वर्गीय आवश्यकताओं के लिए मानक

टीईसी 72010:2023

(सं: टीईसी ७२०१०:२०२१ को अधिक्रमित करता है)

STANDARD FOR GENERIC REQUIREMENTS

TEC 72010:2023

(Supersedes No. TEC 72010:2021)

ऑप्टिकल एक्सेस टेक्नोलॉजी के लिए ऑप्टिकल स्प्लिटर और डब्ल्यूडीएम कपलर

OPTICAL SPLITTER AND WDM COUPLER FOR OPTICAL ACCESS TECHNOLOGY

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली-११०००१, भारत

TELECOMMUNICATION ENGINEERING CENTRE

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This Standard for Product/Equipment pertains to Optical Splitter and WDM coupler to be used in optical access technology. Optical splitters capable of providing m: N optical splits, on end to end basis, are envisaged, where m = 1 or 2 and N = 2, 4, 8, 16, 32, 64,128 and 256. A wavelength selective branching device is also envisaged (used in WDM transmission systems) in which optical signals can be transferred between two predetermined ports, depending on the wavelength of the signal (clause 6.51 in [IEC/TR 61931]) for point to multipoint FTTH architecture.

CONTENTS

HISTORY SHEET

S.No.	Standard / document No.	Title	Remarks
1.	TEC/GR/TX/OPT-001/01/APR-2012	Optical splitter for PON technology	Release 1
2.	TEC 72010:2012	Optical splitter for PON technology	New document number as per Revised numbering scheme issued by RC division No 447/2019-RC/TEC dt 07.09.2020
3.	TEC 72010:2021	Optical Splitter And WDM Coupler For Optical Access Technology	Release 2 Includes requirement of WDM coupler
4.	TEC 72010:2023	Optical Splitter And WDM Coupler For Optical Access Technology	Release 3*

*Note: The earlier Release 3 issue (December 2023) required some editorial corrections to insert word "Maximum" in respect of the requirement related to ‘PON Splitter Box Size’ mentioned at Chapter-1, Clause 2.2.1(c)(xi) of TEC Standard TEC 72010:2023. Accordingly, the earlier Release 3 issue has been replaced by this updated Release 3 document. Therefore, for all relevant purposes, this document may be referred.

REFERENCES

S.No.	Document No.	Title/Document Name
1.	IEC 61931 : 1998/ IS 16283 :2014	Fibre Optic Terminology
2.	IEC/IS 60529 : 2001	Degrees of protection provided by enclosures (IP Code)
3.	ITU-T Rec.G.652	Characteristics of a Single Mode Optical Fibre and Cable
4.	ITU-T Rec. G.657	Characteristics of a bending-loss insensitive single-mode optical fibre and cable
5.	ITU-T Rec.G.984.1	Gigabit-capable Passive Optical Networks (GPON): General Characteristics.
6.	ITU-T Rec.G.984.2	Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification
7.	ITU-T Rec.G.984.5	Gigabit-capable passive optical networks (GPON): Enhancement band: Amendment 1
8.	ITU-T Rec. L36/ L.404	Field mountable single-mode optical fibre connectors
9.	ITU-T L.66	Optical fibre cable maintenance criteria for inservice fibre testing in access networks
10.	TEC 14016:2010	QM-333 - Specification for environmental testing of electronic equipment for transmission and switching use

11.	TEC 71010:2017 (Old No. TEC/GR/PON01/03.FEB.2017)	Generic Requirements for FTTH/FTTB/FTTC Broadband Access Applications using Gigabit Passive Optical Network (GPON)
12.	TEC 71050:2018	Generic Requirements for 10 Gigabit Passive
	(Old No TEC/GR/TX/XG-PON-01/02.March.2018)	Optical Network (XG-PON) Technology for FTTx based Broadband Applications
13.	TEC 71030:2018 (Old No. TEC/GR/FA/XGS-001/01/OCT-18)	Generic Requirements for 10 Gigabit capable symmetric Optical Network (XGS-PON) Technology for FTTx based Broadband Applications
14.	TEC 71070:2020 (Old No. TEC/GR/FA/NG2-001/01/MAR-20)	Generic Requirements for 40-Gigabit-capable passive optical-network (NG-PON2) technology for FTTX based broadband applications
15.	TEC 87030:2010 (Old No TEC / GR/ TX/FTB-02/02/APR-2010)	Optical Fibre Termination & Distribution Box (for FTTH applications)

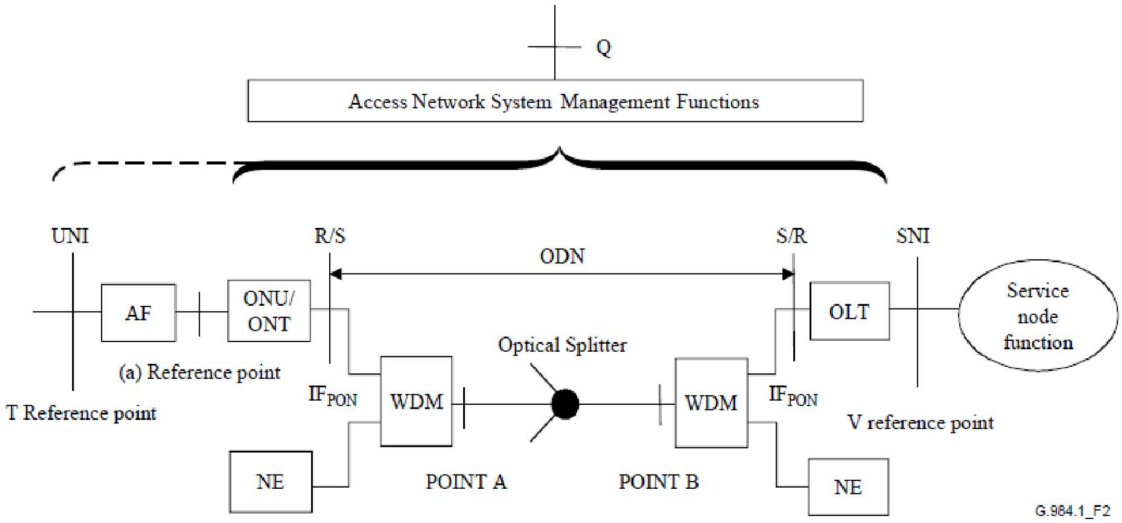
Note:

"Unless otherwise explicitly stated, the latest approved issue of the standard, with all amendments in force, listed in references, on the issuance date of this standard shall be applicable"

CHAPTER-1

1.0 INTRODUCTION:

1.1 Optical Splitter: Optical Splitter is one of the passive components of PON Technology. It may be installed in the Central Office/Remote Office/Cabinet/MDU/MTU/FDMS-OD/OJC etc. Optical splitters are capable of providing m: N splits where m = 1 or 2 and N = 2, 4, 8, 16, 32, 64, 128 and 256. The user may use a combination of these split options.



WDM	Wavelength Division Multiplex Module (If WDM is not used, this function is not necessary)
NE	Network Element which uses the different wavelength from the OLT and the ONU
AF	Adaption Function (Sometimes, it may be included in ONU)
S	Point on the optical fibre just after the OLT(downstream)/ONU(Upstream) optical correction point (i.e. optical connector or optical splice)
R	Point on the optical fibre just after the ONU(downstream)/OLT(Upstream) optical correction point (i.e. optical connector or optical splice)
(a) Reference Point	If AF is included in the ONU, this point is not necessary.
Point A/B	If WDM is not used, these points are not necessary.
Note -Whether or not the AF is an operating object of the Q interface depends on the service.	

Figure-1: Configuration for a Passive Optical Network

1.2 WDM device: A wavelength selective branching device (used in WDM transmission systems) in which optical signals can be transferred between two predetermined ports, depending on the wavelength of the signal (clause 6.51 in [IEC/TR 61931]).

Both wavelength multiplexers (MUXs) and wavelength demultiplexers (DMUXs) are generally called 'WDM devices' since often the same device can be used to multiplex and demultiplex channels

Use of WDM devices is shown in figure-2 and figure-3 along with splitter. WDM can also be used in place of splitter for point to multipoint architecture. WDM is a must requirement for co-existence of different wavelength on same optical fibre (ODN).

Figures 2 and 3 are reference diagrams of optical access network (OAN) architectures and assume that wavelength blocking filters (WBF) are used when G-PON, video and NGA share the same ODN

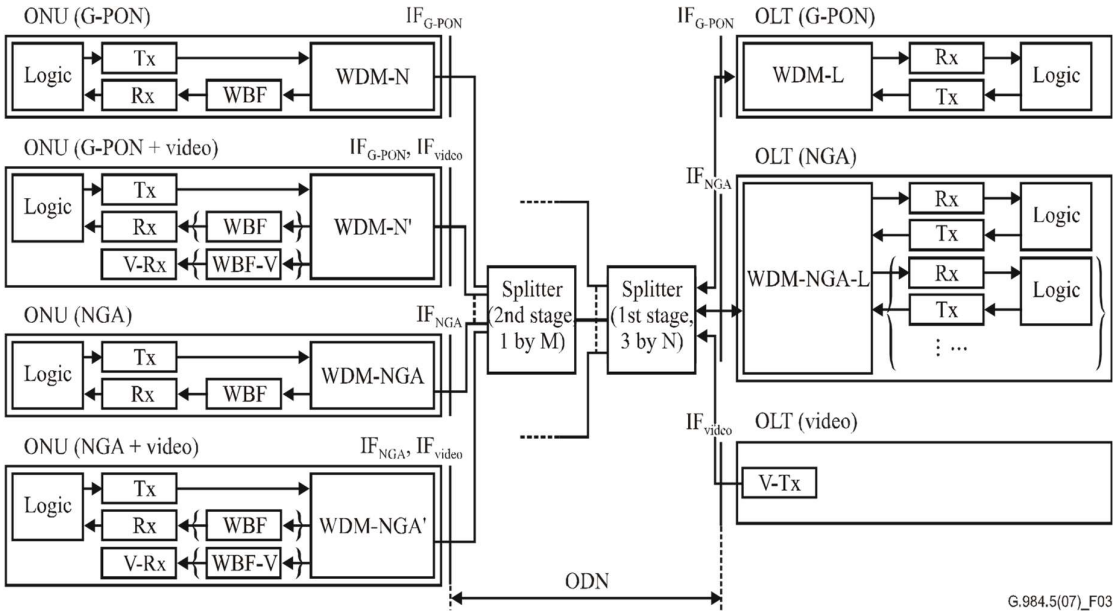
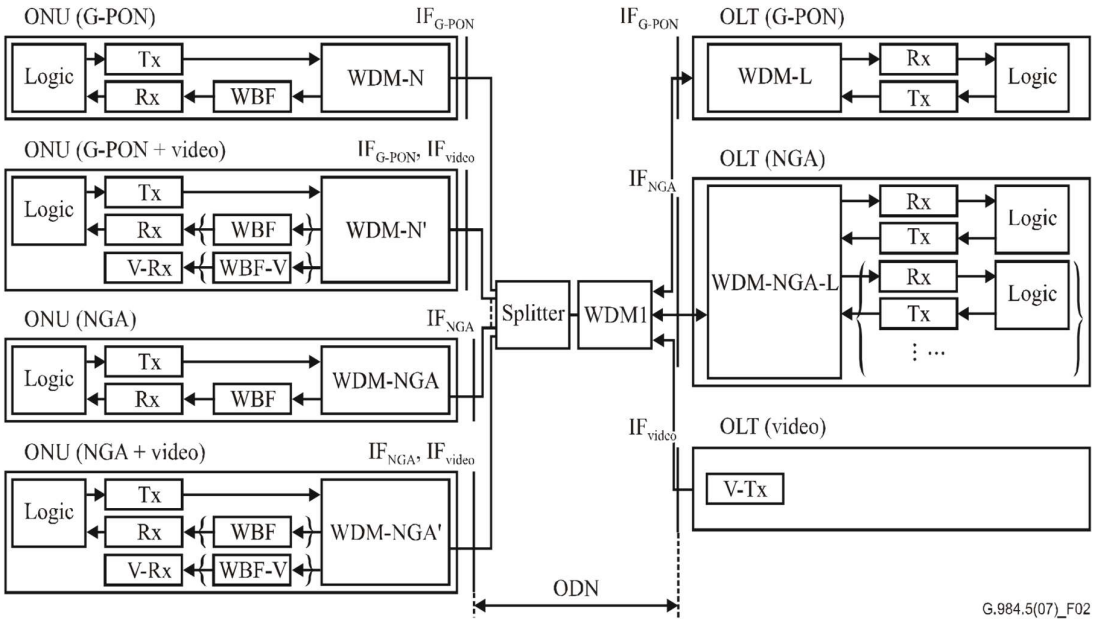


