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Generic Requirements for Ethernet Media Converter

GR No. TEC/GR/TX/EMC-001/02/SEP-12
(Supersedes GR No.: GR/EMC-01/01.SEP.2006)

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History Sheet

Sl. No.	GR No.	Particulars	Remarks
1.	GR/EMC-01/01. SEP. 2006	GR for Ethernet Media Converter (EMC)	1st release
2.	TEC/GR/TX/EMC-001/02/ SEP-12	GR for Ethernet Media Converter (EMC)	Current release

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Applicable References

IEEE 802.3	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer
IEEE 802.3 u	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer
IEEE 802.3ah	Ethernet in First Mile
IEEE 802.3ab	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer
IEEE 802.1ad	Ethernet Bridging Standards
IEEE 802.1 p/q/d	
IEC Publication 479-1	Guide on the effects of current passing through the human body
IEC Publication 215	Safety requirements of radio transmitting equipments
IEC Publication 1000-4-2	Testing and measurement techniques of Electrostatic discharge immunity test
IEC Publication 1000-4-3	Radiated RF electromagnetic field immunity test
IEC Publication 1000-4-4	Testing and measurement techniques of electrical fast transients/burst immunity test
IEC Publication 1000-4-6	Immunity to conducted disturbances
IS 8437 {1993}	Guide on the effects of current passing through the human body
IS 13252 {1993}	Safety of information technology equipment including electrical business equipment
TMF 814, TMF 608, TMF 513	TMN Forum Management Standards

Equivalence of EMC standards

IEC/CISPR	Euro Norm
CISPR22	EN55022
IEC61000-4-2	IEC61000-4-2
IEC61000-4-3	IEC61000-4-3
IEC61000-4-4	IEC61000-4-4
IEC61000-4-5	IEC61000-4-5
IEC61000-4-6	IEC61000-4-6

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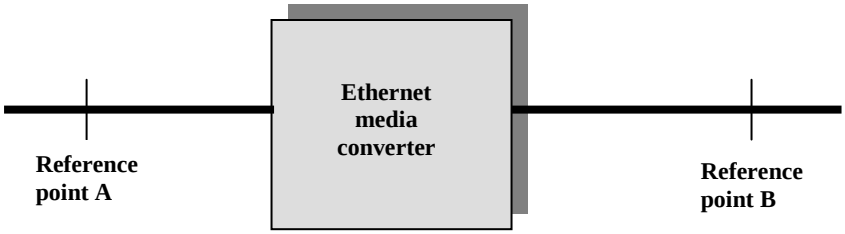
PART I: TECHNICAL REQUIREMENTS

1.0 Introduction

The Ethernet Media Converter is a device that converts an electrical Ethernet interface into an optical interface for transmission over optical-fibre cable (and vice-versa) and/or works as optical wavelength converter where a multimode optical Ethernet interface is converted to a single-mode interface and vice-versa, depending upon the network applications and requirements. A broad schematic for illustration purpose is given in Fig. 1. Based on various network applications, various Categories and Types of Media Converters have been identified and specified in the GR.

Such media converter is commonly used to extend transport reach for Ethernet traffic between two end points using single-mode or multi-mode optical fibre cable, as applicable, beyond the reach possible on copper pairs.



Note: The interface options for reference point 'A' and 'B' may be- 10/100BaseTX Fast Ethernet on copper and 100BaseFX/LX Fast Ethernet and 1000BaseSX/LX/LX-10/PX-20 GigE on fibre. The ports of media converter may be used for any of the directions of transmission – UNI or NNI.

Figure-1: A broad schematic for Ethernet media converter

2.0 Media conversion support

The following six 'types' of media converters are envisaged in the GR for the media conversion where wavelength translation is required:

a. **Type I**

10/100BaseT electrical interface to 100BaseFX (per IEEE 802.3) multi-mode interface and vice versa, as per purchaser's requirements.

Four models are envisaged based on the reach requirements:

1. **Model A:** 2 kilometers nominal distance
2. **Model B:** 15 kilometers maximum distance
3. **Model C:** 40 kilometers maximum distance
4. **Model D:** 80 kilometers maximum distance.

b. **Type II**

10/100BaseT (per IEEE 802.3) electrical interface to 100BaseLX (per IEEE 802.3ah) single-mode interface and vice versa.

c. **Type III**

100BaseFX (per IEEE 802.3) multimode interface to 100BaseLX (per IEEE 802.3ah) single-mode interface and vice versa.

d. **Type IV**

1000BaseSX multimode interface to 1000BaseLX interface and vice-versa.

e. **Type V**

1000BaseSX multimode interface to 1000BaseLX-10 interface and vice-versa.

f. **Type VI**

1000BaseSX multimode interface to 1000BasePX-20D/U interface and vice-versa.

The purchaser shall specify exact requirements for various '*Types'* of media converters, as above.

3.0 Media converter categories

The GR envisages two broad Categories of media converters. Both Categories of media converters shall support various 'types' of models for 10/100BaseT and 1000BaseT interface options. The purchaser shall specify the exact such requirements.

Category-I: Such media converter shall be a rack-mountable configuration mainly for central office (CO) deployment. It shall be chassis-based equipment with multiple IO cards

with single or multiple Ethernet interfaces per card. Options shall be provided for various media conversion/translation application as detailed in Clause 2.0 above. The system design shall support a mix or various Types of IO cards equipped in the equipment. The purchaser shall be free to specify number of cards per chassis and no. of Ethernet ports of specific Ethernet UNI and NNI interfaces per such card.

Category II: Such media converter shall be a compact standalone device for customer premise applications. Models shall be provided for various media conversation/translation as detailed in Clause 2.0 above.

3.1 Details of Category I & II Media Converters

Both Category I & II media converters shall be centrally managed through SNMPv2/3 or Telnet remote management interfaces using Command Line Interface (CLI) or Graphical User Interface (GUI).

a. **Category I (Rack-mounted model):** The rack-mounted model shall fit into a 19" standard rack and shall accommodate at least 21 nos. of media converter per rack. This model shall be generally used at Central Office and hence shall be working on -48V exchange power supply. The equipment shall be able to power on from a voltage source having nominal voltage of -48 volt DC with a voltage variation between -40 to -60 volts. This model shall support Ethernet (RJ45) port or RS232 serial port for connectivity to remote management system as well as to a Local Craft Terminal. From the management perspective, there shall be cascading port to support the control of multiple chasses in a rack through a system supplied shall manage at least 500 such media converter from centralized locations or as specified by purchaser.

There might be separate cards for different media converter Types as identified in Clause 2.

b. **Category II – Standalone model:** This type of media converter shall be used at customer-end and shall work on 230V AC mains. The module shall work for voltage range of 180 to 290 volts, with frequency range of 50 Hz +/- 2 Hz. The stand-alone Media Converter shall have built-in power supply arrangements and no external power module shall be permitted. The purchaser may however convey DC operation requirements. This model shall support Ethernet (RJ45) port or RS232 serial port for connectivity to remote management system as well as to Local Craft Terminal. The management system supplied shall manage at least 100 such Media Converters from centralized locations or as specified by purchaser. (*The Cat.I device is chassis driven equivalent to 21 stand-alone Cat.II devices).*

4.0 Functional requirements

4.1 General features

Use of Small-Form Pluggable Optics (SFP) and Gigabit Interface Converter (GBIC) is recommended for ease of maintenance in both the 'Categories' of Media Converters; however hard-wired optical interfaces may also be accepted by purchaser.

