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INTERNATIONAL STANDARD

colour inside

Fibre optic active components and devices – Performance standards – Part 5: ATM-PON transceivers with LD driver and CDR ICs

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FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 5: ATM-PON transceivers with LD driver and CDR ICs

FOREWORD

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International Standard IEC 62149-5 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2009 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) description of types in Clause 4 has been removed;

b) titles of reference documents have been updated.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
86C/1667/FDIS	86C/1678/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62149 series, published under the general title *Fibre optic active components and devices – Performance standards,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Fibre optic transceivers are used to convert electrical signals into optical signals and vice versa. The optical performance criteria are generally well specified for a number of internationally agreed applications areas such as ITU-T Recommendation G.983.1 and IEEE Std 802.3. This document aims to assure inter-changeability in performance between fibre optic transceivers for ATM-PON (ATM-based broadband passive optical network) systems supplied by different manufacturers but does not guarantee operation between fibre optic transceivers.

Manufacturers using this document are responsible for meeting the required performance and/or reliability and quality assurance under a recognized scheme.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 5: ATM-PON transceivers with LD driver and CDR ICs

1 Scope

This part of IEC 62149 specifies performance on the transceiver modules for asynchronous-transfer-mode passive optical network (ATM-PON) systems recommended by the International Telecommunication Union (ITU) in ITU-T Recommendation G.983.1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-6~~:2007~~, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27~~:2008~~, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60332-3-24, *Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

IEC 60825-1~~:2007~~, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60950-1~~:2005~~, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61280-1-1~~:1998~~, *Fibre optic communication subsystem basic test procedures – Part 1-1: Test procedures for general communication subsystems – Transmitter output optical power measurement for single-mode optical fibre cable*

IEC 61280-1-3~~:1998~~, *Fibre optic communication subsystem ~~basic~~ test procedures – Part 1-3: ~~Test procedures for~~ General communication subsystems – Central wavelength and spectral width measurement*

IEC 61280-2-2~~:2008~~, *Fibre optic communication subsystem test procedures – Part 2-2: Digital systems – Optical eye pattern, waveform and extinction ratio measurement*

IEC 61300-2-4~~:1995~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre~~/~~ or cable retention*

IEC 61300-2-17~~:2003~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

IEC 61300-2-18~~:2005~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19~~:2005~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

IEC 61300-2-22~~:2007~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-3-6~~:2003~~, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61753-1~~:2007~~, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance ~~for performance standards~~*

~~IEC 61931, *Fibre optic – Terminology*~~

IEC 62148-1, *Fibre optic active components and devices – Package and interface standards – Part 1: General and guidance*

IEC 62150-2~~:2004~~, *Fibre optic active components and devices – Test and measurement procedures – Part 2: ATM-PON transceivers*

ITU-T Recommendation G.957:2006, *Optical interfaces for equipments and systems relating to the synchronous digital hierarchy*

ITU-T Recommendation G.983.1:2005, *Broadband optical access systems based on Passive Optical Networks (PON)*

3 Term, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

NOTE Further terminology concerning related physical concepts, types of devices, general terms, and terms related to ratings and characteristics can be found in IEC 61931. See also ITU-T Recommendation G.983.1.

3.1.1
optical access network
OAN
set of access links sharing the same network-side interfaces and supported by optical access transmission systems

Note 1 to entry: The OAN ~~may~~ can include a number of ODNs connected to the same OLT.

3.1.2
optical distribution network
ODN
apparatus or component that provides the optical transmission means from the OLT to the users and vice versa

Note 1 to entry: The ODN utilizes passive optical components.

3.1.3
optical line termination
OLT
apparatus that provides the network-side interface of the OAN and is connected to one or more ODNs

3.1.4
optical network unit
ONU
apparatus that provides (directly or remotely) the user-side interface of the OAN, and is connected to the ODN

3.2 Abbreviated terms

ATM-PON	asynchronous transfer mode passive optical network
ATT	attenuator
BER	bit error ratio
CDR	clock and data recovery
CMOS	complementary metal-oxide semiconductor
DUT	device under test
~~ERD~~	~~Error ratio detector~~
~~EX~~	~~Extinction ratio~~
~~FTT Cab/C/B/H~~	~~Fibre to the cabinet/curb/building/home~~
IC	integrated circuit
LD	laser diode
MLM	multi-longitudinal mode
~~PPG~~	~~Pulse pattern generator~~
RMS	root mean square
SLM	single-longitudinal modes

4 Classification

Fibre optic transceiver modules are classified into ~~5~~ several types of forms according to the combination of mating types of electrical and optical interfaces (for details, see IEC 62148-1). ~~Those combinations include the following:~~

~~Type 1: Fibre optic connector interface with direct solderable type electrical terminals.~~

~~Type 2: Fibre optic connector interface with plug-in type electrical terminals.~~

~~Type 3: Fibre optic pigtail interface with direct solderable type electrical terminals.~~

~~Type 4: Fibre optic pigtail interface with plug-in type electrical terminals.~~

~~Type 5: Modules are not classified into type 1 to type 4. (A typical example is a module that has both electrical connectors and non-connector type terminals as an electrical interface such as a coaxial connector for signal and lead terminals for the power supply.)~~

5 Product definition

5.1 Description of transceiver module

Information on the following devices constituting the optical transceiver module shall be stated. This statement shall include details of technologies. For example, technologies used for ICs such as CMOS, bipolar, etc., shall be described.

- For a transmitter:
  - laser diode (in this description, a single- or a multi-longitudinal mode type shall be specified);
  - monitoring photodiode;
  - driver IC;
  - thermal sensor (where appropriate).
- For a receiver:
  - photodiode;
  - pre-amp IC;
  - data/clock recovery IC.
- For a wavelength division multiplexer device:
  - technology used for this device.
- For a package:
  - refer to the ~~IEC document number standardized as a package interface standard~~ IEC 62148 series.

5.2 Description of applied form

According to ITU-T Recommendation G.983.1, the applied form of nominal bit rate, the class (class B or class C), the applied unit (ONU or OLT), and the number of fibres (one for duplex working or two for simplex working) shall be stated.

5.3 Block diagram

A block diagram or equivalent circuit information on the optical transceiver module shall be given (see Figure 1).

The following terminals may be distinguished:

- supply terminals, i.e., terminals intended to be connected to the power supplies;
- input and output terminals, i.e., terminals into or out of which signals are passed.

The term "signal" includes both pulse and more complex waveforms and includes strobe or control pulses.

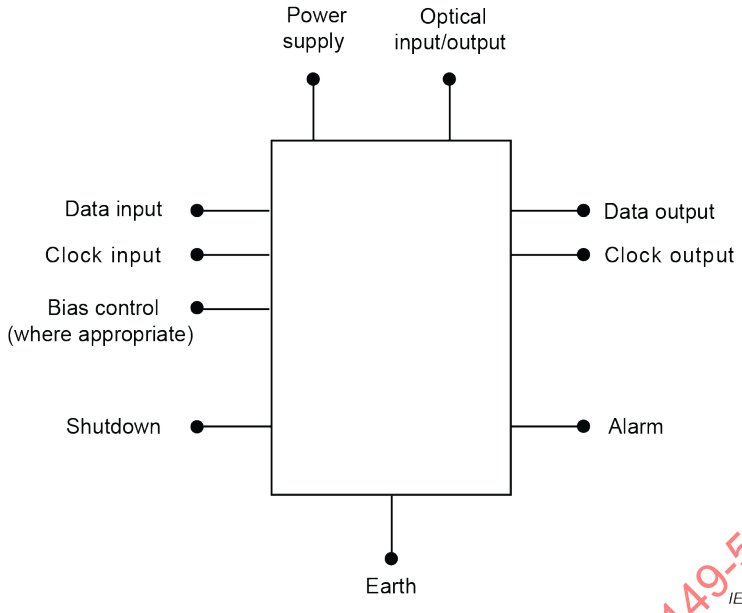


Figure 1 – Functional block diagram (example)

5.4 Absolute limiting rating

Absolute limiting (maximum) ratings imply that no catastrophic damage will occur if the product is subjected to these ratings ~~for short periods~~, provided each limiting parameter is in isolation and all other parameters have values within the normal performance parameters. It should not be assumed that limiting values of more than one parameter could be applied at any one time.

Table 1 – Absolute maximum ratings

Items	Condition	Letter symbol	Requirements		Units
			Minimum	Maximum	
Storage temperature[a]		T_{stg}	–40	85	°C
Storage relative humidity		H_{stg}	5	95	%
Bend radius of pigtail for ~~type 3, 4, and 5~~ transceivers (at specified distance from the case)[b]		r	30		mm
Shock[c]	Pulse ~~cycle~~ duration: 18 ms 3 times/axis			300	m/s^2
Vibration[d]	10 Hz to 55 Hz, 3 axes, 1,5 mm, 2 h			100	m/s^2
Tensile force on devices with pigtail Buffer-coated fibre[e] Reinforced fibre[e]		F		5 100	N
Electrical limiting values					
– Power supply voltage		~~V_{SUPmax}~~ U_{SUPmax}	−0,5	4,0	V
– Input voltage		~~V_{INmax}~~ U_{INmax}	−0,5	~~V_{sup}~~ U_{sup}	V
– Output voltage		~~V_{OUTmax}~~ U_{OUTmax}	0	~~V_{sup}~~ U_{sup} + 0,5	V
– Output current PECL interface LVTTL interface		I_{OUTmax}	 0 −20	 50 20	mA
Optical limiting values					
– Permissible input power		P_{in}		−5	dBm

[a] Ambient temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

[b] IEC 62148-1 shall be referred to for detail.