Figure 2 – Optical access network architecture reference diagram



(NOTE – WDM1 can be replaced by WDM1r, CE or CEM.)

Figure 3 – Optical access network architecture reference diagram

CE	Coexistence element that may be located in the central office to combine/isolate the wavelengths of NG-PON2 and legacy PON signals and which occasionally combines the video signals and/or OTDR signals
CEM	Coexistence element that may be located in the central office to combine/isolate the wavelengths of TWDM PON, PtP WDM PON and legacy PON signals and which occasionally combines the video signals and/or OTDR signals
Rx	Optical receiver
Tx	Optical transmitter
V-Rx	Video receiver
V-Tx	Video transmitter
WBF	Wavelength blocking filter for blocking interference signals to Rx
WBF-V	Wavelength blocking filter for blocking interference signals to V-Rx
WDM-N	WDM filter in G-PON ONU to combine/isolate the wavelengths of G-PON upstream and downstream
WDM-N'	WDM filter in G-PON ONU to combine/isolate the wavelengths of G-PON upstream and downstream and isolate the video signal(s)
WDM-	WDM filter in NGA ONU to combine/isolate the wavelengths of NGA upstream

NGA	and downstream
WDM-NGA'	WDM filter in NGA ONU to combine/isolate the wavelengths of NGA upstream and downstream and isolate the video signal(s)
WDM-L	WDM filter in G-PON OLT to combine/isolate the wavelengths of G-PON upstream and downstream
WDM-NGA-L	WDM filter in NGA OLT to combine/isolate the wavelengths of NGA upstream and downstream of one or more channels
WDM1	WDM filter that may be located in the central office to combine/isolate the wavelengths of G-PON and NGA signals and which occasionally combines the video signals and/or OTDR signals
WDM1r	WDM filter that may be located in the central office to combine/isolate the wavelengths of G-PON and XG-PON signals and which occasionally combines the video signals and/or OTDR signals.

2.0 Physical Requirement:

2.1 The WDM coupler may be mounted in 19" rack when installed in Central office and mounted in box when installed on pole/wall etc.

2.2 The Optical Splitter may be characterize by place of installation/environment and form. The Optical splitter may be mounted in 19" rack when installed in Central office and mounted in box when installed on pole/wall etc.

2.2.1 The detailed characterization of Optical Splitter is given below:

Type 1- Bare splitter shall be offered in following category:

i. Bare splitter with 250µm Fiber in input and output
   This type of splitter shall be mounted in a Joint Closure/Outdoor FDMS OR Box where inputs and output needs to be directly spliced to the fibers of the cable.

ii. Bare splitter with 250µm Fiber/Ribbon in input and 4F/6F/8F/12F Ribbon output
   This type of splitter shall be mounted in a Joint Closure/Outdoor FDMS OR Box where inputs and output needs to be directly spliced to the fibers of the cable with 4F/6F/8F/12F ribbon.

iii. Bare splitter with 900µm Fiber in input and output
   This type of splitter shall be mounted in a Joint Closure/Outdoor FDMS OR Box where inputs and output needs to be directly spliced to the fibers of the cable.

This type may also find use in indoor applications such as Type-I FDMS wherein 900µm will be more rigid in routing.

iv. Bare splitter with 900µm Fiber in input and output

The input and outputs are connectrised with SC / LC type with APC / UPC endface. This type of splitter shall be mounted in a box where inputs and output needs to be patched to connectorised input / output of fibers using suitable adapters.

a) Type 2: Rack mounted splitter:

These shall be mounted on a rack which has 19" / ETSI mounting frames. The unit shall be supplied with suitable Mounting brackets movable or fixed (as desire by the user). In general, unit may have following dimensions; (i) mx2 / mx4 / mx16 shall be supplied in 1U, (ii) mx32 in 2U and (iii) mx64 shall be supplied in 3U where m is number of inputs. However exact requirement of “dimension” shall be specified by the user. The Input and output shall be terminated with suitable connectors for connecting to the adapters in the front panel. The front panel should have adapters mounted. The maximum depth of the unit shall not exceed 280mm. The adapters shall be clearly numbered and inputs and outputs be clearly identified. The type of splitter premounted in the unit shall be as described in 2.2.1.a.

b) Type 3: Box mounted Splitter:

The splitters shall be pre mounted in a box. The Box mounted Splitter shall be able to be installed on wall / Pole. The splitter box is expected to be deployed in any of the IC, IN, OA, OG environments. The box body can be of metal or of plastic.