Hot-swapping of cards shall be supported for Category I media converter including power supply and control cards without pre-configuration through management system:

UTP to optical conversion and optical to optical translation shall comply with the following requirements:

i. The Ethernet interfaces shall be complaint to relevant IEEE 802.3 standards for 100BaseTX and 100BaseFX Fast Ethernet interfaces, and 1000BaseSX and 1000BaseLX Gigabit Ethernet interfaces. It shall also support IEEE 802.3x flow control and auto-negotiation of speed as per relevant IEEE standards.

ii. The Ethernet interfaces shall be compliant to IEEE 802.3ah standards for 100BaseLX Fast Ethernet, 1000BaseLX-10 and 1000BasePX-20D/U Gigabit Ethernet interfaces. It shall also support IEEE 802.3x flow control and auto-negotiation of speed as per relevant IEEE standards..

iii. It shall support single-mode and multimode optical interfaces, as specified in the GR. It shall be supported through various IO cards in Category I equipment and through a combination of various models in Category II media converter.

iv. The equipment may support both multimode and single-mode interfaces on separate boards; the choice shall be as conveyed in purchaser requirements.

v. It shall support full/half-duplex mode of communication and shall be DIP switch selectable.

vi. TP port's, Half/Full mode, and Force/Auto mode shall be DIP switch selectable.

vii. It shall support auto-sensing of MDI/MDX for UTP copper port.

viii. It shall support DIP/Slide-switch for UTP uplink or downlink or any other suitable option.

ix. Fibre connection's Half/Full mode shall be DIP switch selectable.

x. Link Fault Pass-Through (LEP) shall be DIP switch selectable.

xi. It shall support RJ45 Female (UTP), LC, SC or FC/PC optical connector option

xii. It shall support a Bit Error Rate (BER) 1 in 10^{12} or better at physical layer. The same shall be monitored through management system and LCT.

xiii. Hot insertion and removal shall not damage the card as per Clause 22.4.6/IEEE 802.3.

xiv. The equipment shall support the stated reach with a Bit Error Rate 1 in 10^{9} at MAC layer. The same shall be monitored through management system and LCT.

xv. It shall support Automatic UTP polarity correction.

xvi. The equipment shall be capable of working on all media types listed in Table 38-6/IEEE 802.3 (i.e. 50 µm and 62.5 multimode fibre and 10 µm single mode fibre).

xvii. The equipment shall meet the PMD requirements as specified in IEEE 802.3 and IEEE 802.3ah standards.

xviii. Delay time of UTP to optical conversation shall be 130ns or better.

xix. The round-trip delay shall be as per IEEE 802.3 and IEEE 802.3, ah (as applicable for specific Type/Category of equipment).

xx. The definition of mechanical interface and connector-pin numbering shall be as per clause nos. 22.6.1/IEEE 802.3 respectively.

xxi. The equipment shall support the MIB and PICS as per IEEE 802.3 and 802.3ah for 10/100Base and 1000Base interfaces (as applicable for specific Type/Category of equipment).

xxii. The equipment shall support the remote loop-back.

xxiii. The equipment shall support OAM as specified in IEEE 802.3 and IEEE 802.3ah for each of interface specified in this GR (as applicable for specific Type/Category of equipment)

4.2 **Other features: LED indicators**

The media converter, in both 'Categories', shall support at least following LED's for monitoring as network status indicator:

i. **Power Supply Indicator:** This shall be steady when DC power is available to the converter.

ii. **Link Indicator:** This shall be steady when twisted pair or fibre optic link is properly connected.

iii. **Optic Reception Indicator:** This shall be lit when the optical signal is received.

iv. **UTP Reception Indicator:** This shall be lit when electrical signal is received.

v. **Speed Indicator:** This shall blink when there is activity on the connected port.

vi. **UTP (Ethernet) Activity Indicator:** This indicator shall blink when Ethernet data processing activity takes place.

5.0 Ethernet Interfaces

The GR describes the interface characteristics and specifications for various Ethernet interfaces. The same shall be complied during testing. The exact number and type of interfaces shall be specified by the purchaser.

Media converter shall support at least following interface, whereas the Type & Category of media converter shall be specified by the purchaser.

5.1 10/100/1000 BaseT electrical interface

The 10/100/1000BaseT Ethernet signal shall be as per IEEE802.3u.

Connector : RJ-45, 8-pin connector.
Cable type : Unshielded twisted pair cable (UTP) Cat. 5
Link length : 100 meters vide Table 29-5/IEEE 802.3.

5.2 100BaseFX optical interface

Type of optical fibre : Multimode fibre & Single-mode fibre as applicable
Window of operation : 850nm (Multimode) and 1260-1310nm (Single-mode)
Link length : As per Table 1 below.
Connector : FC/PC, SC or ST type.

Four models are envisaged for various reach options.

Model A: Meeting IEEE 802.3u 100BaseFX standard specification; with 1261-1360nm laser wavelength on 50-62.5/125 micron multimode fibre-optic cable, 2,000 meters maximum distance.

Fibre optic ports meeting IEEE 802.3u 100BaseFX standard specification; 7-9/125 micron single-mode fibre optic cable, spanning:

Model B: 15 kilometers maximum distance.
Model C: 40 kilometers maximum distance.
Model D: 80 kilometers maximum distance.

Table 1

	Model A*	**Model B****	**Model C****	**Model D****
Fibre reach	2 km	15 km	40 km	80 km
TX Power Min	-19 dBm	-15 dBm	-15 dBm	-5 dBm
TX Power Max	-14 dBm	-8 dBm	-8 dBm	0 dBm
RX	-31 dBm	-28 dBm	-34 dBm	-34 dBm

Sensitivity Min				
Source Wavelength	1310nm	1310nm	1310nm	1550nm

* Multi-mode Fibre-Optic Cable. The interface shall be supplied with multi-mode to single-mode adaptor as an integral part of the offer.

** Single-mode Fibre Optic Cable

Max power at RX -8 dBm or better

Performance
Latency: <4.2 µs (LIFO)
Throughput @ 100Base: 148,809 pps (64-byte packets).

5.3 100BaseLX10 optical interface

Link length : Upto 10 kms.
Type of fibre : Single-mode fibre

5.3.1 100BaseLX10 optical Transmitter characteristics

The detailed transmitter characteristics are given in Table 58-3/IEEE 802.3ah as reproduced below.

Table 58-3-100BASE-LX10 transmit characteristics

Description	Type B1.1, B1.3 SMF	Unit
Transmitter type [a]	Longwave Laser	
Signaling speed (range)	125 ± 100 ppm	MBd
Operating wavelength range [b]	1260 to 1360	nm
RMS spectral width (max)	7.7	nm
Average launch power (max)	-8	dbm
Average launch power (min)	-15	dbm
Average launch power of OFF transmitter (max)	-45	dbm
Extinction ratio (min)	5	db
RIN_{12} OMA [c] (max)	-110	Db/Hz
Optical return loss tolerance (max)	12	db
Launch OMA (min)	-14.8 (33.1)	dbm (µW)
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3, Y4}	{0.18, 0.29, 0.35, 0.35, 0.38, 0.4, 0.55}	UI
Transmitter and dispersion penalty (max)	4.5	db
Decision timing offset for transmitter and	± 1.6	ns

dispersion penalty (min)		

[a] The nominal transmitter type is not intended to be a requirement on the source type, and any transmitter meeting the transmitter characteristics specified may be substituted for the nominal transmitter type.

[b] The great majority of the transmitted spectrum must fall within the operating wavelength range, see 58.7.2.

[c] The RIN_{12} OMA recommendation is informative not mandatory.

5.3.2 100BaseLX10 Receive characteristics

The detailed receiver characteristics are given in Table 58-3 of IEEE 802.3ah as reproduced below.

Window of operation : 1310nm
No. of fibres used : 2
Maximum chl. Insertion loss : 6 dB
Connector type : As specified in IEEE 802.3ah

Table 58-4/IEEE 802.3ah: 100BASE-LX10 receive characteristics

Description	Type B1.1, B1.3 SMF	Unit
Signaling speed (range)	125 ± 50 ppm	MBd
Operating wavelength range	1260 to 1360	Nm
Bit error ratio (max)	10^{-12}	
Average received power a (max)	-8	dBm
Receiver sensitivity (max)	-25	dBm
Receiver sensitivity as OMA (max)	-24.8 (3.3)	dBm (µW)
Receiver reflectance (max)	-12	dB
Stressed receiver sensitivity [c]	-20.1	dBm
Stressed receiver sensitivity as OMA (max)	-19.9 (10.2)	dBm (µW)
Vertical eye-closure penalty d (min)	3.7	dB
Stressed eye jitter (min)	0.25	UI pk-pk
Jitter corner frequency	20	kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	0.05, 0.15	UI
Signal detect threshold (min)	-45	dBm

[a] The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having a power level equal to the average received power (max) plus at least 1 dB..