[c] IEC 60068-2-27 shall be referred to for detail.

[d] IEC 60068-2-6 shall be referred to for detail.

[e] ~~For the requirements see~~ The requirements of IEC 61753-1 shall be applied.

5.5 Functional specification

Electro-optical characteristics for the items in Table 3 shall be satisfied at the operating environmental conditions specified in Table 2.

~~NOTE~~ Optical characteristics specified in ITU-T Recommendation G.983.1 should be satisfied.

Each electrical and optical characteristic~~s~~ of 5.5 shall be measured under conditions specified in each reference.

Each electrical and optical characteristic of 5.5 shall be stated under specified worst-case conditions, with respect to the recommended range of operating conditions as stated. The measuring method of each electrical and optical characteristics specified in Table 3 shall be measured based on the method stated in the reference of each row.

Table 2 – Operating environment

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Power supply voltage	~~V_{SUP}~~ U_{SUP}	3,135	3,3	3,465	V
Operating case temperature[a]	T_{case}	–5		75	°C
Ambient relative humidity[a]	RH	5		95	%

[a] Operating case temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

Table 3 – Electrical and optical characteristics

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
1	Nominal bit rate	B		155,52		Mb/s	
2	Mean launched power[a] – Class B – Class C	P_{mean}	 –4 –2		 +2 +4	dBm	IEC 61280-1-1
3	Transmitter wavelength	λ	1 260		1 360	nm	IEC 61280-1-3
4	Mask of transmitter eye diagram[b]	–					
5	Extinction ratio	~~Ex~~ r_{Ex}	10			dB	IEC 61280-2-2
6	For MLM laser, maximum RMS width	$\Delta\lambda$			5,8	nm	IEC 61280-1-3
7	For SLM laser, maximum –20 dB width	$\Delta\lambda$			1,0	nm	IEC 61280-1-3
8	For SLM laser, minimum side mode suppression ratio	~~SMSR~~ r_{SMSR}	30			dB	IEC 61280-1-3
9	Maximum reflectance measured at transmitter wavelength	R_{TX}	–6			dB	IEC 61300-3-6, ~~4.1~~
10	Receiver overload: – Class B – Class C	S_O	 –8 –11			dBm	IEC 62150-2
11	Receiver sensitivity: – Class B – Class C	S			 –30 –33	dBm	IEC 62150-2
12	Maximum reflectance measured at receiver wavelength	R_{RX}	–20			dB	IEC 61300-3-6, ~~4.1~~
13	Tolerance to the reflected optical power[c]				10	dB	ITU-T G.957:2006, Appendix III
14	Clock input voltage (high)	See Table 4 and Table 5					
15	Clock input voltage (low)	See Table 4 and Table 5					
16	Clock input voltage (swing centre)	See Table 4 and Table 5					
17	Data input voltage (high)	See Table 4 and Table 5					
18	Data input voltage (low)	See Table 4 and Table 5					
19	Data input voltage (swing centre)	See Table 4 and Table 5					
20	Clock output voltage (high)	See Table 4 and Table 5					
21	Clock output voltage (low)	See Table 4 and Table 5					

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
22	Data output voltage (high)	See Table 4 and Table 5					
23	Data output voltage (low)	See Table 4 and Table 5					
24	Alarm output voltage (high)[d]	See Table 6 and Table 7					IEC 62150-2
25	Alarm output voltage (low)[d]	See Table 6 and Table 7					IEC 62150-2
26	Shutdown input voltage (high)[e]	See Table 8					IEC 62150-2
27	Shutdown input voltage (low)[e]	See Table 8					IEC 62150-2
28	Bias control voltage (high)[f]	U_{BiasH}					
29	Bias control voltage (low)[f]	U_{BiasL}					
30	Line code		Scrambled NRZ				
31	Launched optical power without input to transmitter[g] – Class B – Class C		−40 −43			dBm	IEC 61280-1-1
32	Tolerance to the transmitter incident light power[g]		−15			dB	
33	Consecutive identical digit immunity[b]						
34	Jitter generation[b]						
35	Jitter tolerance[b]						
36	Jitter transfer[b]						

[a] Pseudo random data shall be put into the transmitter according to the specification of 8.2.6.3 of ITU-T Recommendation G.983.1:2005.

[b] These items shall be specified so as to meet the specifications of ITU-T Recommendation G. 983.1.

[c] This item shall be measured based on the measuring method described in the reference. See Annex A for more detail.

[d] With logic 'low', an alarm signal is effective. The alarm test shall be done whether logic 'low' is put out when no optical power is launched to the transceiver, and logic 'high' is put out when optical power more than that specified in item 11 is launched to the transceiver (see Annex B).

[e] With logic 'low', a shutdown signal is effective. The shutdown test shall be done whether optical power less than that specified in item 31 is launched when logic 'low' is put into the 'shutdown' terminal, and optical power within the range specified in item 2 is launched when logic 'high' is put into the 'shutdown' terminal (see Annex B).

[f] These items shall be specified between vendors and users.

[g] Measurement methods on these items are stated in 5.5.

The clock and data input/output interface shall be satisfied with either the specification listed in Table 4 or Table 5. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 4 – Electrical interface characteristics (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	~~$V_{CINH} - V_{SUP}$~~ $U_{CINH} - U_{SUP}$	−1,17		−0,88	V
Clock input voltage (low)	~~$V_{CINL} - V_{SUP}$~~ $U_{CINL} - U_{SUP}$	−1,81		−1,43	V
Data input voltage (high)	~~$V_{DINH} - V_{SUP}$~~ $U_{DINH} - U_{SUP}$	−1,17		−0,88	V
Data input voltage (low)	~~$V_{DINL} - V_{sup}$~~ $U_{DINL} - U_{sup}$	−1,81		−1,43	V
Clock output voltage (high)[a]	~~$V_{COUTH} - V_{SUP}$~~ $U_{COUTH} - U_{SUP}$		−0,96		V
Clock output voltage (low)[a]	~~$V_{COUTL} - V_{SUP}$~~ $U_{COUTL} - U_{SUP}$		−1,71		V
Data output voltage (high)[a]	~~$V_{DOUTH} - V_{SUP}$~~ $U_{DOUTH} - U_{SUP}$		−0,96		V
Data output voltage (low)[a]	~~$V_{DOUTL} - V_{SUP}$~~ $U_{DOUTL} - U_{SUP}$		−1,71		V
[a] Outputs terminated to ~~V_{SUP}~~ U_{SUP} – 2 V.					

Table 5 – Electrical interface characteristics (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	~~V_{CINH}~~ U_{CINH}	~~V_{CINL}~~ U_{CINL} + 0,3		~~V_{SUP}~~ U_{SUP}	V
Clock input voltage (low)	~~V_{CINL}~~ U_{CINL}	0		~~V_{CINH}~~ U_{CINH} – 0,3	V
Clock input voltage (swing centre)	~~$V_{Ccenter}$~~ $U_{Ccenter}$	~~V_{SUP}~~/U_{SUP}/ 2 – 0,1		~~V_{SUP}~~/U_{SUP}/ 2 + 0,1	V
Data input voltage (high)	~~V_{DINH}~~ U_{DINH}	~~V_{DINL}~~ U_{DINL} + 0,3		~~V_{SUP}~~ U_{SUP}	V
Data input voltage (low)	~~V_{DINL}~~ U_{DINL}	0		~~V_{DINH}~~ U_{DINH} + 0,3	V
Data input voltage (swing centre)	~~$V_{Dcenter}$~~ $U_{Dcenter}$	~~V_{SUP}~~/U_{SUP}/ 2 – 0,1		~~V_{SUP}~~/U_{SUP}/ 2 + 0,1	V
Clock output voltage (high)[a]	~~V_{COUTH}~~ U_{COUTH}	~~V_{TT}~~ U_{TT} + 0,4			V
Clock output voltage (low) [a]	~~V_{COUTL}~~ U_{COUTL}			~~V_{TT}~~ U_{TT} – 0,4	V
Data output voltage (high)[a]	~~V_{DOUTH}~~ U_{DOUTH}	~~V_{TT}~~ U_{TT} + 0,4			V
Data output voltage (low) [a]	~~V_{DOUTL}~~ U_{DOUTL}			~~V_{TT}~~ U_{TT} – 0,4	V
[a] ~~V_{TT}~~ U_{TT} = 1,5 V to 1,8 V					

The alarm output interface shall be satisfied with either the specification listed in Table 6 or Table 7. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 6 – Electrical interface characteristics of alarm output voltage (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	~~V_{ALH}~~ U_{ALH}	2,4			V
Alarm output voltage (low) [a]	~~V_{ALL}~~ U_{ALL}			0,4	V
[a] Test shall be performed with current at high level, I_{ALH} = –2 mA, and current at low level, I_{ALL} = 2 mA, at V_{SUP} between 3,135 V and 3,465 V.					

Table 7 – Electrical interface characteristics of alarm output voltage (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	~~V_{ALH}~~ U_{ALH}	~~V_{SUP}~~ U_{SUP} – 0,2			V
Alarm output voltage (low) [a]	~~V_{ALL}~~ U_{ALL}			0,2	V
[a] Test shall be performed with current at high level, I_{ALH} = –100 µA, and current at low level, I_{ALL} = 100 µA, at ~~V_{SUP}~~ U_{SUP} between 3,135 V and 3,465 V.					