In case of metal, it shall be made out of 0.75 mm thick MS sheet with powder coating (minimum 70-100 microns). In case of plastic, it shall be made of ABS and have UV resistance.

The unit shall have the following features:

i. Shall be able to accommodate splitters as described in 2.2.1.a.

ii. The box shall have proper inside arrangement for fixing the splitter module and patching Connectors & Adapters.

iii. Adequate arrangement for incoming and outgoing optical fibres/ patch cord/ pig tail shall be made inside the box.

iv. Box shall have a mid span cable port which can accommodate mid span cables.

v. All incoming & outgoing holes/ports shall be covered by good quality rubber grommet.

vi. The wall/pole mounting fixing/sliding arrangement shall be provided in the box.

vii. The box shall have front cover and shall be provided with gasket for sealing and should be tightly screwed for proper locking arrangement.

viii. For indoor applications (IC or IN), the minimum recommended protection level against ingress of objects is IP 40. For box above or at ground level (OA and OG), the minimum recommended protection level against ingress of objects and water is IP 55 according to IS/IEC 60529.

ix. The box shall be qualified as per the test procedures mentioned in clause 4 of TEC 87030:2010 (Old No. TEC / GR/ TX/FTB-02/02/APR2010).

x. In general, box may have following mountings, however exact requirement of “number of splitters, number of splice sleeve mounting capacity, splice position for mid-span cable splice, number of SC type adopters, dimension of mid-span cable, and number, diameter and shape of drop cable” shall be specified by the user:

x.1 Box may accommodate mx2 / mx4 / mx8 / mx16.

x.2 It may have up to 24 no’s of splice sleeve mounting capacity.

x.3 Splice provision on base of box may be provided for mid-span cable splice.

x.4 It may have up to 4/6/10/18 nos of SC type adapter holding capability.

x.5 It may have a mid-span cable port which can accommodate a mid-span cable of 6~15mm in diameter.

x.6 The box may have number of drop cable port equal or greater than the number of splitter output.

x.7 Box may accommodate drop cable of 3~8mm in diameter.

x.8 The drop cable can be of flat or round shape.

xi. PON Splitter Box Size: [Optional]

Parameters	1x2	1x4	1x8	1x16	1x32	1x64	1x128	1x256
Size (LxWxH) (mm) Max	315 × 275 × 105	315 × 275 × 105	320 x 280 x 115	320 × 280 × 115	450 × 440 × 175	450 × 440 ×175	1030 × 525 × 310	1350 × 525 × 360

Parameters	2x2	2x4	2x8	2x16	2x32	2x64	2x128	2x256
Size (LxWxH) (mm) Max	315 × 275 × 105	315 × 275 × 105	320 x 280 x 115	320 × 280 × 115	450 × 440 × 175	450 × 440 × 175	1030 × 525 × 310	1350 × 525 × 360

2.3 Optical Splitter Module:

2.3.1 Optical Splitter may be supplied in the configurations as described below:

i) 1:2 PON-Splitter
ii) 1:4 PON-Splitter
iii) 1:8 PON-Splitter
iv) 1:16 PON-Splitter
v) 1:32 PON-Splitter
vi) 1:64 PON-Splitter
vii) 1:128PON-Splitter
viii) 1:256PON-Splitter
ix) 2:2 PON- Splitter
x) 2:4 PON-Splitter
xi) 2:8 PON-Splitter
xii) 2:16 PON-Splitter
xiii) 2:32 PON-Splitter
xiv) 2:64 PON-Splitter

xv) 2:128PON-Splitter

xvi) 2:256 PON- Splitter

2.4 WDM coupler Configuration requirements

The WDM, WDM1, WDM1r, CEx and CEMx devices can have several different configurations depending on whether a video overlay service or an optical time domain reflectometer (OTDR) is provided.

This standard also presents various methods for the coexistence of multiple PON generations on a common ODN, which allow the reuse of already deployed fibre and splitters when evolving an operator's network to a higher capacity

3.0 **Specifications**

3.1 Optical splitter specifications:

Passive optical splitter bank must include 1xN and/or 2xN (with 1 & 2 representing number of input ports and 'N' several output ports) configuration. The fibre types used in the manufacturing of Passive Optical Splitter, connectors shall be compliant with ITU-T Rec. G.652/G.657A and ITU-T Rec. L.404/L36. The overall permissible maximum insertion loss (dB) for a splitter is given in tables below.

Table-1 1xN Symmetrical splitter - optical specifications

The following optical specifications must be met under any combination of environmental, mechanical, and polarization conditions. All values listed in this Table do not account for connectors loss.										
Splitter			1x2	1x4	1x8	1x16	1x32	1x64	1x128	1x256
Insertion Loss Maximum(dB)(CR)	Normal Reach	WR1	3.9	7.4	10.6	14.1	17.5	20.9	25.5	28
		WR2	4.0	7.6	10.9	14.5	18.1	21.5	-	-
	Extended Reach	WR1	3.8	7.1	10.5	13.7	17.1	20.3	-	-
		WR2	3.9	7.3	10.8	14.1	17.7	20.9	-	-
Uniformity maximum(dB)	Normal reach	WR1	0.5	0.8	1.0	1.3	1.8	2.0	2.6	-
		WR2	0.6	1.0	1.3	1.7	2.4	2.6	-	-
		WR1	0.4	0.6	1.0	1.3	1.5	1.9	-	-

	Extended Reach	WR2	0.5	0.8	1.3	1.7	2.1	2.5	-	-
PDL (Polarization-dependent loss) (dB) Maximum Value			0.2	0.2	0.25	0.3	0.4	0.4	0.8	-
Operating Wavelength		WR1	1260-1360nm /1480-1625 nm							
		WR2	1260-1360nm /1480-1660 nm							
Return Loss(dB)			>55							
Dire`ctivity(dB)			>55							
Fibre type			Single mode Fibre, G.652/G.657A compliant both sides							