[b] See 1.4 for definition of reflectance.

[c] The stressed receiver sensitivity is optional.

[d] Vertical eye closure penalty and the jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.

5.4 1000BaseSX optical gigabit Ethernet

General Characteristics

Fibre type : MMF (B1.1, B1.3)
Number of fibres : 2
Nominal transmit/receiver wavelength : 850nm
Minimum range : 0.5 km
Connector : LC or SC or FC/PC type.

Table 38-2/802.3-Operating range for 1000BASE-SX over optical fibre types

Fibre Type	Model bandwidth @ 850 nm (min. overfilled launch) (MHz – km)	Minimum range (meters)
62.5 µm MMF	160	2 to 220
62.5 µm MMF	200	2 to 275
50 µm MMF	400	2 to 500
50 µm MMF	500	2 to 550
10 µm MMF	NA	No supported

* The interface shall be supplied with multi-mode to single-mode adaptor as an integral part of the offer.

Table 38-5/IEEE 802.3: Worst-case 1000BASE-SX link power budget and penalties [a]

Parameter	62.5 µm MMF		50 µm MMF		Unit
Model	160	200	400	500	MHz-km
Link power budget	7.5	7.5	7.5	7.5	dB
Operating	220	275	500	550	m
Channel insertion loss [b, c]	2.38	260	3.37	3.56	dB
Link power penalties [c]	4.27	4.29	3.57	3.57	dB
Unallocated margin in link power budget [c]	0.84	0.60	0.05	0.37	dB

[a] Link penalty are used for link budget calculations. They are not requirements and are not meant to be tested.
[b] Operating distances used to calculate the channel insertion loss (see 1.4) are the maximum values specified in Table 38-2.
[c] A Wavelength of 830 nm is used to calculate channel insertion loss, link power penalties, and unallocated margin.

5.4.1 1000BaseSX optical Transmitter characteristics

The detailed transmitter characteristics are given in Table 38-3 of IEEE 802.3ah as reproduced below:

Table 38-3/802.3-1000BASE-SX transmit characteristics

Description	62.5 µm MMF	50 µm MMF	Unit
Transmitter type [a]	Shortwave Laser		
Signaling speed (range)	125 (100 ppm)		GBd
Wavelength (λ, range)	770 to 860		nm
Trise/Tfall (max; 20%-80%; λ > 830 nm)	0.26		ns
T_{rise}/T_{fall} (max; 20%-80%; λ ≤ 830 nm)	0.21		ns
RMS spectral width (max)	0.85		nm
Average launch power (max)	See footnote a		dBm
Average launch power (min)	-9.5		dBm
Average launch power of OFF transmitter (max) b	-30		dBm
Extinction ratio (min)	9		dB
RIN (max)	-117		dB/Hz
Coupled Power Ratio (CPR) (min) [c]	9 < CPR		dB

[a] The 1000BASE-SX launch power shall be the lesser of the class 1 safety limit as defined by 38.7.2 or the average receive power (max) defined by Table 38-4.

[b] Example of an OFF transmitter are: no power supplied to the PMD, laser shutdown for safety conditions, activation of "transmit disable" or other optional module laser shut down conditions. During all conditions when the PMA is powered, the ac signal (data) into the transmit port will be valid encoded 8B/10B patterns (this is a requirement of the PCS layers) except for short duration during system power-on reset or diagnostics when the PMA is placed in a loopback mode.

[c] Redial overfilled launches are described in 38A.2, while they may meet CPR ranges, should be avoided.

5.4.2 1000BaseSX optical Receiver characteristics

The detailed receiver characteristics are given in Table38-4/IEEE 802.3 as reproduced below:

Table 38-4/802.3-1000BASE-SX receive characteristics

Description	62.5 µm MMF	50 µm MMF	Unit
Signaling speed (range)	125 ± 100 ppm		GBd
Wavelength (λ, range)	770 to 860		nm
Average receive power (max)	0		dBn

Receive sensitivity	-17		dBm
Return loss (min)	12		dB
Stressed receive sensitivity	-12.5	-13.5	dBm
Vertical eye-closure penalty	2.60	2.20	dB
Receive electrical 3 dB upper cutoff electrical 3 dB upper outoff frequency (max)	1500		MHz

[a] Measured with conformance test signal at TP3 (see 38.6.11) for BER = 10^{-12} at the eye centre,.

[b] Measured with a transmit signal having a 9 dB extinction ratio. If another extinction ratio is used, the stressed receive sensitivity should be corrected for the extinction ration penalty.

[c] Vertical eye-closure penalty is a test condition for measuring stressed receive sensitivity. It is not a required characteristic of the receiver.

5.5 1000BaseLX optical gigabit Ethernet interface (Reach 5 kms)

General Characteristics

Fibre type : SMF (B1.1, B1.3)
Number of fibres : 2
Nominal transmit/receive wavelength : 1310 nm
Minimum range : 0.5 m to 5km
Connector : LC or SC or FC/PC type.

Table38-6/802.3-Operating range for 1000BASE-LX over each optical fibre type

Fibre Type	Model bandwidth @ 1300 nm (min. overfilled launch) (MHz – km)	Minimum range (meters)
62.5 µm MMF	500	2 to 550
62.5 µm MMF	400	2 to 550
50 µm MMF	500	2 to 550
10 µm MMF	NA	2 to 5000

Table 38-9/802.3-Worst case 1000BASE-LX link power budget and penalties[a]

Parameter	62.5 µm MMF	50 µm MMF		10 µm MMF	Unit
Model bandwidth as measured at 1300 nm (minimum, overfilled launch)	500	400	500	N/A	MHz-km
Link power budget	7.5	7.5	7.5	8.0	dB
Operating distance	550	550	550	5000	m
Channel insertion loss [b, c]	2.35	2.35	25	4.57	dB
Link power penalties	3.48	5.08	3.96	3.27	dB

Unallocated margin in link power budget [c]	1.67	0.07	1.19	0.16	dB

[a] Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested..

[b] Operating distance used to calculate the channel insertion loss (see 1.4) are the maximum values specified in Table 38-6.

[c] A wavelength of 1270 mm is used to calculate channel insertion loss, link power penalties, and unallocated margin.

5.5.1 Optical Transmitter characteristics

The detailed transmitter characteristics are:

Table 38-7/802.3-1000BASE-LX Transmit characteristics

Description	62.5 µm MMF	50 µm MMF	10 µm MMF	Unit
Transmitter type	Longwave Laser			
Signaling speed (range)	125 ± 100 ppm			GBd
Wavelength (range)	1270 to 1355			nm
T_{rise}/T_{fall} (max; 20%-80%; response time)	0.26			ns
RMS spectral width (max)	4			nm
Average launch power (max)	-3			dBm
Average launch power (min)	-11.5	-11.5	-11.0	dBm
Average launch power of OFF transmitter (max)	-30			dBm
Extinction ratio (min)	9			dB
RIN (max)	-120			dB/Hz
Coupled Power Ration (CPR) [a]	28<CPR<40	12<CPR<20	NA	dB

[a] Due to the dual media (single mode and multimode) support of the LX transmitter, fulfillment of this specification requires a single mode fibre offset-launch mode conditioning patch cord described in 38.11.4 for MMF operation. This patch cord is not used for single mode operation.

5.5.2 1000BaseLX optical Receiver characteristics

The detailed receiver characteristics are given in Table 38-8/IEEE 802.3ah.

