16

received signals on the single balanced pair of conductors into the PMA\_UNITDATA.indication parameter 17

rx\_sym. It detects 5B symbols from the signals received at the TCI and presents these sequences to the PCS 18

Receive function. 19

20

The PMA Receive function recovers encoded clock and data information from the DME encoded stream 21

received at the TCI. The clock recovery provides a synchronous clock for sampling the signal on the pair. 22

While it may not drive the MII directly, the clock recovery function is the underlying source of RX\_CLK. In 23

order to meet the specifications of 188.6.6.1, the PMA and PCS Receive functions have at most 800 ns from 24

when the first DME symbol after SILENCE is detected to find the 5B boundary and to synchronize on the 25

DME stream respectively. 26

27

The PMA Receive function interprets the signals at the TCI using the inverse mapping described in 188.5.2 28

for the PMA Transmit function and transfers the 5B code groups by the means of the 29

PMA\_UNITDATA.indication. When the PMA Receive function does not detect a DME symbol on the line, 30

it shall convey the symbol 'I' (meaning SILENCE.) 31

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# PMA electrical specifications 33

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This subclause defines the electrical characteristics of the PMA for a 10BASE-T1M PHY. 35

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## Electrical isolation 37

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A PHY with a TCI that is an MPI (see 189.1.2) shall meet the isolation requirements defined in 189.6.2. 39

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* + 1. **EMC tests** 41

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Direct Power Injection (DPI) and 150  emission tests for noise immunity and emission as per 188.6.2.1 43

and 188.6.2.2 can be used to establish a baseline for PHY EMC performance. These tests provide a high 44

degree of repeatability and a good correlation to immunity and emission measurements. Operational 45

requirements of the transceiver during the test are determined by the manufacturer. 46

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Applications for the specified device commonly have additional requirements that limit its conducted radio 48

frequency emission and its susceptibility to electromagnetic interference. Such requirements are beyond the 49

scope of this standard. 50

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## 188.9.1.4 TCI fault tolerance 1

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Each balanced pair of the TCI shall withstand without damage the application of short circuits of any 3

conductor to the other conductor of the same pair or ground potential, as per Table 188–3, under all 4

operating conditions indefinitely. Normal operation shall resume after all short circuits have been removed. 5

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## Table 188–3—Fault conditions 8

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|  |  |
| --- | --- |
| **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 |

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# Environmental specifications 27

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## General safety 29

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Equipment subject to this clause shall conform to the general safety requirements in J.2 or IEC 61010-1, as

appropriate. 31

All equipment subject to this clause is expected to conform to all applicable local, state, national, and 32

application-specific standards. 33

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## Network safety 35

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All cabling and equipment subject to this clause is expected to be mechanically and electrically secure in a 37

professional manner. All 10BASE-T1M cabling is expected to be routed according to any applicable local, 38

state, or national standards considering all relevant safety requirements. In automotive applications, all 39

10BASE-T1M cabling is expected to be routed to provide maximum protection by the motor vehicle sheet 40

metal and structural components, following SAE J1292, ISO 14229, and ISO 15764. The designer is urged 41

to consult the relevant local, national, and international safety regulations to ensure compliance with the 42

appropriate requirements. 43

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## Environmental safety 45

46

This subclause sets forth a number of recommendations and guidelines related to safety concerns; this list is 47

neither complete nor does it address all possible safety issues. The designer is urged to consult the relevant 48

local, national, and international safety regulations to ensure compliance with the appropriate requirements. 49

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Systems described in this subclause are subject to various environmental hazards during their installation 51

and use. In particular, equipment used in automotive and industrial environments can expect to meet the 52

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potential environmental stresses with respect to their mounting location defined for the application. Stresses 1

expected in these environments may include but are not limited to those found in the listed specifications. 2

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The following specifications describe potential environmental stresses in an automotive environment: 4