Table-2 2xN Symmetrical splitter - optical specifications

The following optical specifications must be met under any combination of environmental, mechanical, and polarization conditions. All values listed in this Table do not account for connectors loss.										
Splitter			2x2	2x4	2x8	2x1	2x3	2x6	2x	2x2
						6	2	4	128	56
Insertion Loss Maximum (dB)(CR)	Normal Reach	WR1	4.2	7.7	11.2	14.7	18.2	21.7	26	29
		WR2	4.3	7.9	11.5	15.1	18.7	22.3	-	
	Extended Reach	WR1	4.1	7.5	10.9	14.3	17.7	21.1	-	
		WR2	4.2	7.7	11.2	14.7	18.2	21.7	-	
Uniformity maximum (dB	Normal reach	WR1	0.9	1.3	1.7	2.1	2.5	2.9	3.0	
		WR2	1.0	1.5	2.0	2.5	3.0	3.5	-	
	Extended Reach	WR1	0.8	1.2	1.6	2.0	2.4	2.8	-	
		WR2	0.9	1.4	1.9	2.4	2.9	3.4	-	
PDL (dB) maximum Value			0.3	0.3	0.4	0.4	0.5	0.5	0.8	
Operating Wavelength		WR1	1260-1360nm /1480-1625 nm							
		WR2	1260-1360nm /1480-1660 nm							

Return Loss(dB)	>55
Directivity(dB)	>55
Fibre type	Single mode Fibre, G.652/G.657A compliant both sides

3.2 Specifications of WDM coupler based on the applications and requirements

Case1: WDM Coupler with GPON and RF video

The first case is defined when WDM Coupler is used to combine the downstream video wavelength of 1550nm. Multiple dedicated wavelengths may be used, as per the ITU-T Rec. G.984.x, for various applications e.g. voice, video, internet, data etc., and enabling combined optical transmission through a single fiber. For example, two dedicated wavelengths may be used for downstream and upstream (~1490nm & 1310nm respectively) for data and voice transport and other one (~1550nm) may be used for downstream video.

Table 3 – Parameters and Specifications for WDM Coupler with GPON and RF video

S. N.	Parameters	Minimum	Maximum	Unit	Remarks
1.	Video Band (RF video)	1539	1564	nm	$\lambda 3$
2.	Data band (GPON)	1260 1480	1360 1500	nm	$\lambda 1$ $\lambda 2$
3.	Video Isolation	20	-	dB	Port COM to RF video
4.	Data isolation	20	-	dB	Port COM to Data port worst point over data isolation
5.	Insertion loss GPON band	-	0.8	dB	Loss without connector
6.	Insertion loss Video band	-	1.0	dB	Loss without connector

7.	PMD		0.1	ps	All ports over data and video bands
8.	PDL		0.1	dB	All ports over data and video bands
9.	CD	-1	1	Ps/nm	All ports over data and video bands
10.	Directivity	55		dB	All ports over data and video bands
11.	Return Loss	55		dB	All ports over data and video bands
12.	Input power		24	dB	All ports over data and video bands

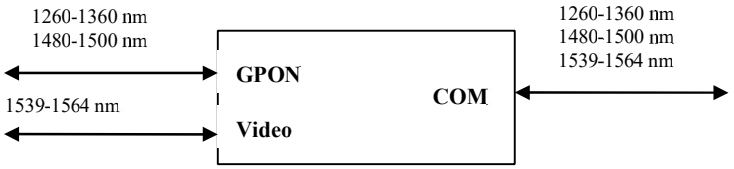


Figure 4 – Reference diagram of a WDM with GPON and Video support

Case2: WDM Coupler with GPON and OTDR

This case is defined when WDM Coupler is combining GPON band with OTDR. For GPON, two dedicated wavelengths may be used for downstream and upstream (~1490nm & 1310nm respectively) for data and voice transport. The wavelength range 1615-1660 nm may be used for OTDR signal.

Table 4 – Parameters and Specifications for WDM Coupler with GPON and OTDR

S. N.	Parameters	Minimum	Maximum	Unit	Remarks
1.	Data band (GPON)	1260 1480	1360 1500	nm	
2.	OTDR	1615	1660	nm	
3.	OTDR Isolation	15	-	dB	Port COM to OTDR

4.	Data isolation	30	-	dB	Port COM to Data port worst point over data isolation
5.	Insertion loss GPON band	-	1.0	dB	Loss without connector
6.	Insertion loss OTDR	-	0.9	dB	Loss without connector
7.	PMD		0.1	ps	
8.	PDL		0.1	dB	
9.	Directivity	50		dB	
10.	Return Loss	45		dB	

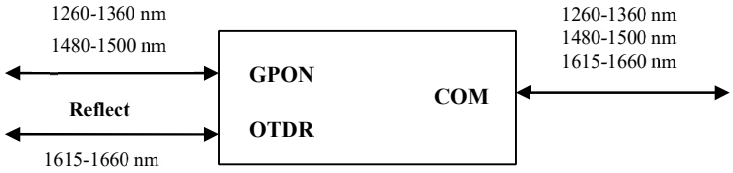


Figure 5 – Reference diagram of a WDM with G-PON and OTDR support

Case3: WDM1r Coupler with GPON, XGPON, OTDR and Video

This case is defined by GPON network coexisting XGPON along with video and OTDR. The wavelength range assumed for the OTDR is referred from [ITU-T L.66]. Figure 6 shows the reference diagram of this filter.