Table 38-8/802.3-1000BASE-LX receiver characteristics

Description	Value	Unit
Signaling speed (range)	125 ± 100 ppm	GBd

Wavelength (range)	1270 to 1355	nm
Average receive power (max)	-3	dBm
Receiver sensitivity	-19	dBm
Return loss (min)	12	dB
Stressed receiver sensitivity [a, b]	-14.4	dBm
Vertical eye-closure penalty [c]	2.60	dB
Receive electrical 3 dB upper cutoff frequency (max)	1500	MHz

[a] Measured with conformance test signal at TP3 (see 38.6.11) for BER = 10^{-12} at the eye centre..

[b] Measured with a transmit signal having a 9 dB extinction ratio. If another extension radio is used, the stressed receive should be corrected for the extinction ration penalty.

[c] Vertical eye-closure penalty is a test condition for measuring stressed receive sensitivity. It is not a required characteristic of the receiver.

5.6 1000BaseLX10: (Reach 10 kms)

General characteristics:

Fibre type : SMF (B1.1, B1.3)
Number of fibres : 2
Nominal transmit/receive wavelength : 1310nm
Minimum range : 0.5 m to 10 km
Connector : LC or SC or FC/PC type.

5.6.1 1000BaseLX10 optical Transmitter characteristics

The detailed transmitter characteristics are given in Table 59-3/IEEE 802.3ah.

Table 59-3/802.3ah: 1000BASE-LX10 transmit characteristics

Description	SMF	50 µm MMF	62.5 µm MMF	Unit
Nominal transmitter type [a]	Longwave Laser			
Signaling speed (range)	125 ± 100 ppm			Gbd
T_{rise}/T_{fall} (max; 80%; response time)	0.30			ns
Operating wavelength range [b]	1260 to 1360			nm
RMS spectral width (max)	See Table 59-4			nm
Average launch power (max)	-3			dBm
Average launch power (min)	-9	-11.0	-11.0	dBm
Average launch power of OFF transmitter (max)	-45			dBm
Extinction ratio (min)	6			dB
RIN12OMA (max)	-113			dB/Hz

Launch OMA (min)	8.7 (130)	-10.2 (100)	-10.2 (100)	dBm (μW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}	Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}			UI
Decision timing offsets for transmitter and dispersion penalty (min)	±80			ps
Transmitter reflectance (max)	-6			dB
Transmitter and dispersion penalty, TDP (max) Transmitter and dispersion penalty, TDP (max)	3.3		3.5	dB
Differential delay, reference receiver for TDP (min) [c]	NA		367	ps

[a] The nominal device type is not intended to be a requirement on the source type, and any device meeting the transmitter characteristics specified may be substituted for the nominal device type.

[b] The great majority of the transmitted spectrum must fall within the operating wavelength range. The allowable range of central wavelengths is narrower than the operating wavelength range by the actual RMS spectral width at each extreme.

[c] Delay is calculated as Td=L/(3.BWf) where BWf is defined to -3 dB (optical). 1000BASE-LX is rated for 550 m of 500 MHz.km fibre while 1000BASE-LX also covered 550 m of 400 MHz.km fibre, but this is now seen as a historical bandwidth requirement.

Note Link penalties are used to calculate link budget and distances and is not intended to be tested. A wavelength 1270nm is used to evaluate channel insertion loss, link power penalties, and unallocated margin. Attenuation for 10μ single-mode fibre at1300nm window is taken as 0.5dB/km.

Table 59-4/802.3ah: 1000BASE-LX10 and 1000BASE-BX10 TX Spectral limits

Center Wavelength (nm)	**RMS spectral width (nm) (Max) [a]**	**RMS spectral width (nm) to achieve <0.115 (Information)**
1260	2.09	1.43
1270	2.52	1.72
1280	3.13	2.14
1286	3.50	2.49
1290		2.80
1297		3.50
1329		
1340		2.59
1343		2.41
1350	3.06	2.09
1360	2.58	1.76
1480 to 1500	0.88	0.60

[a] These limits for the 1000BaseLX10 transmitter are illustrated in Figure 59-3 =. Limits at intermediate wavelength may be found by interpolation.

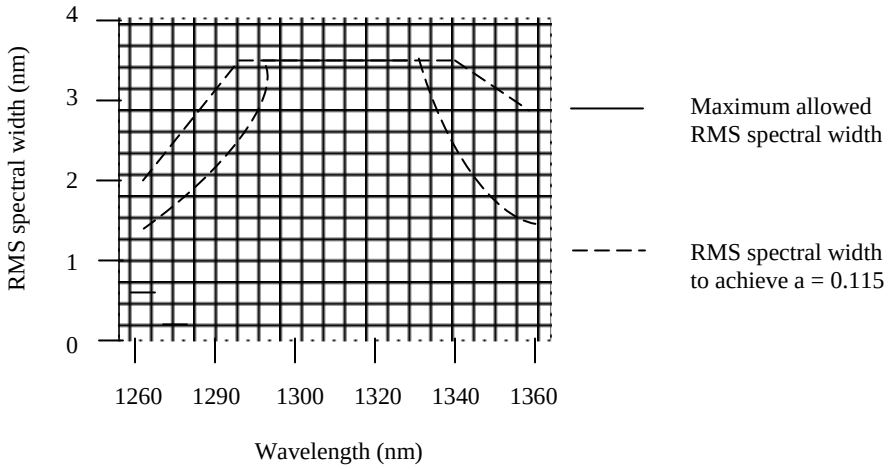


Figure 2: 1000 BaseLX10 Transmitter Spectral Limits

5.6.2 1000BaseLX10 optical Receiver characteristics

The detailed receiver characteristics are given in Table 59-5/IEEE 802.3ah.

Table 59-5/802.3ah-1000BASE-LX10 receive characteristics

Description	Value	Unit
Signaling speed (range)	125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1360	nm
Average received power (max)	-3	dbm
Receiver sensitivity (max)	-19.5	dbm
Receiver sensitivity as OMA (max)	-18.7 (13.4)	dbm (µW)
Bit error ratio (max)	10^{-12}	
Receiver reflectance (max) [a]	-12	db
Stressed receiver sensitivity (max)	1-5.4	dbm
Stressed receiver sensitivity as OMA (max)	-14.6 (35)	dbm (µW)
Vertical eye-closure penalty (min)	3.6	db
Receiver electrical 3 dB upper cutoff frequency (max)	1500	MHz
Signal detect threshold (min)	-45	dbm
Stressed eye jitter (min) [b]	0.3	UI pk to pk
Jitter corner frequency	637	KHz
Sinusoidal jitter limits for stressed receiver conformance test (min. max)	0.05, 0.15	UI

[a] See 1.4 for definition of reflectance.

[b] Vertical eye closure penalty and jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver. .

5.7 1000BasePX-20D optical gigabit Ethernet interface (Reach 20 kms)

General characteristics

Fibre type : SMF (B1.1, B1.3)
Number of fibres : 2
Nominal transmit/receive wavelength : 1310 nm
Minimum range : 0.5 m to 20 km
Jitter specifications : Ref Table 60/8 IEEE802.3ah
Connector : LC or SC or FC/PC type.

5.7.1 1000BasePX20-D and PX-20U optical Transmitter characteristics

The detailed transmitter characteristics are given Table 60-6/IEEE802.3ah.

Table 60-6-1000BASE D -PX20- and 1000BASE-PX20-U transmit characteristics

Description	1000BASE-PX20-D	1000BASE-PX20-U	Unit
Nominal transmitter type [a]	Longwave Laser	Longwave Laser	
Signaling speed (range)	125 ± 100 ppm	125 ± 100 ppm	GBd
Wavelength [b] (range)	1480 to 1500	1260 to 1360	nm
RMS spectral width (max)	See Table 60-7		nm
Average launch power (max)	+7	+4	dbm
Average launch power (min)	+2	-1	dbm
Average launch power of OFF transmitter (max)	-39	-45	dbm
Extinction ratio (min)	6	6	db
RIN_{15} OMA (max)	-115	-115	db/Hz
Launch OMA (min)	2.8 (1.9)	-022 (0.95)	dbm (µW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}	{0.22, 0.375, 0.20, 0.20, 0.30}	{0.22, 0.375, 0.20, 0.20, 0.30}	UI
Ton (max)	N.A.	512	ns
Toff (max)	N.A.	512	ns
Optical return loss tolerance (max)	15	15	db
Optical return loss of ODN (min)	20	20	db
Transmitter reflectance (max)	-10	-10	db

Transmitter and dispersion penalty (max)	2.3	1.8	db
Decision timing offset for transmitter and dispersion penalty (min)	± 0.1	± 0.125	UI

[a] The nominal device type is not intended to be a requirement on the source type, and any device meeting the transmitter characteristics specified may be substituted for the nominal device type.