Shutdown input interface shall be satisfied with ~~either~~ specifications listed in Table 8. New interface dimensions will be added properly.

Table 8 – Electrical interface characteristics of shutdown input voltage (both PECL and LVTTL types)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Shutdown input voltage (high)[a]	~~V_{SDH}~~ U_{SDH}	2,0		~~V_{SUP}~~ U_{SUP} + 0,3	V
Shutdown input voltage (low)[a]	~~V_{SDL}~~ U_{SDL}	–0,3		0,8	V
[a] Test shall be performed with ~~V_{SUP}~~ U_{SUP} between 3,135 V and 3,465 V.					

NOTE The interfaces listed in Table 6, Table 7 and Table 8 refer to EIA/JEDEC JESD8-B, with the exception of power supply voltage ~~V_{SUP}~~ U_{SUP}, which is ~~definitely~~ specified in Table 2.

Relationship of the phase between clock and data signals is shown in Figure 2. Phase of data signals are timed so that data signals are latched at a fall time of clock.

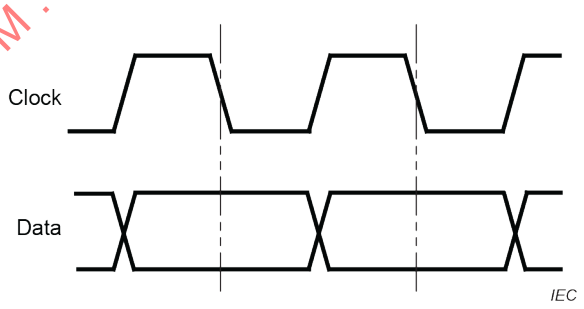


Figure 2 – Relationship of phase between clock and data signals

Examples of recommended electrical circuit diagrams for LVTTL-type interface are shown in Figure 3 a) and b).

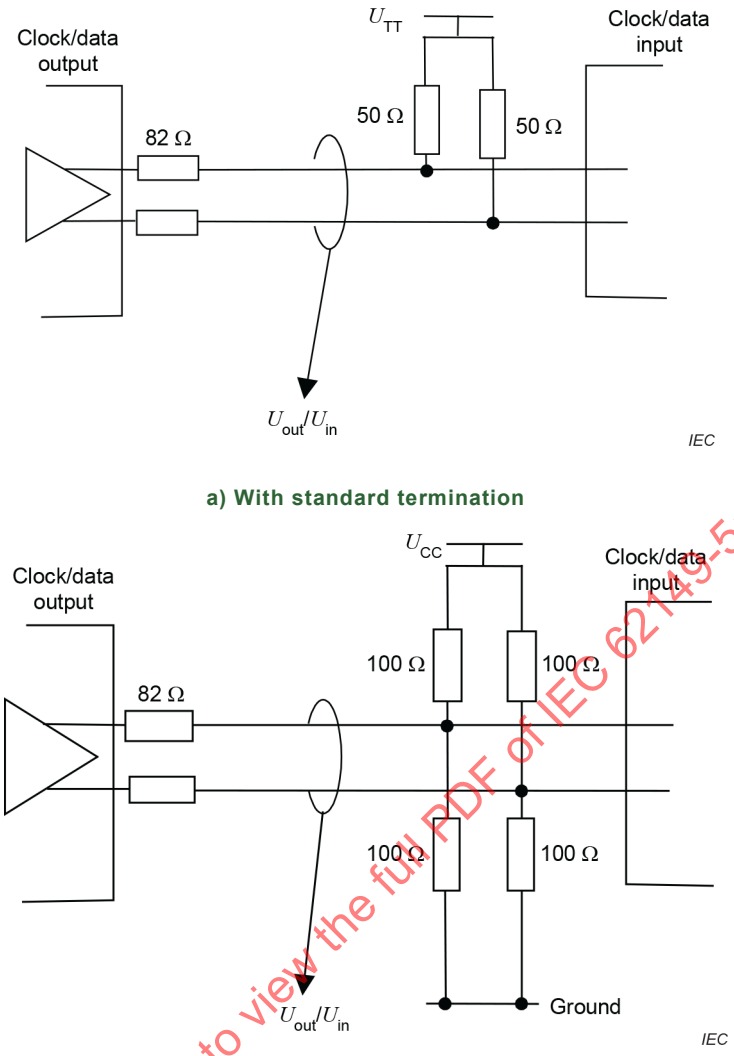


Figure 3 – Recommended electrical circuit diagram for LVTTL-type interface (examples)

Launched optical power without input to transmitter (Table 3, item 31) is schematically defined in Figure 4. The measuring method of the power shall basically follow IEC 61280-1-1, but it shall be specified in detail between vendors and users.

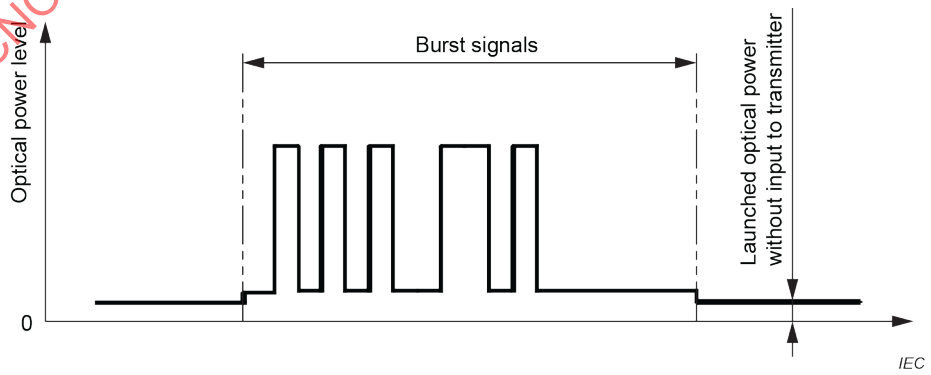


Figure 4 – Schematic drawing for defining launched optical power without input to transmitter

Tolerance to the transmitter incident light power (Table 3, item 32) is measured, for example, by an experimental setup shown in Figure 5. The value of reflection at the reflector is set so that incident light power back to the transmitter is 15 dB less than that of mean transmitter launching power. Pass/~~fall~~ fail criteria depend on whether or not the waveform of signals transmitted from the DUT and monitored at the waveform monitor satisfies the eye mask specified in Table 3, item 4.

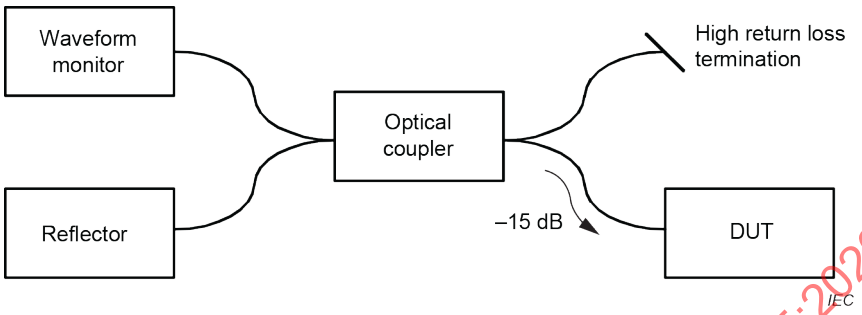


Figure 5 – ~~Schematic drawing for defining launched optical power without input to transmitter~~ Experimental setup for measuring tolerance to the transmitter incident light power

6 Testing

6.1 General

Initial characterization and qualification shall be undertaken. Qualification maintenance is carried out using periodic testing programs. Test case temperature conditions for all tests, unless otherwise stated, are 25 °C ± 2 °C.

6.2 Characterization testing

Characterization testing including both transmitter and receiver sections shall be carried out based on the specifications listed in Table 9 for the transmitter section and Table 10 for the receiver section. This testing shall be carried out on at least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. If any changes occur in the design of the transceiver, the testing shall be carried out again.

6.2.1 Characterization: transmitter section

Table 9 – Transmitter section characterization tests

Parameters	Test conditions	Test limit minimum	Test limit maximum	Unit
	As a minimum, 11 devices taken from a manufacturing lot for each user to be measured at case temperatures of (−5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and ~~V_{cc}~~ U_{cc} at (~~V_{nom}~~ U_{nom} − 5 %) V, (~~V_{nom}~~ U_{nom}) V and (~~V_{nom}~~ U_{nom} + 5 %) V			
Mean launched power	Single-mode fibre, PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – Class B – Class C	 −4,0 −2,0	 +2,0 +4,0	dBm
Central wavelength	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation	1 260	1 360	nm
Spectral width	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – MLM laser – SLM laser		 5,8 1,0	nm
Extinction ratio	155,52 Mbit/s square wave	10		dB
Mask test of eye diagram[a]	Fourth-order Thomson filter (cut-off frequency is 0,75 × 155,52 MHz), PRBS 2^{23} – 1 at 155,52 Mbit/s	No hits	No hits	
Shutdown test of launched power	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation, Shutdown input voltage: low level – Class B – Class C		 −40 −43	dBm

[a] Mask of the eye diagrams for downstream and upstream transmissions are specified in ITU-T Recommendation G.983.1.