Table 5 – Parameters and Specifications for WDM1r Coupler with GPON, XGPON, OTDR and Video

S. N.	Parameters	Minimum	Maximum	Unit	Remarks
1.	Data band (GPON)	1290 1480	1330 1500	nm	$\lambda 1$ $\lambda 2$
2.	Data band (XGPON)	1260 1575	1280 1581	nm	$\lambda 3$ $\lambda 4$
3.	Video Band	1550	1560	nm	$\lambda 5$
4.	OTDR	1625	1675	nm	$\lambda 6$

5.	Data isolation (GPON)	30		dB	Port COM-GPON, worst point over data bands
6.	Data isolation (XGPON)	30		dB	Port COM-XGPON, worst point over data bands
7.	Video isolation	30		dB	Port COM to RF video excluding connector loss
8.	OTDR isolation	30		dB	Port Com- OTDR excluding connector loss
9.	Insertion Loss (GPON bands)		1.0	dB	Loss without connectors
10.	Insertion Loss (XGPON bands)		1.5	dB	Loss without connectors
11.	Insertion Loss (Video bands)		1.7	dB	Loss without connectors
12.	Insertion Loss (OTDR bands)		1.1	dB	Loss without connectors
13.	PDL		0.1	dB	
14.	PMD		0.1	ps	
15.	CD	-1	1	ps/nm	
16.	Input power		23	dB	
17.	Directivity	50		dB	
18.	Return Loss	50		dB	

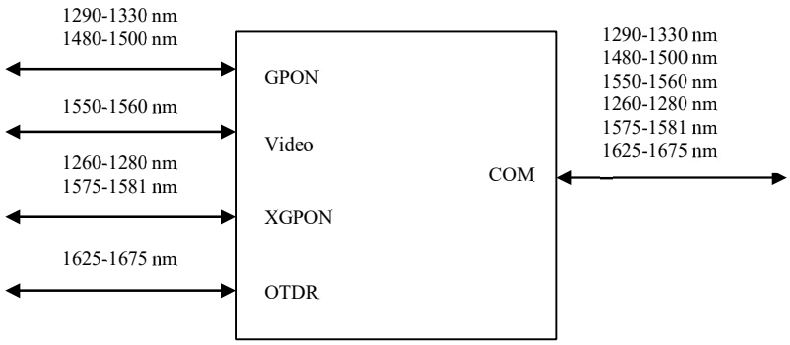


Figure 6 – Reference diagram of a WDM1r with GPON, RF video, XGPON and OTDR support

Case4: WDM1r Coupler (CEx) with GPON, XGPON, OTDR and NGPON2

This case is defined by GPON coexisting with NGPON2, XGPON and OTDR

Assumptions for this scenario are listed below

Total tolerated penalty (caused by finite isolation and directivity) = 0.5 dB

i. ODN maximum differential loss =15dB
ii. ODN Class = C+
iii. Number of NGPON2 channels = 8 TWDM + 8 PTP WDM iv. No isolation is assumed to be provided by the NGPON2 WDM v. NGPON2 OPP values corresponding to the 8 ch, 20 km case
vi. OTDR equipment is assumed to include an input filtering device providing 30 dB of isolation
vii. OTDR pulse power = +23 dBm, ER=10 dB, Rate = 100 Mbit/s

Table 6 – Parameters and Specifications for WDM1r Coupler (CEx) with GPON, XGPON, OTDR and NGPON2

S. N.	Parameters	Minimum	Maximum	Unit	Remarks
1.	Data band (GPON)	1290 1480	1330 1500	nm	λ1 λ2
2.	Data band (XGPON)	1260 1575	1280 1581	nm	λ3 λ4
3.	Data band (NGPON2)	1524 1596	1544 1625	nm	λ5 λ6
4.	OTDR	1640	1660	nm	λ7
5.	Data isolation (GPON)	35		dB	Port COM-GPON

6.	Data isolation (XGPON)	35		dB	Port COM-XGPON,
7.	Data isolation (NGPON2)	40		dB	Port COM to NGPON2
8.	OTDR isolation	10		dB	Port COM- OTDR
9.	Insertion Loss (GPON bands)		1.0	dB	Loss without connectors
10.	Insertion Loss (XGPON bands)		1.5	dB	Loss without connectors
11.	Insertion Loss (Video bands)		1.7	dB	Loss without connectors
12.	Insertion Loss (GPON bands)		1.1	dB	Loss without connectors
13.	PDL		0.1	dB	
14.	PMD		0.1	ps	
15.	CD	-1	1	ps/nm	
16.	Input power		23	dB	
17.	Directivity GPON XGPON NGPON2	 40 45 55		dB	
18.	Directivity to	25		dB	
	OTDR port				
19.	Return Loss	50		dB	

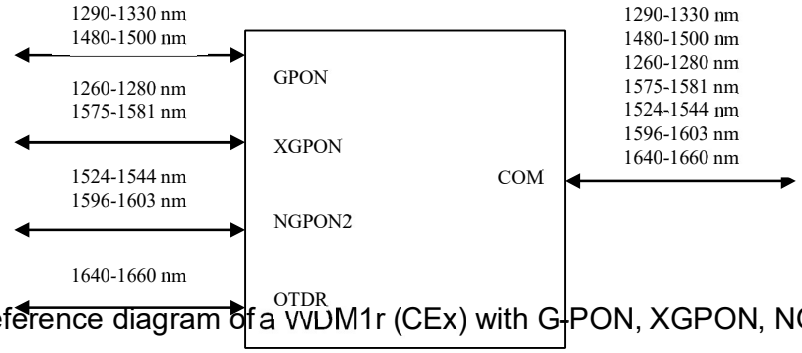


Figure 7 – Reference diagram of a WDM1r (CEx) with G-PON, XGPON, NGPON2 and OTDR support