[b] This represents the range of center wavelength ± 1σ of the rms spectral width.

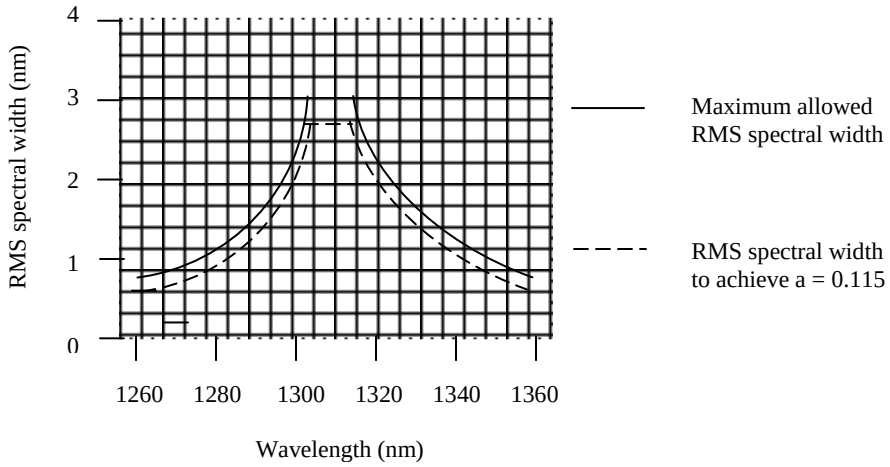


Figure 3. Transmitter Spectral Characteristics: 1000PX20D

5.7.2 1000Base PX20-D and PX-20U optical Receiver characteristics

The detailed receiver characteristics are given Table 60-8/IEEE 802.3ah.

Table 60-8-1000BASE-PX20-D and 1000BASE-PX20-U receive characteristics

Description	1000BASE-PX20-D	1000BASE-PX20-U	Unit
Signaling speed (range)	125 ± 100 ppm	125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1360	1480 to 1500	nm
Bit error ratio (max)	10^{-12}		
Average received power (max)	-6	-3	dbm
Damage threshold (max)	+4	+7	dbm
Receiver sensitivity (max)	-27	-24	dbm
Receiver sensitivity OMA (max)	-26.2 (2.4)	-23.2 (5)	dbm (µW)
Signal detect threshold (min)	-45	-44	dbm
Receiver sensitivity (max)	-12	-12	db
Stressed receiver sensitivity (max)	24.4	-22.1	dbm
Stressed receiver sensitivity	-23.6	-21.3	dbm

OMA (max) [a]	(4.3)	(7.4)	(µW)
Vertical eye-closure penalty (min) [b]	2.2	1.5	db
$T_{ransmitter\ setting}$ (max) [c]	400	N.A	ns
Stressed eye jitter (min)	0.28	0.25	dbm (µW)
Jitter corner frequency	637	637	KHz
Sinusoidal jitter limits for stressed receiver conformance test (min. max)	0.05, 0.15	0.05, 0.15	UI

[a] The stressed receiver sensitivity recommendation is optional.

[b] Vertical eye closure penalty and the jitter specification are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.

[c] $T_{receiver\ \ setting}$ is informative. The combined Treceiver_setting and CDR lock time is normative. See 65.3 for CDR lock times.

6.0 Jitter requirements

Transmitter optical waveform (transmit eye)

The required transmitter pulse shape characteristics are specified in the form of a mask of the transmitter eye diagram as shown in Figure 58-5 for 100BASE-LX10. Compliance is to be assured during system operation. The transmitter optical waveform of a port transmitting the test pattern specified for the PMD type, e.g. in clause 58.7.1/802.3ah, shall meet specifications according to the methods specified below.