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* General loads: ISO 16750-1 6
* Electrical loads: ISO 16750-2, ISO 7637-2, and ISO 8820-1 7
* Mechanical loads: ISO 16750-3, ASTM D4728, and ISO 12103-1 8
* Climatic loads: ISO 16750-4, and IEC 60068-2-1, IEC 60068-2-27, IEC 60068-2-30, 9

IEC 60068-2-38, IEC 60068-2-52, IEC 60068-2-64, and IEC 60068-2-78 10

* Chemical loads: ISO 16750-5 and ISO 20653 11

12

The following specifications define potential environmental stresses in an industrial environment: 13

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* Environmental loads: IEC 60529 and ISO 4892 15
* Mechanical loads: IEC 60068-2-6 and IEC 60068-2-31 16
* Climatic loads: IEC 60068-2-1, IEC 60068-2-2, IEC 60068-2-14, IEC 60068-2-27, 17

IEC 60068-2-30, IEC 60068-2-38, IEC 60068-2-52, and IEC 60068-2-78 18

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Additional environment(s) require careful analysis prior to implementation to determine appropriate 20

environmental safety requirements. 21

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## Electromagnetic compatibility 23

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A system integrating the 10BASE-T1M PHY is expected to comply with all applicable local and national 25

codes for electromagnetic compatibility. In addition, the system may need to comply with more stringent 26

requirements for the limitation of electromagnetic interference. 27

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# Delay constraints 43

The PHY shall comply with the timing requirements specified in Table 188–4. 45

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the network to comply with the other requirements while exceeding the unit load restrictions. This should be 1

done only by experienced installers or under engineering supervision. 2

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## 189.5.5.4 MPD Transmit Power Signature (TPS) 4

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TPS is a minimum current waveform reported by an MPD which allows an MPD to minimize its power 6

consumption while signaling the MPSE to continue transmitting power. 7

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An MPD that requires power from the MPI shall report a valid TPS at the MPI. An MPD that does not report 9

TPS within the limits of TTPSDO as defined in Table 189–5 may have its power removed. IMPI\_TPS, TTPS\_MPD, 10

and TTPSDO\_MPD, are defined in Table 189–10. 11

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TPS shall consist of current draw equal to or above IMPI\_TPS for a minimum duration of TTPS\_MPD followed 13

by an optional TPS dropout for no longer than TTPS\_MPD. 14

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## Table 189–10—MPD Transmit Power Signature (TPS) parameters 17

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|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Parameter** | **Symbol** | **Min** | **Max** | **Units** |
| 1 | MPD MPI current | IMPI\_TPS | 10 | - | mA |
| 2 | MPD TPS time | TTPS\_MPD | 7 | - | ms |
| 3 | MPD TPS dropout period | TTPSDO\_MPD | - | 310 | ms |

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# Additional electrical specifications 28

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This clause defines additional electrical specifications for a fully connected MPoE system (that is, MPSE, 30

cabling, one or more MPDs, and related PHYs) and therefore to each element of such a system. 31

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## MPI return loss 33

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When the MPI is a TCI, the TCI return loss at TC1 and TC2 shall meet the values determined using 35

Equation (188–7) with the other trunk TC (i.e., TC2 or TC1, respectively) terminated in 100  with a DTE 36

or simulated DTE load present at the TCI, plus 10log10(N\_load), where N\_load is the maximum number of 37

unit loads for the DTE. 38

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## Electrical distribution system compatibilty 40

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MPoE permits two approaches to electrical isolation of the MPI to allow MPoE to adapt to common power distribution systems encountered in the environments where MPoE is likely to be deployed. The first approach targets low-voltage systems that intentionally ground one conductor, such as a Protective Extra-Low Voltage (PELV) system. The second approach targets low-voltage systems that prohibit intentional grounding of any conductor, such as a Safety Extra-Low Voltage (SELV) system.