6.2.2 Characterization: receiver section

Table 10 – Receiver section characterization tests

Parameters	Test conditions	Test limit minimum	Test limit maximum	Unit
	At minimum, 11 devices taken from an initial manufacturing lot to be measured at case temperatures of (–5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and ~~V~~$_{cc}$ U_{cc} at (~~V~~$_{nom}$ U_{nom} – 5 %) V, (~~V~~$_{nom}$ U_{nom}) V and (~~V~~$_{nom}$ U_{nom} + 5 %) V			
Sensitivity at ~~1E-~~ 10^{-10} BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10dB extinction ratio source – Class B – Class C		−30,0 −33,0	dBm
Overload at ~~1E-~~ 10^{-10} BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	−8 −11		dBm
Alarm on threshold[a]	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	−30,0 −33,0		dBm

[a] Alarm signal is effective with logic "low" specified in Table 6 and Table 7 when optical power less than that of threshold is launched to the transceiver.

6.3 Performance testing

Performance testing is undertaken to assure reliability of products when characterization testing is complete. The testing items, definite testing conditions and pass/fail criteria are listed in Table 11. This testing shall be carried out on at least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. The products may be new or sourced from a previous test.

Table 11 – Performance testing plan

Items	Reference	Condition	Criteria [a]	Failure
Mechanical shock	IEC 60068-2-27	300 m/s^2, 18 ms, 3 times/axis	$\lvert\Delta P_{mean}\rvert \leq 1$ dB $\lvert\Delta S_{min}\rvert \leq 1$ dB at 25 °C	0/11
Vibration	IEC 60068-2-6	100 m/s^2, 10Hz to 55 Hz, 3 axes, 1,5 mm, 2 h		
Fibre pull[b]	IEC 61300-2-4	100 N ± 2 N at 5 N/s, 120 s duration for reinforced cables 5 N ± 0,5 N at 0,5 N/s, 60 s duration for buffered fibres		
Temperature cycling[b]	IEC 61300-2-22	–40 °C to + 85 °C 1 h duration at extremes, more than 12 cycles		
High temperature storage[b]	IEC 61300-2-18	+85 °C, more than 96 h duration		
Low temperature storage[b]	IEC 61300-2-17	–40 °C, more than 96 h duration		
Damp heat[b]	IEC 61300-2-19	+40 °C ± 2 °C, RH: 93 % ± 2 %, 96 h duration		
Flammability	IEC 60332-3-24			

[a] Pass/fail criteria are specified to be 1 dB maximum change (or less) in mean launched power and receiver sensitivity, respectively. The quantity of 1 dB is determined to include the 0,5 dB pass/fail criteria specified in Telcordia GR-468-CORE and a 0,5 dB margin in measurement error.

[b] The testing conditions of these items may refer to Telcordia GR-468-CORE instead of IEC 61753-1 if a user requires it.

7 Environmental specifications

7.1 General safety

All products meeting this document shall conform to IEC 60950-1.

7.2 Laser safety

Fibre optic transceivers shall be class 1 laser-certified under any condition of operation. This includes single-fault conditions, whether coupled into a fibre or out of an open bore. Transceivers shall be certified to be in conformance to IEC 60825-1.

Laser safety standards and regulations require that the manufacturer of a laser product provide information about the product's laser, safety features, labelling, use, maintenance and service. This documentation shall explicitly define requirements and usage restrictions on the host system necessary to meet these safety certifications.

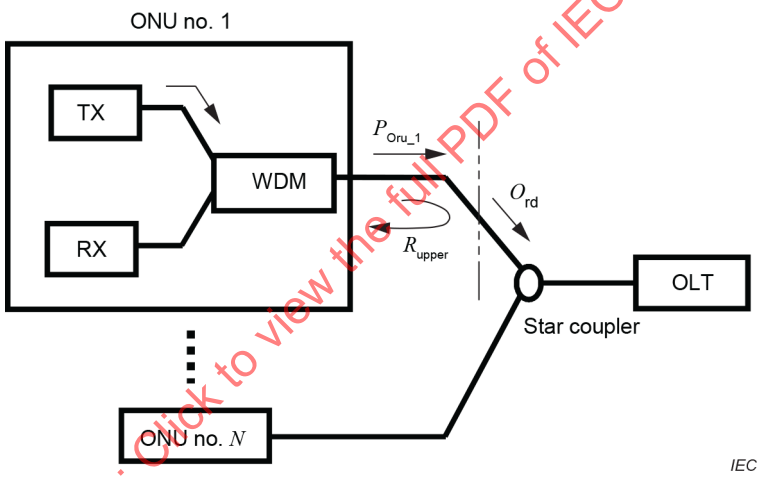
7.3 Electromagnetic emission

Products defined in this document shall comply with IEC 61000-6-3 for the limitation of electromagnetic interference.

Annex A
(informative)

Measurement on tolerance to the reflected optical power (Table 3, item 13)

Tolerance to the reflected optical power is defined in ITU-T Recommendation G.983.1 as the allowable ratio of optical input average power of O_{rd} to reflected optical average power at minimum receiving sensitivity when multiple reflected light is regarded as a noise light at O_{rd}. Here, O_{rd} is the optical interface at the reference point between the ONU and the ODN for downstream directions. A specified value of 10 dB in Table 3, item 13, means that the BER specification shall be satisfied, even if noise light with a power of 10 dB less than the receiver sensitivity is put into the transceiver. In addition, the influence of reflectance into the ONU receiver is described in Appendix II.2.2 of ITU-T Recommendation G.983.1:2005. Figure A.1 shows the model for incidence into the ONU receiver that is described in Appendix II.2.2. This model considers that transmitted signals from the ONU no. 1 return to the ONU no. 1 receiver as a noise through the reflection of ODN and through a WDM. Thus, the noise light is the reflected light of burst signals transmitted from the ONU itself with wavelength between 1 260 nm and 1 360 nm that is specified in Table 3, item 3.

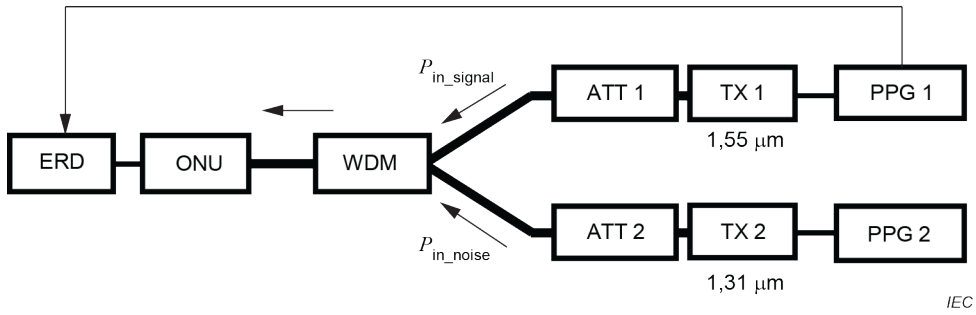


Key

OLT optical line termination
ONU optical network unit
RX receiver
TX transmitter
WDM wavelength division multiplexer

Figure A.1 – Model for incidence into ONU receiver

According to the model described above, burst signals with 1 300-nm band wavelength shall be used as a noise by an example measuring system shown in Figure A.2. It should be noted that the reflected optical power to the receiver section (RX) in the ONU, which is the specification of Table 3, item 13, is determined by the input power of a noise light (P_{in_noise}) and WDM isolation. As WDM isolation is not directly measured because the WDM device is inside the ONU, it is impossible to measure the true value specified in Table 3, item 13.



Key

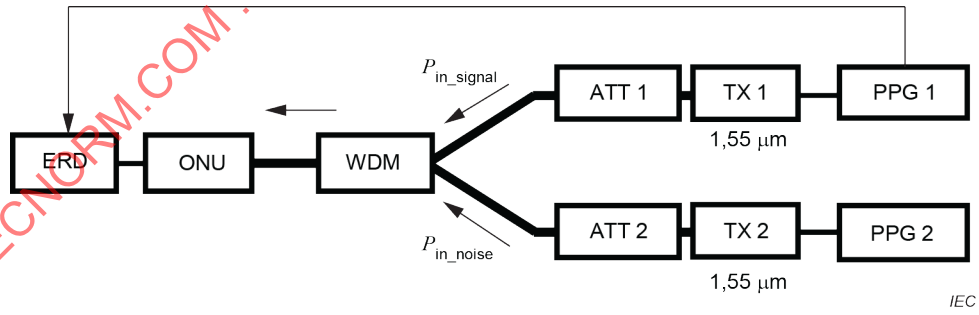
ATT attenuator
ERD error rate detector
ONU optical network unit
PPG pulse pattern generator
TX transmitter
WDM wavelength division multiplexer

Figure A.2 – Example system to measure tolerance to the reflected optical power

This document recommends the measuring system shown in Figure A.3 to examine the tolerance to the reflected optical power. A key feature of the system is that continuous optical light with the same wavelength band (between 1 480 nm and 1 580 nm) as the downstream input signal is used as a noise. This quasi-noise light is modulated at the same bit rate (155,52 Mb/s) as the downstream input signal.

NOTE Modulation of the quasi-noise light is not necessarily synchronized with the signal.