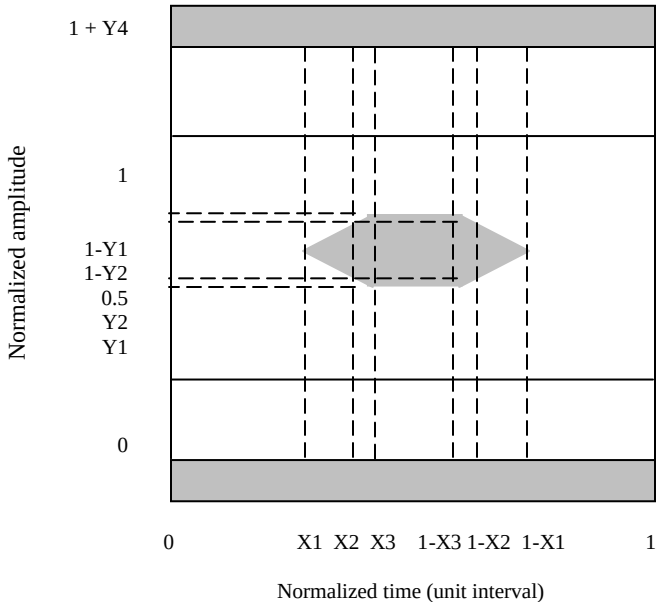


Figure 4. Transmitter Eye Mask Definition: 100BaseLX10

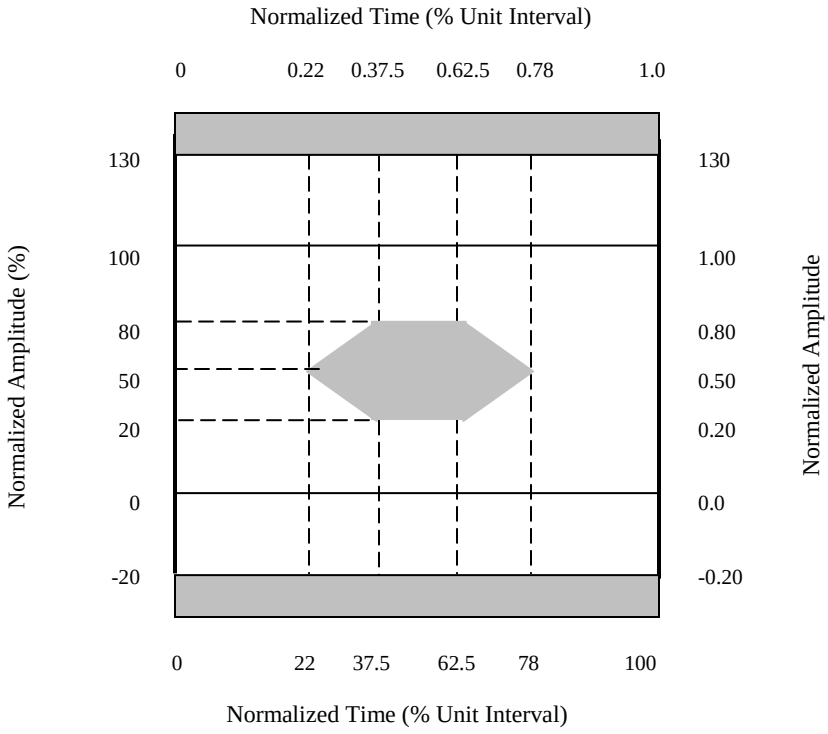


Figure 5. Transmitter Eye Definition: 1000BaseLX and SX

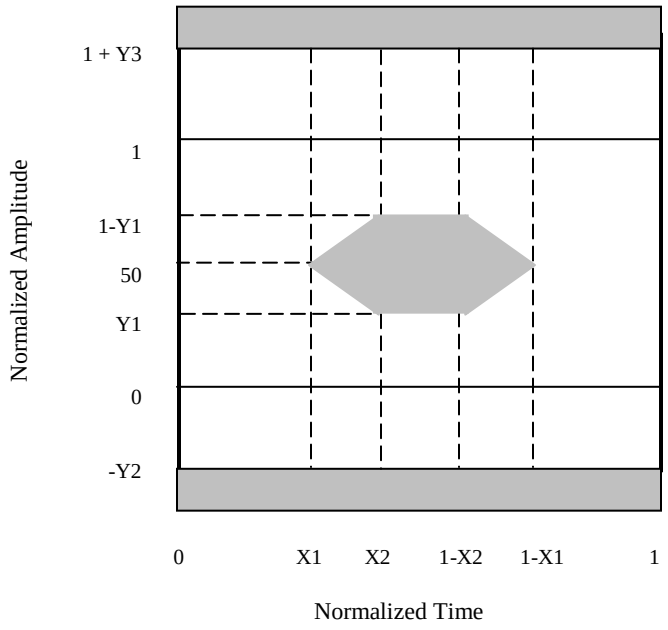


Figure 6. Transmitter Optical Eye Definition: 1000BaseLX10

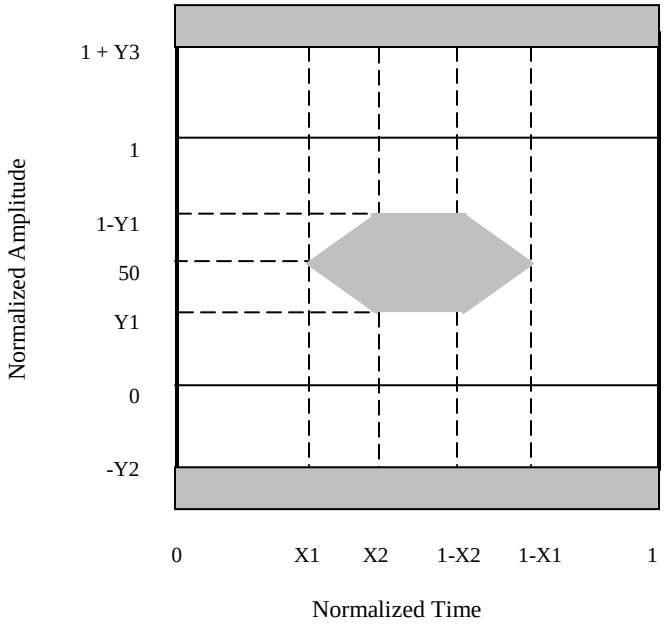


Figure 7. Transmitter Eye Characteristics: 1000BasePX20D

Table 38-10/802.3-1000BASE-SX and 1000BASE-LX jitter budget

Compliance point	Total jitter [a]		Deterministic jitter	
	UI	ps	UI	ps
TP1	0.240	192	0.100	80
TP1 to TP2	0.284	227	0.100	80
TP2	0.431	345	0.200	160
TP2 to TP3	0.170	136	0.050	40
TP3	0.510	408	0.250	200
TP3 to TP4	0.332	266	0.212	170
TP4 [b]	0.749	599	0.462	370

[a] Total jitter is composed of both deterministic and random components. The allowed random jitter equals the allowed total jitter minus the actual deterministic jitter at that point.

[b] Measured with a conformance test signal as TP3 (see 38.6.11) set to and average optical power 0.5dB greater that the stressed receive sensitivity from Table 38-4 for 1000 Base-SX and Table 38-8 for 1000Base-Lx.

Table 59-9/802.3ah-1000BASE-LX10 Jitter budget on MMF (Information)

	Total Jitter		W	
Reference point	**UI**	**ps**	**UI**	**ps**
TP1	0.240	192	0.100	80

TP2 to TP2	0.284	227	0.100	80
TP2	0.431	345	0.200	160
TP2 to TP3	0.170	136	0.050	40
TP3	0.510	408	0.250	200
TP3 to TP4	0.332	266	0.212	170
TP4	0.749	599	0.462	370

W is similar but not necessarily identical to deterministic jitter (DJ). A jitter measurement procedure is described in 58.7.12. Other jitter measurements are described in 59.7.12 and 59.7.13. Jitter at TP2 or TP3 is defined with a receiver of the same bandwidth as specified for the transmitted eye.

Table 59-10/802.3ah-1000BASE-LX10 Jitter budget on SMF

	Total Jitter		**W**	
Reference point	**UI**	**ps**	**UI**	**ps**
TP1	0.240	192	0.100	80
TP2 to TP2	0.334	267	0.150	120
TP2	0.481	385	0.250	200
TP2 to TP3	0.119	95	0	0
TP3	0.510	408	0.250	200
TP3 to TP4	0.332	266	0.212	170
TP4	0.749	599	0.462	370

Note Information jitter values are chosen to be compatible with the limits for eye mask and TDP (see 58.7.9). A margin between the total jitter at TP4 and the eye opening imposed by the decision point offsets for TDP is intended to allow for the performance of test equipment used for TDP measured, to avoid very involved jitter calibrations.
Total jitter in this table is defined at 10^{-12} BER. In a commonly used model,

$$TJ = 14.1\sigma + DJ \text{ at } 10^{12}$$

Table 60-10-1000BASE-PX10 and 1000BASE-PX20 downstream jitter budget (information)

	Total Jitter		**Deterministic jitter**	
Reference point	**UI**	**ps**	**UI**	**ps**
TP1	0.24	192	0.10	80
TP1 to TP2	0.191	153	0.15	120
TP2	0.431	345	0.25	200
TP2 to TP3	0.009	7	0	0
TP3	0.44	352	0.25	200
TP3 to TP4	0.309	247	0.212	170
TP4	0.749	599	0.462	370

Table 60-11-1000BASE-PX10 and 1000BASE-PX20 upstream jitter budget (information)

	No jitter input to ONU				Jitter input to ONU			
	Total Jitter		W		Total Jitter		W	
Reference point	**UI**	**ps**	**UI**	**ps**	**UI**	**ps**	**UI**	**ps**
TP1	0.19	152	0.06	48	0.24	192	0.11	88
TP1 to TP2	0.16	128	0.14	112	0.16	128	0.14	112
TP2	0.35	280	0.20	160	0.40	320	0.25	200
TP2 to TP3	0.09	72	0.05	40	0.09	72	0.05	40
TP3	0.44	352	0.25	200	0.49	392	0.30	24
TP3 to TP4	0.18	144	0.15	120	0.18	144	0.15	120
TP4	0.62	496	0.40	320	0.67	536	0.45	360

7.0 Powering requirements

The media converter, irrespective of 'Category', shall support the following powering arrangements. *Purchaser shall specify AC or DC operation requirements.*

AC Operation (to be specified by purchaser):

a. External Power Adapter: In case of DC operation, an external AC power (Voltage Range: 180 to 290 volts, with frequency range: 50 Hz +/- 2 Hz) shall be applied to the adapter, which would provide required DC power to the media converter for its operation.

b. Internal AC power supply: AC power (Voltage Range: 220V +10% or – 15%, frequency range: 50 Hz +/- 2 Hz) shall be applied to the media converter, which in turn converts (internally) AC to required DC supply for its operation.

Any of the above options shall be permissible if AC operation is specified by purchaser.

c. DC Operation (to be specified by purchaser):

DC supply: The media converter shall be able to be powered on from a voltage source having nominal voltage of -48 volt. DC with a voltage variation of -40 to -60 volt.

8.0 Management system

The management system shall be modeled in full compliance of IEEE 802.3 and 802.3ah standards for performance primitives & OAM etc. The equipment shall provide an in-built supervisory management system.

It shall be possible to configure the equipment for any of the interfaces and their associated parameters specified under relevant interface specifications as detailed in the GR.

The main function of the supervisory and management system shall be as below:

8.1 Operations, Administration and Maintenance (OAM)

The equipment shall support the OAM functions specified in IEEE802.3 and 802.3ah. The some of the FCAPs listed below shall also be supported by the equipment.