Case5: WDM1r Coupler (CE) with GPON, XGSPON, NGPON2 and PtP WDM

This case is defined by GPON coexisting with NGPON2, XGSPON and PtP WDM

Table 7 – Parameters and Specifications for WDM1r Coupler (CE) with GPON, XGSPON, NGPON2 and PtP WDM

S. N.	Parameters	Minimum	Maximum	Unit	Remarks
1.	Data band (GPON)	1290 1480	1330 1500	nm	λ1 λ2
2.	Data band (XGSPON)	1260 1575	1280 1581	nm	λ3 λ4
3.	Data band (NGPON2)	1524 1596	1544 1603	nm	λ5 λ6
4.	Data band (PtP WDM PON)	1606	1625	nm	λ7
5.	Isolation - GPON	30		dB	Isolation @ XGSPON & NGPON2 & PtP WDM PON
6.	Isolation- XGSPON	30		dB	Isolation @ GPON & NGPON2 & PtP WDM PON
7.	Isolation- NGPON2	30		dB	Isolation @ GPON & XGSPON & PtP WDM PON

8.	Isolation-Ptp WDM	30		dB	Isolation @ GPON & XGSPON & NGPON2
9.	Insertion Loss (GPON bands)		0.8	dB	Loss without connectors
10.	Insertion Loss (XGSPON bands)		1.3	dB	Loss without connectors
11.	Insertion Loss (NGPON2)		1.4	dB	Loss without connectors
12.	Insertion Loss (PtP WDM PON)		1.6	dB	Loss without connectors
13.	PDL		0.2	dB	
14.	PMD		0.1	ps	
15.	Ripple		0.3	dB	
16.	Input power		23	dB	
17.	Directivity	50		dB	For port of GPON, XGSPON and NGPON2
18.	Return Loss	45		dB	
19.	Optical power		27	dB	

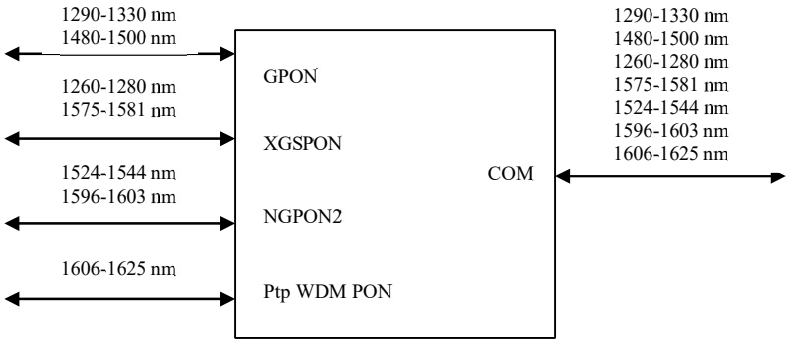


Figure 8 – Reference diagram of a WDM1r (CEx) with GPON, XGSPON, NGPON2 and PtP WDM PON support

Case 6: WDM Coupler for NGPON2

WDM for NGPON2 wavelengths.

Table 8 – Specifications and Parameters for WDM Coupler for NGPON2

S.N.	Parameters		Min	Max	Unit
1)	Operating wavelength (NGPON2)		1532 1596	1540 1603	nm
2)	Centre wavelength	Down	1596.34,1597.19,1598.04,1598.89		nm
3)		Up	1532.68,1533.47,1534.25,1535.04		nm
4)	Central space			0.8	nm
5)	Passband			±0.11	Nm
6)	Insertion Loss	1596.34/1532.68		2.3	dB
7)		1597.19/1533.47		2.3	dB
8)		1598.04/1534.25		2.3	dB
9)		1598.89/1535.04		2.3	dB
10)	Isolation (adjacent channel)		30		dB
11)	Isolation (Non-adjacent Channel)		35		dB
12)	Directivity		50		dB
13)	Return Loss		45		dB
14)	PDL			0.3	dB
15)	PMD			0.1	ps
16)	Output power			23	dBm
17)	Fiber type		G.657A1		

3.3 Connectors & Adapters: The SC/UPC, SC/APC, LC/UPC or LC/APC connectors and adapters shall be used in the system. The following optical specifications must be met under any combination of environmental, mechanical and polarization conditions:

Table-9

Parameter	Condition	Specifications		Unit
		Minimum	Maximum	
Insertion Loss (CR)	Mated pair	-	0.3	dB
Return Loss	UPC	50	-	dB
	APC	60	-	dB
Ferrule material		Ceramic (Zirconia)		
Adaptor sleeve		Ceramic (Zirconia)		

Note: UPC connectors are good enough when the video overlay is not deployed. APC connectors are a must when the video overlay is deployed.

4.0 General Requirement

4.1 Optical Splitter/WDM coupler shall be manufactured as per the latest state-of-art technology.

4.2 It shall be compact in design and its construction shall be inherently robust and rigid for all conditions of operation adjustment, replacement, storage and transport.

4.3 The equipment shall be composite in construction and light weight. The manufacturers shall furnish the actual dimensions and weight of the equipment.

4.4 All the connectors shall be reliable and of standard type to ensure failure free operation over long periods and under specified environmental conditions.

4.5 All the connectors and the cable shall be of low loss type and suitably shielded.

4.6 Optical Splitter /WDM coupler shall be protected against the entry of dust and insect.

4.7 It shall be able to work without any degradation in saline atmosphere in coastal areas and should be protected against corrosion.

4.8 It shall be accessible for operation, testing and easy handling from front side.

4.9 The thickness of powder coating shall be 70-100 microns minimum in case of metal enclosure.

5.0 Operational Requirement

5.1 System for Optical Splitter/WDM coupler shall be able to accommodate module, incoming and outgoing cables/Patch Cords (PC)/Pig Tails (PT) in a systematic manner.