Input power of the signal light (P_{in_signal}) is set to the minimum receiver sensitivity specified in Table 3, item 11, by using an attenuator (ATT 1). Input power of the noise light (P_{in_noise}) is set to 10 dB less than P_{in_signal} by using an attenuator (ATT 2). The pass/fail criterion is whether the bit error ratio (BER) specification is satisfied at this condition. By this measuring system, the specified value of Table 3, item 13, is directly set by using the ~~ATT~~ attenuators.



Key

ATT attenuator
ERD error rate detector
ONU optical network unit
PPG pulse pattern generator
TX transmitter
WDM wavelength division multiplexer

Figure A.3 – Recommended system to measure tolerance to the reflected optical power

Annex B
(informative)

Logic level of alarm and shutdown signal

Annex B specifies that alarm and shutdown signals are effective when the logic level is "low" (see 5.5). In the transceivers used for data communication systems, such as SFF transceivers, the function "signal detect" is adopted with an active "high" logic level. Active "low" logic for the alarm signals for the transceivers specified in Annex B is compatible with the idea of those for data communication systems. Concerning the logic level of shutdown signals, active "low" is based on the idea of "fail safe". The logic level is also harmonized with the general logic in the digital optical communications systems that the state of "light on" is "high" and "light off" is "low".

Bibliography

IEC 60617 ~~(all parts)~~, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60793 (all parts), *Optical fibres*

IEC 60794 (all parts), *Optical fibre cables*

IEC 60825 (all parts), *Safety of laser products*

IEC 60874 (all parts), *Fibre optic interconnecting devices and passive components – Connectors for optical fibres and cables*

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IEC 61754 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces*

IEC TR 61931, *Fibre optic – Terminology*

IEC 62007-1~~:1999~~, *Semiconductor optoelectronic devices for fibre optic system applications – Part 1: Specification template for essential ratings and characteristics*

IEC 62007-2:~~1999~~, *Semiconductor optoelectronic devices for fibre optic system applications – Part 2: Measuring methods*

~~IEC 62148-1:2002, *Fibre optic active components and devices – Package and interface standards – Part 1: General and guidance*~~

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EIA/JEDEC JESD8-B, *Unified wide power supply voltage range CMOS DC interface standard for non-terminated digital integrated circuits*

IEEE Std 802.3, *IEEE Standard for Ethernet*

Telcordia GR-468-CORE for optoelectronic systems

IEC 62149-5

Edition 3.0 2020-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic active components and devices – Performance standards – Part 5: ATM-PON transceivers with LD driver and CDR ICs

Composants et dispositifs actifs fibroniques – Normes de performances – Partie 5: Émetteurs-récepteurs ATM-PON avec programme de gestion LD et CI CDR

IEC 62149-5:2020-08(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 5: ATM-PON transceivers with LD driver and CDR ICs

FOREWORD

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International Standard IEC 62149-5 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the second edition published in 2009 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) description of types in Clause 4 has been removed;
b) titles of reference documents have been updated.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
86C/1667/FDIS	86C/1678/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62149 series, published under the general title *Fibre optic active components and devices – Performance standards,* can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

Fibre optic transceivers are used to convert electrical signals into optical signals and vice versa. The optical performance criteria are generally well specified for a number of internationally agreed applications areas such as ITU-T Recommendation G.983.1 and IEEE Std 802.3. This document aims to assure inter-changeability in performance between fibre optic transceivers for ATM-PON (ATM-based broadband passive optical network) systems supplied by different manufacturers but does not guarantee operation between fibre optic transceivers.

Manufacturers using this document are responsible for meeting the required performance and/or reliability and quality assurance under a recognized scheme.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 5: ATM-PON transceivers with LD driver and CDR ICs

1 Scope

This part of IEC 62149 specifies performance on the transceiver modules for asynchronous-transfer-mode passive optical network (ATM-PON) systems recommended by the International Telecommunication Union (ITU) in ITU-T Recommendation G.983.1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60332-3-24, *Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

IEC 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60950-1, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61280-1-1, *Fibre optic communication subsystem basic test procedures – Part 1-1: Test procedures for general communication subsystems – Transmitter output optical power measurement for single-mode optical fibre cable*

IEC 61280-1-3, *Fibre optic communication subsystem test procedures – Part 1-3: General communication subsystems – Central wavelength and spectral width measurement*

IEC 61280-2-2, *Fibre optic communication subsystem test procedures – Part 2-2: Digital systems – Optical eye pattern, waveform and extinction ratio measurement*

IEC 61300-2-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre or cable retention*

IEC 61300-2-17, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

IEC 61300-2-18, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

IEC 61300-2-22, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

IEC 61753-1, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance*

IEC 62148-1, *Fibre optic active components and devices – Package and interface standards – Part 1: General and guidance*

IEC 62150-2, *Fibre optic active components and devices – Test and measurement procedures – Part 2: ATM-PON transceivers*

ITU-T Recommendation G.957:2006, *Optical interfaces for equipments and systems relating to the synchronous digital hierarchy*

ITU-T Recommendation G.983.1:2005, *Broadband optical access systems based on Passive Optical Networks (PON)*

3 Term, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms, definitions and abbreviated terms apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at https://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

NOTE Further terminology concerning related physical concepts, types of devices, general terms, and terms related to ratings and characteristics can be found in IEC 61931. See also ITU-T Recommendation G.983.1.

3.1.1
optical access network
OAN
set of access links sharing the same network-side interfaces and supported by optical access transmission systems

Note 1 to entry: The OAN can include a number of ODNs connected to the same OLT.

3.1.2
optical distribution network
ODN
apparatus or component that provides the optical transmission means from the OLT to the users and vice versa

Note 1 to entry: The ODN utilizes passive optical components.

3.1.3
optical line termination
OLT
apparatus that provides the network-side interface of the OAN and is connected to one or more ODNs

3.1.4
optical network unit
ONU
apparatus that provides (directly or remotely) the user-side interface of the OAN, and is connected to the ODN

3.2 Abbreviated terms

ATM-PON	asynchronous transfer mode passive optical network
ATT	attenuator
BER	bit error ratio
CDR	clock and data recovery
CMOS	complementary metal-oxide semiconductor
DUT	device under test
IC	integrated circuit
LD	laser diode
MLM	multi-longitudinal mode
RMS	root mean square
SLM	single-longitudinal modes

4 Classification

Fibre optic transceiver modules are classified into several types of forms according to the combination of mating types of electrical and optical interfaces (for details, see IEC 62148-1).

5 Product definition

5.1 Description of transceiver module

Information on the following devices constituting the optical transceiver module shall be stated. This statement shall include details of technologies. For example, technologies used for ICs such as CMOS, bipolar, etc., shall be described.

- For a transmitter:
  - laser diode (in this description, a single- or a multi-longitudinal mode type shall be specified);
  - monitoring photodiode;
  - driver IC;
  - thermal sensor (where appropriate).
- For a receiver:
  - photodiode;
  - pre-amp IC;
  - data/clock recovery IC.

- For a wavelength division multiplexer device:
  - technology used for this device.
- For a package:
  - refer to the IEC 62148 series.

5.2 Description of applied form

According to ITU-T Recommendation G.983.1, the applied form of nominal bit rate, the class (class B or class C), the applied unit (ONU or OLT), and the number of fibres (one for duplex working or two for simplex working) shall be stated.

5.3 Block diagram

A block diagram or equivalent circuit information on the optical transceiver module shall be given (see Figure 1).

The following terminals may be distinguished:

- supply terminals, i.e., terminals intended to be connected to the power supplies;
- input and output terminals, i.e., terminals into or out of which signals are passed.

The term "signal" includes both pulse and more complex waveforms and includes strobe or control pulses.

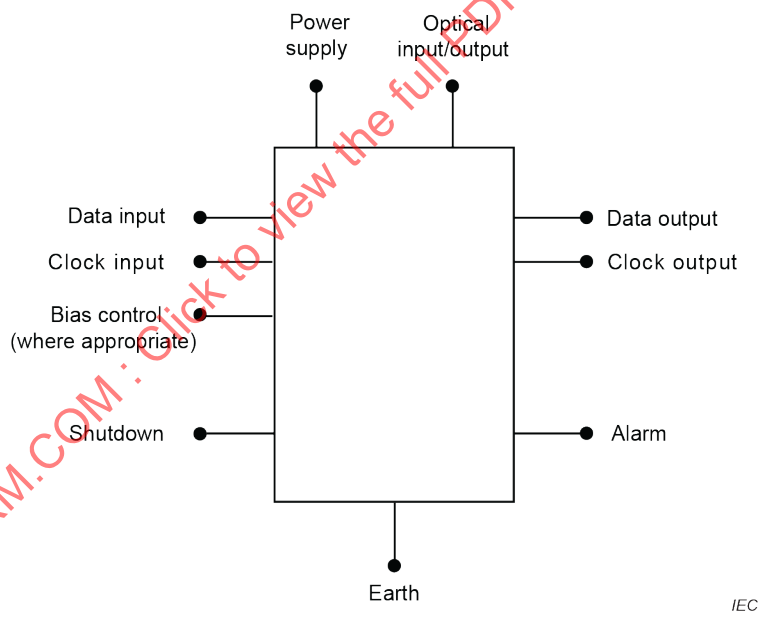


Figure 1 – Functional block diagram (example)

5.4 Absolute limiting rating

Absolute limiting (maximum) ratings imply that no catastrophic damage will occur if the product is subjected to these ratings, provided each limiting parameter is in isolation and all other parameters have values within the normal performance parameters. It should not be assumed that limiting values of more than one parameter could be applied at any one time.