## Electrical distribution system types 1

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There are two electrical power distribution system types that require different approaches to grounding. They are as follows: 4

* **Isolated MPoE power distribution system:** A mixing segment that crosses ground references, the boundary between separate power distribution systems, or the boundaries of a single building. 9

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* **Grounded MPoEpower distribution system:** When a mixing segment, with all its associated interconnected equipment, shares a common, continuous ground.

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## Isolated MPoE requirements 15

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Isolated MPDs and MPSEs shall provide isolation between all accessible external conductors, including frame

ground (if any), and all MPI leads, including those not used by the MPD or MPSE. Any equipment that can

be connected to an MPSE or MPD through a non-MPI connector that is not isolated from the MPI leads

needs to provide isolation between all accessible external conductors, including frame ground (if any), and

the non-MPI connector. External accessibility to conductors is specified in Section 5.4.10.1 b) of

IEC 62368-1:2023.

Attachment of a mixing segment via an MPI of an MPD or MPSE that has multiple instances of an 17

MPI requires electrical isolation between each segment and the protective ground of the MPSE or MPD. 18

This electrical isolation shall meet the isolation requirements as specified in Annex J.1 with electrical 20

strength test c) details being replaced by: “An impulse test consisting of a 1500 V, 10/700 waveform, 21

applied 10 times, with a 60 s interval between pulses. The shape of the impulses is 10/700 (10 μs virtual 22

front time, 700 μs virtual time to half value)”, as defined in ITU-T Recommendation K.44. 23

24

An multiport MPSE does not require electrical power isolation between mixing segments. A multiport MPD or combination MPSE and MPD requires electrical power isolation between mixing segments. 29

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An Isolated MPSE shall switch the more negative conductor. It is allowed to switch both conductors.

## 189.6.2.1.2 Grounded MPoE requirements 1

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A Grounded MPSE or MPD does not require electrical power isolation between link segments and shall provide the means to connect the more negative conductor directly to ground.

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A Grounded MPSE shall switch the more positive conductor.

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## Fault tolerance 19

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MPDs tolerate 60 V in either polarity (see 188.9.1.3). 21

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MPSEs tolerate 60 V applied with specified polarity in 189.4.2. MPSEs tolerate ILIM for TLIM when 23

connected to the mixing segment in reverse polarity and the power source is another MPSE. 24

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# Environmental specifications 26

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## General safety 28

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Equipment subject to this clause shall conform to the general safety requirements in Annex J.2. In particular, 30

the MPSE shall be classified as a Limited Power Source in accordance with Annex Q of IEC 62368-1:2023, 31

as applicable. For automotive applications, systems described in this clause may be subject to additional 32

requirements; refer to ISO 26262. All equipment subject to this clause additionally may be required to 33

conform to any applicable local, state, or national standards related to safety, including national motor 34

vehicle standards related to safety. 35

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## Network safety 37

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This subclause sets forth a number of recommendations and guidelines related to safety concerns. The list is 39

neither complete nor does it address all possible safety issues. The designer is urged to consult the relevant 40

local, national, and international safety regulations to verify compliance with the appropriate requirements. 41

LAN cabling systems described in this clause are subject to at least four direct electrical safety hazards 42

during their installation and use. These hazards are as follows: 43

* a) Direct contact between LAN components and power, lighting, or communications circuits. 44
* b) Static charge buildup on LAN cabling and components. 45
* c) High-energy transients coupled onto the LAN cabling system. 46
* d) Voltage potential differences between safety grounds to which various LAN components are con- 47

nected. 48

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Such electrical safety hazards should be avoided or appropriately protected for proper network installation 50

and performance. In addition to provisions for proper handling of these conditions in an operational system, 51

special measures should be taken to verify that safety features are not negated during installation of a new 52

network or during modification of an existing network. 53

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## Installation and maintenance guidelines 1

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It is a mandatory requirement that sound installation practice, as defined by applicable local codes and 3

regulations, be followed in every instance in which such practice is applicable. In particular, users are 4

cautioned to be aware of the ampacity of cabling, as installed, and local codes and regulations, e.g., NFPA70 5