5.2 It shall have sufficient provision for storing the extra length of Optical Fibre/Patch Cords/Pig Tails.

5.3 It shall allow an easy opening and closing without any degradation in the performance of Patch Cords/Pig tail.

5.4 Identification mechanism of incoming (1XN or 2XN) and outgoing (1,2…N) cables/ Patch Cords/Pig Tails shall be provided.

5.5 Suitable cap shall be provided for all connectors to avoid entry of dust for unused connectors

5.6 Marking for port numbering for Optical Splitter/WDM coupler shall be provided.

5.7 Marking shall be provided on the body of Optical Splitter /WDM coupler for input and output port as well as on the adapter panel. Marking for indication of input side or output side should also be provided on the adapter panel.

6.0. Quality Requirements

6.1 It shall be manufactured in accordance with the international quality standards ISO 9001:2015 series of standards for which the manufacturer shall be duly accredited.

6.2 The product shall conform to the requirements for environment as specified in the latest TEC Standard SD: QM-333 - “Standard for Environmental Testing of Telecommunication Equipment” (No TEC 14016:2010). The applicable tests shall be conducted for respective environmental categories as follows:

1xN & 2xN symmetrical splitters

At Cabinet/Pole (outdoor):	QM-333 ‘E’ category.
At MDU/MTU /Central office (indoor):	QM-333 ‘E’ category.

WDM Coupler

At Cabinet/Pole (outdoor):	QM-333 'E' category.
At MDU/MTU /Central office (indoor):	QM-333 'E' category.

Connectors

At Cabinet/Pole (outdoor):	QM-333 'E' category.
At MDU/MTU /Central office (indoor):	QM-333 'E' category.

Note:

(i) The Environmental category of product will be based on declaration of intended use by manufacturer.

(ii) "Rain" environment test shall be conducted in case of outdoor deployment of the products.

7.0 **Marking**: Marking should be provided on the box of the Optical Splitter /WDM coupler indicating the following information by the method of screen printing or other suitable method.

i. Logo/ Name of the Service Provider :
ii. Type of PON Splitter with capacity & Model No.:
iii. Type of WDM coupler with wavelength & Model No.:
iv. Serial No.:
v. Batch No. & Date/Year of Production:
vi. Name of the Manufacturer:

8.0 **Type Approval**: Type approval may be taken for either of optical splitters or WDM coupler against this standard.

CHAPTER-2

9.0 Information for the procurer of product

9.1 Optical splitters are capable of providing up-to 1: 256 optical splits, on end to end basis, per PON interface on OLT, are envisaged. There shall be various options provided to purchaser such as m: N splits where m = 1 or 2 and N = 2,4, 8, 16, 32,64,128 and 256. The user user may use a combination of these split options. (Clause 1.1).

9.2 The connector type supplied should be as mentioned in purchase order / tender specifications.(Clause 2.2.1(a)(iv)).

9.3 Type 2: Rack mounted splitter: These shall be mounted on a rack which has 19" / ETSI mounting frames. The unit shall be supplied with suitable Mounting brackets movable or fixed (as desire by the user). In general, unit may have following dimensions; (i) mx2 / mx4 / mx16 shall be supplied in 1U, (ii) mx32 in 2U and (iii) mx64 shall be supplied in 3U where m is number of inputs. However exact requirement of “dimension” shall be specified by the user. The Input and output shall be terminated with suitable connectors for connecting to the adapters in the front panel. The front panel should have adapters mounted. The maximum depth of the unit shall not exceed 280mm. The adapters shall be clearly numbered and inputs and outputs be clearly identified. User will specify connector/adopter type to be supplied. (Clause 2.2.1(b)).

9.4 In general, Box may have following mountings, however exact requirement of “number of splitters, number of splice sleeve mounting capacity, splice position for mid-span cable splice, number of SC type adopters, dimension of mid-span cable, and number, diameter and shape of drop cable” shall be specified by the user. (Clause 2.2.1(c)(x))

9.5 Purchaser may specify the requirement of Splitter box size. (Clause 2.2.1(c)(xi))

ABBBREVIATIONS

ABS	Acrylonitrile Butadiene Styrene
APC	Angle Polished Connector
CE	Coexistence element
COM	Common port
CR	Coupling Ratio
ETSI	European Telecommunications Standards Institute
FDMS-OD	Fiber Distribution Management System-Outdoor
FTTH	Fibre to the home
GPON	Gigabyte Passive Optical Network
IC	Indoor in controlled temperature environment
IN	Indoor in non-temperature-controlled environment
ISO	International Organization for Standardization
LC	Lucent Connector
MDU	Multi Dwelling Unit
MS	Mild Steel
MTU	Multi Termination Unit
NGA	Next Generation Access
NGPON2	Next-Generation Passive Optical Network 2
nm	Nano meter
OA	Outdoor above ground level (aerial), mounted on a wall or pole.
OAN	Optical Access Network
ODN	Optical Distribution Network
OG	Outdoor at ground level, stored in a box or pedestal, standing on the ground, with a base that may reside partially underground.
OJC	Optical Joint Closure
OLT	Optical Line Terminal
OMI	Optical Modulation Index
ONU	Optical Network Unit
ONT	Optical Network Termination
OTDR	Optical Time Domain Reflectometer

PDL	Polarization Dependent Loss
PLC	Planar Light Circuit
PMD	Physical Media Dependent
PON	Passive Optical Network
ps	Pico second
ptp	Point to Point
QM	Quality Manual
RF	Radio Frequency
SC	Square Connector
SNI	Service Node interface
UNI	User Network Interface
UPC	Ultra-Polished Connector
UV	Ultraviolet
V-Rx	Video receiver
V-Tx	Video transmitter
WBF	Wavelength Blocking Filters
WDM	Wavelength Division Multiplexing
XGPON	10 Gigabyte Capable Passive Optical Network

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