Table 1 – Absolute maximum ratings

Items	Condition	Letter symbol	Requirements		Units
			Minimum	Maximum	
Storage temperature[a]		T_{stg}	–40	85	°C
Storage relative humidity		H_{stg}	5	95	%
Bend radius of pigtail for transceivers (at specified distance from the case)[b]		r	30		mm
Shock[c]	Pulse duration: 18 ms 3 times/axis			300	m/s^2
Vibration[d]	10 Hz to 55 Hz, 3 axes, 1,5 mm, 2 h			100	m/s^2
Tensile force on devices with pigtail Buffer-coated fibre[e] Reinforced fibre[e]		F		5 100	N
Electrical limiting values					
– Power supply voltage		U_{SUPmax}	−0,5	4,0	V
– Input voltage		U_{INmax}	−0,5	U_{sup}	V
– Output voltage		U_{OUTmax}	0	U_{sup} + 0,5	V
– Output current PECL interface LVTTL interface		I_{OUTmax}	0 −20	50 20	mA
Optical limiting values					
– Permissible input power		P_{in}		−5	dBm

[a] Ambient temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

[b] IEC 62148-1 shall be referred to for detail.

[c] IEC 60068-2-27 shall be referred to for detail.

[d] IEC 60068-2-6 shall be referred to for detail.

[e] The requirements of IEC 61753-1 shall be applied.

5.5 Functional specification

Electro-optical characteristics for the items in Table 3 shall be satisfied at the operating environmental conditions specified in Table 2. Optical characteristics specified in ITU-T Recommendation G.983.1 should be satisfied.

Each electrical and optical characteristic of 5.5 shall be measured under conditions specified in each reference.

Each electrical and optical characteristic of 5.5 shall be stated under specified worst-case conditions, with respect to the recommended range of operating conditions as stated. The measuring method of each electrical and optical characteristics specified in Table 3 shall be measured based on the method stated in the reference of each row.

Table 2 – Operating environment

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Power supply voltage	U_{SUP}	3,135	3,3	3,465	V
Operating case temperature[a]	T_{case}	–5		75	°C
Ambient relative humidity[a]	RH	5		95	%

[a] Operating case temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

Table 3 – Electrical and optical characteristics

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
1	Nominal bit rate	B		155,52		Mb/s	
2	Mean launched power[a] – Class B – Class C	P_{mean}	 –4 –2		 +2 +4	dBm	IEC 61280-1-1
3	Transmitter wavelength	λ	1 260		1 360	nm	IEC 61280-1-3
4	Mask of transmitter eye diagram[b]	–					
5	Extinction ratio	r_{Ex}	10			dB	IEC 61280-2-2
6	For MLM laser, maximum RMS width	$\Delta\lambda$			5,8	nm	IEC 61280-1-3
7	For SLM laser, maximum –20 dB width	$\Delta\lambda$			1,0	nm	IEC 61280-1-3
8	For SLM laser, minimum side mode suppression ratio	r_{SMSR}	30			dB	IEC 61280-1-3
9	Maximum reflectance measured at transmitter wavelength	R_{TX}	–6			dB	IEC 61300-3-6
10	Receiver overload: – Class B – Class C	S_O	 –8 –11			dBm	IEC 62150-2
11	Receiver sensitivity: – Class B – Class C	S			 –30 –33	dBm	IEC 62150-2
12	Maximum reflectance measured at receiver wavelength	R_{RX}	–20			dB	IEC 61300-3-6
13	Tolerance to the reflected optical power[c]				10	dB	ITU-T G.957:2006, Appendix III
14	Clock input voltage (high)	See Table 4 and Table 5					
15	Clock input voltage (low)	See Table 4 and Table 5					
16	Clock input voltage (swing centre)	See Table 4 and Table 5					
17	Data input voltage (high)	See Table 4 and Table 5					
18	Data input voltage (low)	See Table 4 and Table 5					
19	Data input voltage (swing centre)	See Table 4 and Table 5					
20	Clock output voltage (high)	See Table 4 and Table 5					
21	Clock output voltage (low)	See Table 4 and Table 5					

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
22	Data output voltage (high)	See Table 4 and Table 5					
23	Data output voltage (low)	See Table 4 and Table 5					
24	Alarm output voltage (high)[d]	See Table 6 and Table 7					IEC 62150-2
25	Alarm output voltage (low)[d]	See Table 6 and Table 7					IEC 62150-2
26	Shutdown input voltage (high)[e]	See Table 8					IEC 62150-2
27	Shutdown input voltage (low)[e]	See Table 8					IEC 62150-2
28	Bias control voltage (high)[f]	U_{BiasH}					
29	Bias control voltage (low)[f]	U_{BiasL}					
30	Line code		Scrambled NRZ				
31	Launched optical power without input to transmitter[g] – Class B – Class C		 −40 −43			dBm	IEC 61280-1-1
32	Tolerance to the transmitter incident light power[g]		−15			dB	
33	Consecutive identical digit immunity[b]						
34	Jitter generation[b]						
35	Jitter tolerance[b]						
36	Jitter transfer[b]						

[a] Pseudo random data shall be put into the transmitter according to the specification of 8.2.6.3 of ITU-T Recommendation G.983.1:2005.

[b] These items shall be specified so as to meet the specifications of ITU-T Recommendation G. 983.1.

[c] This item shall be measured based on the measuring method described in the reference. See Annex A for more detail.

[d] With logic ‘low’, an alarm signal is effective. The alarm test shall be done whether logic ‘low’ is put out when no optical power is launched to the transceiver, and logic ‘high’ is put out when optical power more than that specified in item 11 is launched to the transceiver (see Annex B).

[e] With logic ‘low’, a shutdown signal is effective. The shutdown test shall be done whether optical power less than that specified in item 31 is launched when logic ‘low’ is put into the ‘shutdown’ terminal, and optical power within the range specified in item 2 is launched when logic ‘high’ is put into the ‘shutdown’ terminal (see Annex B).

[f] These items shall be specified between vendors and users.

[g] Measurement methods on these items are stated in 5.5.

The clock and data input/output interface shall be satisfied with either the specification listed in Table 4 or Table 5. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 4 – Electrical interface characteristics (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	$U_{CINH} - U_{SUP}$	−1,17		−0,88	V
Clock input voltage (low)	$U_{CINL} - U_{SUP}$	−1,81		−1,43	V
Data input voltage (high)	$U_{DINH} - U_{SUP}$	−1,17		−0,88	V
Data input voltage (low)	$U_{DINL} - U_{sup}$	−1,81		−1,43	V
Clock output voltage (high)[a]	$U_{COUTH} - U_{SUP}$		−0,96		V
Clock output voltage (low) [a]	$U_{COUTL} - U_{SUP}$		−1,71		V
Data output voltage (high) [a]	$U_{DOUTH} - U_{SUP}$		−0,96		V
Data output voltage (low) [a]	$U_{DOUTL} - U_{SUP}$		−1,71		V
[a] Outputs terminated to U_{SUP} – 2 V.					

Table 5 – Electrical interface characteristics (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	U_{CINH}	U_{CINL} + 0,3		U_{SUP}	V
Clock input voltage (low)	U_{CINL}	0		U_{CINH} − 0,3	V
Clock input voltage (swing centre)	$U_{Ccenter}$	U_{SUP}/ 2 − 0,1		U_{SUP}/ 2 + 0,1	V
Data input voltage (high)	U_{DINH}	U_{DINL} + 0,3		U_{SUP}	V
Data input voltage (low)	U_{DINL}	0		U_{DINH} + 0,3	V
Data input voltage (swing centre)	$U_{Dcenter}$	U_{SUP}/ 2 − 0,1		U_{SUP}/ 2 + 0,1	V
Clock output voltage (high)[a]	U_{COUTH}	U_{TT} + 0,4			V
Clock output voltage (low) [a]	U_{COUTL}			U_{TT} − 0,4	V
Data output voltage (high)[a]	U_{DOUTH}	U_{TT} + 0,4			V
Data output voltage (low) [a]	U_{DOUTL}			U_{TT} − 0,4	V
[a] U_{TT} = 1,5 V to 1,8 V					

The alarm output interface shall be satisfied with either the specification listed in Table 6 or Table 7. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 6 – Electrical interface characteristics of alarm output voltage (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	U_{ALH}	2,4			V
Alarm output voltage (low) [a]	U_{ALL}			0,4	V
[a] Test shall be performed with current at high level, I_{ALH} = –2 mA, and current at low level, I_{ALL} = 2 mA, at V_{SUP} between 3,135 V and 3,465 V.					

Table 7 – Electrical interface characteristics of alarm output voltage (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	U_{ALH}	U_{SUP} − 0,2			V
Alarm output voltage (low) [a]	U_{ALL}			0,2	V
[a] Test shall be performed with current at high level, I_{ALH} = –100 µA, and current at low level, I_{ALL} = 100 µA, at U_{SUP} between 3,135 V and 3,465 V.					

Shutdown input interface shall be satisfied with specifications listed in Table 8. New interface dimensions will be added properly.

Table 8 – Electrical interface characteristics of shutdown input voltage (both PECL and LVTTL types)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Shutdown input voltage (high)[a]	U_{SDH}	2,0		U_{SUP} + 0,3	V
Shutdown input voltage (low)[a]	U_{SDL}	–0,3		0,8	V
[a] Test shall be performed with U_{SUP} between 3,135 V and 3,465 V.					