– the National Electrical Code® (NEC®) relevant to the maximum class supported. 6

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It is a mandatory requirement that, during installation of the cabling plant, care be taken to verify that non- 8

insulated network cabling conductors do not make electrical contact with unintended conductors or ground. 9

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All cabling and equipment subject to this clause is expected to be mechanically and electrically secured in a 11

professional manner. In automotive applications, all MPoE cabling should be routed in a way to provide 12

maximum protection by the motor vehicle sheet metal and structural components, following SAE J1292, 13

ISO 14229, and ISO 15764. 14

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## Patch panel considerations 16

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The current capacity of the MPSE should not exceed the current carrying capacity of a cabling cross- 18

connect. The designer should consult the manufacturers’ specifications to verify compliance with the 19

appropriate requirements. 20

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## Telephony voltages 22

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The use of building wiring brings with it the possibility of wiring errors that might connect telephony 24

voltages to an MPSE or MPD. Other than voice signals, the primary voltages that can be encountered are the 25

“battery” and ringing voltages. Although there is no universal standard, the following maximums generally 26

apply: Battery voltage to a telephone line is generally 56 V DC, applied to the line through a balanced 400 Ω 27

source impedance. Ringing voltage is a composite signal consisting of an AC component and a DC 28

component. The AC component is up to 175 Vp at 20 Hz to 60 Hz with a 100 Ω source resistance. The DC 29

component is 56 V DC with 300 Ω to 600 Ω source resistance. Large reactive transients can occur at the 30

start and end of each ring interval. Care should be taken to avoid such connections as they can damage 31

equipment. 32

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Application of any of the above voltages to the MPI of an MPSE or an MPD in non-automotive applications 34

shall not preclude conformance with 189.7.1 and 189.7.2. 35

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## Electromagnetic emissions 37

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The MPD and MPSE powered cabling link shall comply with applicable local and national codes for the 39

limitation of electromagnetic interference. 40

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In automotive applications, when tested according to CISPR 25 test methods, an MPoE system shall meet 42

the following motor vehicle EMC requirements: 43

1. Radiated/Conducted Emissions: CISPR 25, IEC 61967-1/4, and IEC 61000-4-21 44
2. Radiated/Conducted Immunity: ISO 11452, IEC 62132-1/4, and IEC 61000-4-21 45

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1. Electrostatic Discharge: ISO 10605 and IEC 61000-4-2/3 47
2. Electrical Disturbances: IEC 62215-3 and ISO 7637-2/3 48

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Exact test setup and test limit values may be adapted to each specific application. 50

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## 189.7.7 Temperature and humidity 1

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The MPD and MPSE powered cabling link segment is expected to operate over a reasonable range of 3

environmental conditions related to temperature, humidity, and physical handling. Specific requirements 4

and values for these parameters are beyond the scope of this standard. 5

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## 189.7.8 Labeling 7

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It is recommended that the MPSE or MPD (and supporting documentation) be labeled in a manner visible to 9

the user with at least the following parameters: 10

1. System type (i.e., “Type 0”, “Type 1”, or “Type 0/1”). 11
2. Port type (e.g., 10BASE-T1M, TIA Category, or ISO Class). 12

13

1. “MPSE” or “MPD” as appropriate. 14
2. MPoE distribution system compatibility type (e.g., Isolated or Grounded). 15
3. Maximum continuous power supplied or consumed in units of Watts. 16
4. Maximum current supply capacity or consumption in units of Amperes. 17

18

1. For MPDs only, unit loads for each compatible operating voltage range. 19
2. For Isolated MPoE MPSEs or MPDS, indicate any non-MPI connectors which are not isolated from the MPI leads.
3. Any applicable safety warnings. 21

Grounded MPSEs and MPDs permitted in 189.6.2.1.2 shall clearly indicate that it is only compatible with Grounded MPoE system. It should also indicate if the MPI(s) are internally grounded or intended to be grounded at an external connection point.