1. No. frame transmitted
2. No. of frame received
3. No frame received with error
4. No of frames dropped
5. Time stamping on transmitted frames
6. Time stamping on received frames
7. Loss of signal
8. No. of valid frames received
9. Loss of synchronization
10. Multicast frames
11. Frames with V-LAN tagging
12. No. of frames with V-LAN tags with priority
13. Link monitoring
14. Fault propagation

Remote OAM consist of IEEE 802.3ah standard (as applicable for a Category/Type of Media Converter). Tag VLAN can be used to protect this management traffic by prioritizing and isolating it from the user traffic at the demarcation point. This configuration is best suited for networks already using VLAN management. The Media Converter shall be IEEE 802.1Q compliant as well as compatible with other VLAN compliant hardware.

8.2 Performance management

It should be possible to monitor the performance status of the equipment as per relevant IEEE standards:

- Performance history.
- Performance reporting and monitoring.
- The functionality shall store the performance of the system.

8.3 Fault management

The system shall be able to report the fault events of the system including all system interfaces towards user as well as towards network. It shall provide a means to carry out the test functions specified under relevant interface specifications and shall display as:

- Alarm and status display.
- Fault localization
- Storing and processing of current alarm information.
- Storing and processing of historical alarm information.
- Management system shall provide the on-line logging capability for historical alarm events with sufficient information such as managed resource, alarm events type, alarm severity days and time of occurrence.
- Assigning alarm severity, i.e., Critical, Major and Deferred.

8.4 Security management

There should be provision for security management. The stages of security management have to be defined by the manufacturer.

The supervisory and management can be a proprietary design of the manufacturer. The equipment shall provide the following support on the management system:

- Low level protection for read only access for fault and performance information.
- Medium level protection for access to configuration status and feature.
- High level protection for control of access to aforesaid clause and to change the configuration and control parameters.

9.0 Minimum equipment required for testing

9.1 Rack mounted model: Category I

Racks	: 2 nos.
Media converter of type for testing	: 20 nos.
EMS/NMS	: 1 no.

9.2 Stand-alone model: Category II

Media converter of type for testing	: 2 nos.
EMS/NMS	: 1 no.

10.0 Field trial

The equipment shall be subjected to field trial for a minimum period of 2 weeks with working traffic to assess the performance of the equipment in actual field conditions. The equipment shall be loaded with as much traffic as possible. During the field trial testing, it shall be ensured that the equipment meets the GR requirements. Also, a certificate shall be obtained from the maintenance personnel about the satisfactory performance of the equipment.

PART II: GENERAL REQUIREMENTS

1.0 Reference documents

1.1 Whatever that has not been specifically stated in this document, shall deem to be as per relevant latest ITU-T recommendations.

1.2 All references to TEC GRs & other standards imply for their latest issues.

2.0 Engineering requirements

2.1 The equipment shall adopt state of the art technology.

2.2 The equipment shall be of compact and composite construction and lightweight. The actual dimensions and weight of the equipment shall be furnished by the manufacturer.

2.3 All connectors shall be reliable and of standard type to ensure failure free operation over 500 mating and under environmental conditions specified in the GR.

2.4 All connectors and the cables used shall be of low-loss type and suitably shielded.

2.5 The equipment shall preferably work on natural cooling. However, the use of DC operated fans could also be permitted in some equipment. This has to be examined on case to case basis. Two sets of fans are envisaged one as normal and the other as hot standby alternatively. The failure of fan/fans shall extend alarm. The MTBF of the fan shall be more than 50,000 hours.

2.6 The plug-in units shall be hot swappable to allow their removal/insertion while the equipment is in energized condition.

2.7 The mechanical design and construction of each card/unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage and transport and conforming to Para 12 of BSNL-QA document no. QM-333 {1998} – "Specification for environmental testing of electronic equipments for transmission and switching use".

2.8 Each sub-assembly shall be clearly marked with schematic reference to show its function, so that it is identifiable from the layout diagram in the handbook.

2.9 Each terminal block and individual tags shall be numbered suitably with clear identifying code and shall correspond to the associated wiring drawings.

2.10 All controls, switches, indicators etc. shall be clearly marked to show their functions.

2.11 Important Do's and Don'ts about the operation of the equipment shall be clearly indicated at a convenient place on the equipment.

3.0 Operational requirements

3.1 The manufacturer shall guarantee the satisfactory performance of the equipment without any degradation at an altitude upto 3,000 meters.

3.2 The equipment should be able to work without any degradation in saline atmosphere near coastal areas and should be protected against corrosion.

3.3 Visual indication to show power ON/OFF status shall be provided.

3.4 Suitable visual indications shall be provided. (It is suggested that green color for healthy and red color for unhealthy conditions may be provided. Some other color, preferably Amber, may be used for non urgent alarms).

3.5 The software/hardware in equipment shall not pose any problem due to changes in date and time caused by events such as changeover of millennium/century, leap year etc. in the normal functioning of the equipment.

4.0 Quality requirements

4.1 The manufacturer shall furnish the MTBF values. MTBF should meet the values specified in GR. The calculations shall be based on the guidelines in either BSNL QA document No. QM-115 {January 1997}-"Reliability Methods and Predictions" or any other international standard.

4.2 a) The equipment shall be manufactured in accordance with international quality management system ISO 9001:2008 for which the manufacturer should be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

b) The equipment shall be manufactured as per the latest BSNL QA Guidelines indicated in Quality Manuals QM-118 – {Quality and Reliability in product Design.}, QM 205 – {Guidelines for Standard of Workmanship for Printed Boards}, QM 206 – Guidelines for Standard of Workmanship for Printed Board Assemblies}, QM 210 – {Guidelines for Standard of Workmanship for Surface Mounted Devices} and QM 301 – {Transmission Equipment General Documentation}.

4.3 The environmental specifications for the equipment shall be as follows:

The equipment shall conform to the requirements for environmental compliance specified in BSNL-QA document QM-333 {Latest Issue} – "Specification for environmental testing of electronic equipments for transmission and switching use" for operation, transportation and storage. The applicable tests shall be for environmental Category B2 including vibration.

5.0 Maintenance requirements

Maintenance philosophy is to replace faulty units/subsystems after quick on-line analysis through monitoring sockets, alarm indications and Built-in Test Equipment/hand held terminal/lap top PC. The actual repair will be undertaken at centralized repair centres. The corrective measures at site shall involve replacement of faulty units/sub-systems

5.1 The equipment shall have easy access for servicing and maintenance.

5.2 Suitable alarms shall be provided for identification of faults in the system and faulty units.

5.3 Suitable provision shall be made for extension of summary alarms.

5.4 Ratings and types of fuses used are to be indicated by the supplier.

6.0 Power supply

a. The Media Converter shall operate on AC mains supply with tolerable variation in the range 220V +10% or – 15%, frequency range: 50 Hz +/- 2 Hz. Upon AC mains failure, the system shall **optionally** operate with UPS or optionally with 4-8 hours battery backup. The purchaser may specify UPS and optional battery backup requirements and specifications clearly.

b. In case of DC operation, an external AC power (Voltage Range: 180 to 290 volts, with frequency range: 50 Hz +/- 2 Hz, shall be applied to the adapter, which would provide required DC power to the media converter for its operation.

c. The media converter shall be able to be powered on from a voltage source having nominal voltage of -48 volt. DC with a voltage variation of -40 to -60 volt.

7.0 Accessories

7.1 The supplier shall provide one complete set of.

a) All the necessary interfaces, connectors, connecting cables and accessories required for satisfactory and convenient operation of the equipment. Types of connectors, adapters to be used and the accessories of the approved quality shall be clearly indicated in the operating manuals , which should be in conformity with the detailed list in the GR;

b) Software and the arrangement to load the software at site.

Additional sets may be ordered optionally.

7.2 Special tools, extender boards, extender cables and accessories essential for installation, operation, and maintenance of the equipment shall be clearly indicated and supplied along with the equipment.