NOTE The interfaces listed in Table 6, Table 7 and Table 8 refer to EIA/JEDEC JESD8-B, with the exception of power supply voltage U_{SUP}, which is specified in Table 2.

Relationship of the phase between clock and data signals is shown in Figure 2. Phase of data signals are timed so that data signals are latched at a fall time of clock.

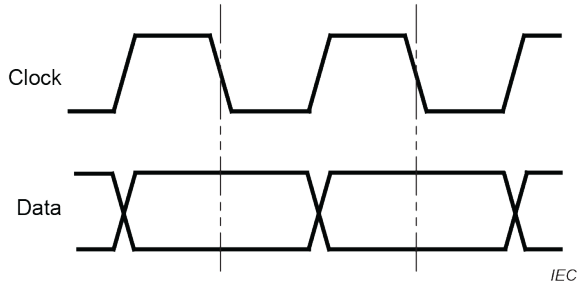
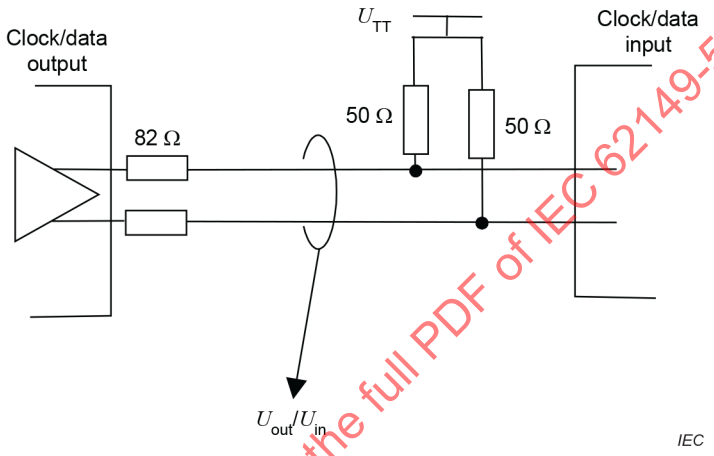
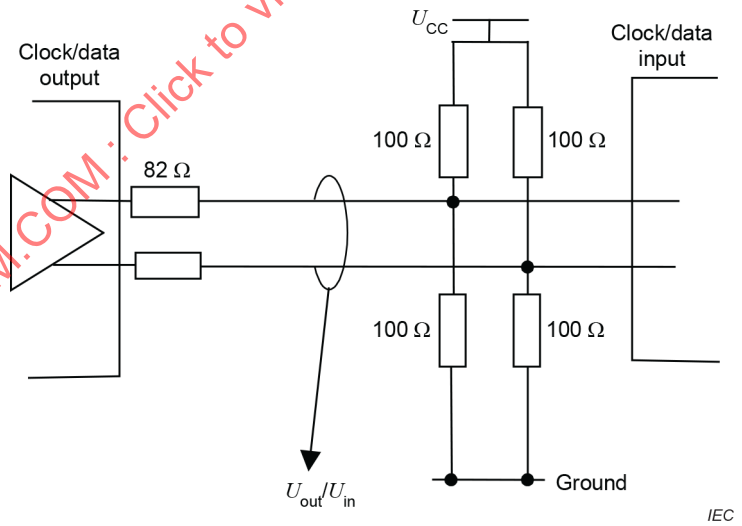


Figure 2 – Relationship of phase between clock and data signals

Examples of recommended electrical circuit diagrams for LVTTL-type interface are shown in Figure 3 a) and b).



a) With standard termination



b) With Thevenin termination

Figure 3 – Recommended electrical circuit diagram for LVTTL-type interface (examples)

Launched optical power without input to transmitter (Table 3, item 31) is schematically defined in Figure 4. The measuring method of the power shall basically follow IEC 61280-1-1, but it shall be specified in detail between vendors and users.

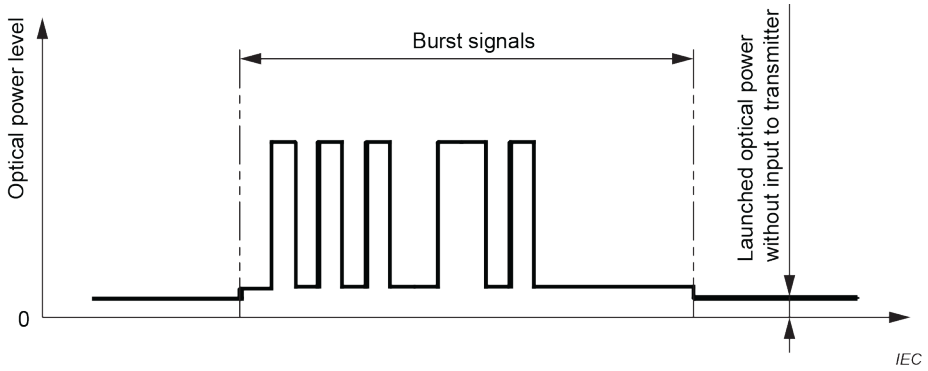


Figure 4 – Schematic drawing for defining launched optical power without input to transmitter

Tolerance to the transmitter incident light power (Table 3, item 32) is measured, for example, by an experimental setup shown in Figure 5. The value of reflection at the reflector is set so that incident light power back to the transmitter is 15 dB less than that of mean transmitter launching power. Pass/fail criteria depend on whether or not the waveform of signals transmitted from the DUT and monitored at the waveform monitor satisfies the eye mask specified in Table 3, item 4.

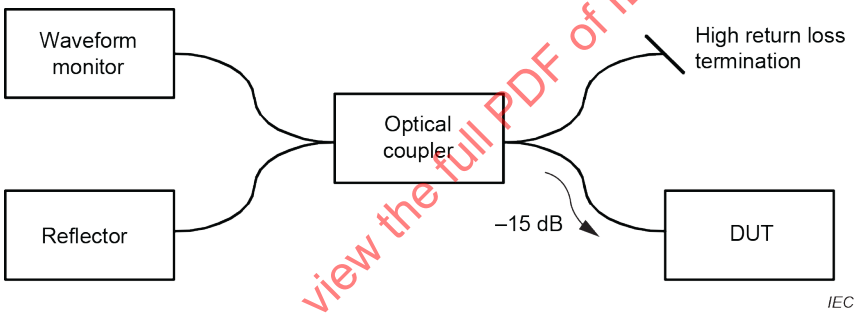


Figure 5 – Experimental setup for measuring tolerance to the transmitter incident light power

6 Testing

6.1 General

Initial characterization and qualification shall be undertaken. Qualification maintenance is carried out using periodic testing programs. Test case temperature conditions for all tests, unless otherwise stated, are 25 °C ± 2 °C.

6.2 Characterization testing

Characterization testing including both transmitter and receiver sections shall be carried out based on the specifications listed in Table 9 for the transmitter section and Table 10 for the receiver section. This testing shall be carried out on at least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. If any changes occur in the design of the transceiver, the testing shall be carried out again.

6.2.1 Characterization: transmitter section

Table 9 – Transmitter section characterization tests

Parameters	Test conditions	Test limit minimum	Test limit maximum	Unit
	As a minimum, 11 devices taken from a manufacturing lot for each user to be measured at case temperatures of (−5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and U_{cc} at (U_{nom} − 5 %) V, (U_{nom}) V and (U_{nom} + 5 %) V			
Mean launched power	Single-mode fibre, PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – Class B – Class C	 −4,0 −2,0	 +2,0 +4,0	dBm
Central wavelength	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation	1 260	1 360	nm
Spectral width	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – MLM laser – SLM laser		 5,8 1,0	nm
Extinction ratio	155,52 Mbit/s square wave	10		dB
Mask test of eye diagram[a]	Fourth-order Thomson filter (cut-off frequency is 0,75 × 155,52 MHz), PRBS 2^{23} – 1 at 155,52 Mbit/s	No hits	No hits	
Shutdown test of launched power	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation, Shutdown input voltage: low level – Class B – Class C		 −40 −43	dBm

[a] Mask of the eye diagrams for downstream and upstream transmissions are specified in ITU-T Recommendation G.983.1.

6.2.2 Characterization: receiver section

Table 10 – Receiver section characterization tests

Parameters	Test conditions	Test limit minimum	Test limit maximum	Unit
	At minimum, 11 devices taken from an initial manufacturing lot to be measured at case temperatures of (–5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and U_{cc} at (U_{nom} – 5 %) V, (U_{nom}) V and (U_{nom} + 5 %) V			
Sensitivity at 10^{-10} BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10dB extinction ratio source – Class B – Class C		 −30,0 −33,0	dBm
Overload at 10^{-10} BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	 −8 −11		dBm
Alarm on threshold[a]	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	 −30,0 −33,0		dBm

[a] Alarm signal is effective with logic "low" specified in Table 6 and Table 7 when optical power less than that of threshold is launched to the transceiver.

6.3 Performance testing

Performance testing is undertaken to assure reliability of products when characterization testing is complete. The testing items, definite testing conditions and pass/fail criteria are listed in Table 11. This testing shall be carried out on at least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. The products may be new or sourced from a previous test.