8.0 Documentation

Technical literature in English or Hindi with complete layout, detailed block schematic and circuit diagram of various assemblies with test voltages/wave forms at different test points of the units shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The soft copy as well as hard copy of the manuals shall also be provided. The manuals shall include the following:

i) **Installation, Operation and Maintenance Manual**

a) Safety measures to be observed in handling the equipment;

b) Precautions for installation, operation and maintenance;

c) Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance, troubleshooting and sub-assembly replacement;

d) Illustration of internal and external mechanical parts.

e) The detailed description about the operation of the software used in the equipment including its installation, loading and debugging etc.

ii) **Repair Manual (to be supplied when ordered)**

a) List of replaceable parts used including their sources and the approving authority;

b) Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate reordering of spares as and when required;

c) Procedure with flow chart for troubleshooting and sub-assembly replacement shall be provided Test fixtures and accessories required for repair shall also be indicated. Systematic trouble shooting charts (fault tree) shall be given for the probable faults with their remedial actions.

9.0 Protection requirements

9.1 The equipment shall have a terminal for grounding.

9.2 Protection against short circuit/open circuit in the accessible points shall be provided.

9.3 All switches/controls on front panel shall have suitable safeguards against accidental operation.

9.4 The equipment shall be adequately covered to safeguard against entry of even dust, insects etc.

10.0 Safety requirements

10.1 The operating personnel should be protected against shock hazards as per IS 8437 {1993} – "Guide on the effects of current passing through the human body" [equivalent to IEC publication 60479-1 {1984}].

10.2 The equipment shall conform to IS 13252 {2003} – "Safety of information technology equipment including electrical business equipment" [equivalent to IEC publication 60950 {2001}] and IS 10437 {1986} – "Safety requirements of radio transmitting equipments" [equivalent to IEC 60215].

11.0 General Electromagnetic Compatibility (EMC) Requirements:

The equipment shall conform to the EMC requirements as per the following standards and limits indicated therein. A test certificate and test report shall be furnished from an accredited test agency.

a) **Conducted and radiated emission *(applicable to telecom equipment)*:**
Name of EMC Standard: "CISPR 22 (2005) with amendment 1 (2005) & amendment 2 (2006) - Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".

Limits:-

i) To comply with Class A of CISPR 22 (2005) with amendment 1 (2005) & amendment 2 (2006).

ii) The values of limits shall be as per TEC Standard No. TEC/EMI/TEL-001/01/FEB-09**.**

b) **Immunity to Electrostatic discharge:**
Name of EMC Standard: IEC 61000-4-2 {2001) "Testing and measurement techniques of Electrostatic discharge immunity test".

Limits: -

i) Contact discharge level 2 {± 4 kV} or higher voltage;

ii) Air discharge level 3 {± 8 kV} or higher voltage;

c) **Immunity to radiated RF**:
Name of EMC Standard: IEC 61000-4-3 (2006) "Testing and measurement techniques-Radiated RF Electromagnetic Field Immunity test"

Limits:-
For Telecom Equipment and Telecom Terminal Equipment with Voice interface (s)

i) Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and

ii) Under test level 3 (10 V/m) for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.

For Telecom Terminal Equipment without Voice interface (s)
Under Test level 2 {Test field strength of 3 V/m} for general purposes in frequency range 80 MHz to 1000 MHz and for protection against digital radio telephones and other RF devices in frequency ranges 800 MHz to 960 MHz and 1.4 GHz to 6.0 GHz.

d) **Immunity to fast transients (burst):**
Name of EMC Standard: IEC 61000- 4- 4 {2004) "Testing and measurement techniques of electrical fast transients/burst immunity test"

Limits:-
Test Level 2 i.e. a) 1 kV for AC/DC power lines; b) 0. 5 kV for signal / control / data / telecom lines;

e) **Immunity to surges:**
Name of EMC Standard: IEC 61000-4-5 (2005) "Testing & Measurement techniques for Surge immunity test"

Limits:-
i) For mains power input ports : (a)1.0 kV peak open circuit voltage for line to ground coupling (b) 0.5 kV peak open circuit voltage for line to line coupling

ii) For telecom ports : (a) 0.5 kV peak open circuit voltage for line to ground (b) 0.5 KV peak open circuit voltage for line to line coupling.

f) **Immunity to conducted disturbance induced by Radio frequency fields:**
Name of EMC Standard: IEC 61000-4-6 (2003) with amendment 1 (2004) & amd. 2 (2006) "Testing & measurement techniques-Immunity to conducted disturbances induced by radio-frequency fields "

Limits:-
Under the test level 2 {3 V r.m.s.}in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.

Note-1 The test agency for EMC tests shall be an accredited agency and details of accreditation shall be submitted.

Alternatively, EMC test report from a non-accredited test lab, which is audited by an accredited lab / accrediting authority for the availability of all the essential facilities (test equipment, test chamber, calibrations in order, test instructions, skilled personnel etc.), required for performing the tests according to the EMC test methods audited, may be acceptable.

However, such accredited lab / accrediting authority should take responsibility of the test results of the "non accredited lab" along with indication of period of such delegation and the submitted test report should be of such valid period of delegation. The audit report, mentioning above facts, should be provided along with EMC test report.

Note-2 For checking compliance with the above EMC requirements, the method of measurements shall be in accordance with TEC Standard No. TEC/EMI/TEL-001/01/FEB-09 and the references mentioned therein unless otherwise specified specifically. Alternatively, corresponding relevant Euro Norms of the above IEC/CISPR standards are also acceptable subject to the condition that frequency range and test level are met as per above mentioned sub clauses (a) to (g) and TEC Standard No. TEC/EMI/TEL-001/01/FEB-09. The details of IEC/CISPR and their corresponding Euro Norms are as follows:

IEC/CISPR	**Euro Norm**
CISPR 22	EN 55022
IEC 61000-4-2	EN 61000-4-2
IEC 61000-4-3	EN 61000-4-3
IEC 61000-4-4	EN 61000-4-4
IEC 61000-4-5	EN 61000-4-5
IEC 61000-4-6	EN 61000-4-6
IEC 61000-4-11	EN 61000-4-11

Annexure-I
Purchase guidelines

PART-I: Technical Requirements

Clause 2.0: Interface conversion support

Exercise interface requirements at UNI/NNI. Specify the Type of Media Converter.

Clause 3.0: Media Converters Categories

Category I

Specify the 'Category' of Media Converter and also specify single or multiple Ethernet interface of specific type per IO card. The purchaser should specify cards per chassis and no. of Ethernet ports of specific interface per such card.

Category II

The purchaser shall specify the exact UNI/NNI interface requirements

Clause 4.0: Category I/II

Specify the number of Media Converters to be managed centrally if 500 node specifications fall short of network requirements.

Clause 7.0: Powering requirements

Specify whether the equipment shall be powered with AC or DC supply.

PART-II: General Requirements

Clause 6.0: Power

Specify whether the equipment shall be powered with AC or DC supply. Specify the requirements of UPS and also specify the battery backup requirements.

GLOSSARY

BER	:	Bit Error Ratio
CO	:	Central Office
CRC	:	Cyclic Redundancy Check
DC	:	Direct Current
DVC	:	Desktop Video Conferencing
EMC	:	Electromagnetic Compatibility
FCS	:	Frame Check Sequence
GR	:	Generic Requirement
IEC	:	International Electro-technical Commission
IO	:	Input Output
ITU	:	International Telecom Union
KHz	:	Kilo Hertz
KV	:	Kilo Volts
LED	:	Light Emitting Diode
LCT	:	Local Craft Terminal
MDF	:	Main Distribution Frame
MDI	:	Media Dependent Interface
NMS	:	Network Management System
NTR	:	Network Timing Reference
OAM	:	Operation, Administration and Maintenances
Ppm	:	Parts Per Million
QA	:	Quality Assurance
RMS	:	Root Mean Square
RT	:	Remote Terminal
SNMP	:	Simple Network Management Protocol
TEC	:	Telecommunication Engineering Centre
TMN	:	Telecom Management Network
VLAN	:	Virtual LAN
PMD	:	Physical Media Dependent sub-layer
PMD	:	Polarization Mode Dispersion
UTP	:	Unshielded Twisted Pair

-------End of the document-------