Table 11 – Performance testing plan

Items	Reference	Condition	Criteria [a]	Failure
Mechanical shock	IEC 60068-2-27	300 m/s^2, 18 ms, 3 times/axis	$\lvert\Delta P_{mean}\rvert \leq 1$ dB $\lvert\Delta S_{min}\rvert \leq 1$ dB at 25 °C	0/11
Vibration	IEC 60068-2-6	100 m/s^2, 10Hz to 55 Hz, 3 axes, 1,5 mm, 2 h		
Fibre pull[b]	IEC 61300-2-4	100 N ± 2 N at 5 N/s, 120 s duration for reinforced cables 5 N ± 0,5 N at 0,5 N/s, 60 s duration for buffered fibres		
Temperature cycling[b]	IEC 61300-2-22	–40 °C to + 85 °C 1 h duration at extremes, more than 12 cycles		
High temperature storage[b]	IEC 61300-2-18	+85 °C, more than 96 h duration		
Low temperature storage[b]	IEC 61300-2-17	–40 °C, more than 96 h duration		
Damp heat[b]	IEC 61300-2-19	+40 °C ± 2 °C, RH: 93 % ± 2 %, 96 h duration		
Flammability	IEC 60332-3-24			

[a] Pass/fail criteria are specified to be 1 dB maximum change (or less) in mean launched power and receiver sensitivity, respectively. The quantity of 1 dB is determined to include the 0,5 dB pass/fail criteria specified in Telcordia GR-468-CORE and a 0,5 dB margin in measurement error.

[b] The testing conditions of these items may refer to Telcordia GR-468-CORE instead of IEC 61753-1 if a user requires it.

7 Environmental specifications

7.1 General safety

All products meeting this document shall conform to IEC 60950-1.

7.2 Laser safety

Fibre optic transceivers shall be class 1 laser-certified under any condition of operation. This includes single-fault conditions, whether coupled into a fibre or out of an open bore. Transceivers shall be certified to be in conformance to IEC 60825-1.

Laser safety standards and regulations require that the manufacturer of a laser product provide information about the product's laser, safety features, labelling, use, maintenance and service. This documentation shall explicitly define requirements and usage restrictions on the host system necessary to meet these safety certifications.

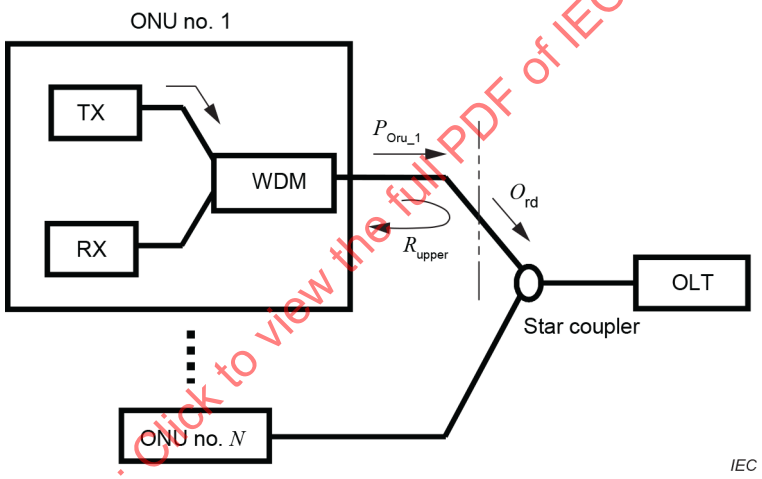
7.3 Electromagnetic emission

Products defined in this document shall comply with IEC 61000-6-3 for the limitation of electromagnetic interference.

Annex A
(informative)

Measurement on tolerance to the reflected optical power (Table 3, item 13)

Tolerance to the reflected optical power is defined in ITU-T Recommendation G.983.1 as the allowable ratio of optical input average power of O_{rd} to reflected optical average power at minimum receiving sensitivity when multiple reflected light is regarded as a noise light at O_{rd}. Here, O_{rd} is the optical interface at the reference point between the ONU and the ODN for downstream directions. A specified value of 10 dB in Table 3, item 13, means that the BER specification shall be satisfied, even if noise light with a power of 10 dB less than the receiver sensitivity is put into the transceiver. In addition, the influence of reflectance into the ONU receiver is described in Appendix II.2.2 of ITU-T Recommendation G.983.1:2005. Figure A.1 shows the model for incidence into the ONU receiver that is described in Appendix II.2.2. This model considers that transmitted signals from the ONU no. 1 return to the ONU no. 1 receiver as a noise through the reflection of ODN and through a WDM. Thus, the noise light is the reflected light of burst signals transmitted from the ONU itself with wavelength between 1 260 nm and 1 360 nm that is specified in Table 3, item 3.

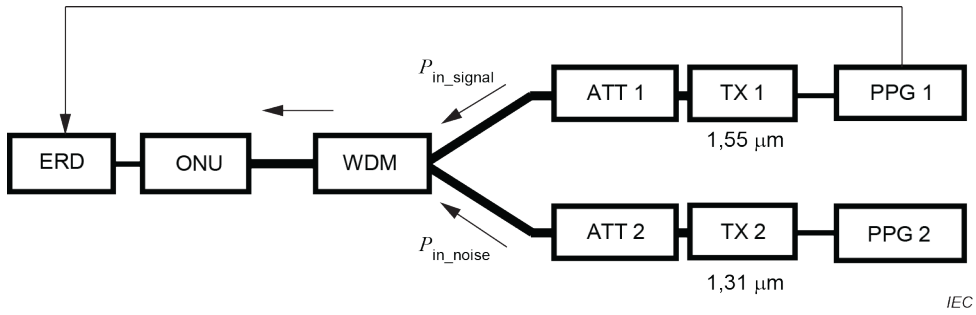


Key

OLT optical line termination
ONU optical network unit
RX receiver
TX transmitter
WDM wavelength division multiplexer

Figure A.1 – Model for incidence into ONU receiver

According to the model described above, burst signals with 1 300-nm band wavelength shall be used as a noise by an example measuring system shown in Figure A.2. It should be noted that the reflected optical power to the receiver section (RX) in the ONU, which is the specification of Table 3, item 13, is determined by the input power of a noise light (P_{in_noise}) and WDM isolation. As WDM isolation is not directly measured because the WDM device is inside the ONU, it is impossible to measure the true value specified in Table 3, item 13.



Key

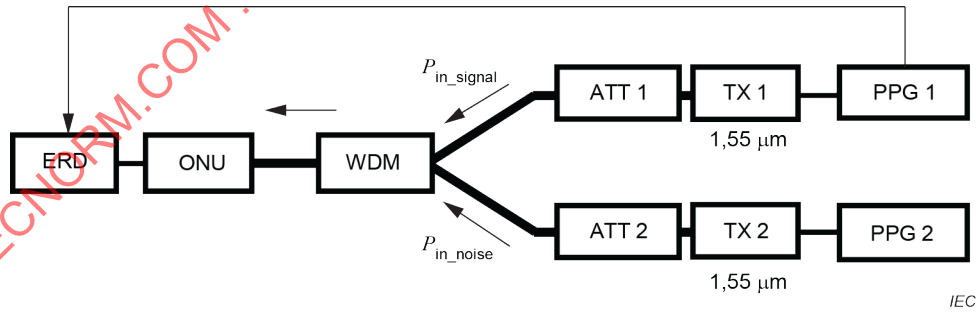
ATT attenuator
ERD error rate detector
ONU optical network unit
PPG pulse pattern generator
TX transmitter
WDM wavelength division multiplexer

Figure A.2 – Example system to measure tolerance to the reflected optical power

This document recommends the measuring system shown in Figure A.3 to examine the tolerance to the reflected optical power. A key feature of the system is that continuous optical light with the same wavelength band (between 1 480 nm and 1 580 nm) as the downstream input signal is used as a noise. This quasi-noise light is modulated at the same bit rate (155,52 Mb/s) as the downstream input signal.

NOTE Modulation of the quasi-noise light is not necessarily synchronized with the signal.

Input power of the signal light (P_{in_signal}) is set to the minimum receiver sensitivity specified in Table 3, item 11, by using an attenuator (ATT 1). Input power of the noise light (P_{in_noise}) is set to 10 dB less than P_{in_signal} by using an attenuator (ATT 2). The pass/fail criterion is whether the bit error ratio (BER) specification is satisfied at this condition. By this measuring system, the specified value of Table 3, item 13, is directly set by using the attenuators.



Key

ATT attenuator
ERD error rate detector
ONU optical network unit
PPG pulse pattern generator
TX transmitter
WDM wavelength division multiplexer

Figure A.3 – Recommended system to measure tolerance to the reflected optical power

Annex B
(informative)

Logic level of alarm and shutdown signal

Annex B specifies that alarm and shutdown signals are effective when the logic level is "low" (see 5.5). In the transceivers used for data communication systems, such as SFF transceivers, the function "signal detect" is adopted with an active "high" logic level. Active "low" logic for the alarm signals for the transceivers specified in Annex B is compatible with the idea of those for data communication systems. Concerning the logic level of shutdown signals, active "low" is based on the idea of "fail safe". The logic level is also harmonized with the general logic in the digital optical communications systems that the state of "light on" is "high" and "light off" is "low".

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Telcordia GR-468-CORE for optoelectronic systems

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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COMPOSANTS ET DISPOSITIFS ACTIFS FIBRONIQUES – NORMES DE PERFORMANCES –

Partie 5: Émetteurs-récepteurs ATM-PON avec programme de gestion LD et CI CDR

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La Norme internationale IEC 62149-5 a été établie par le sous-comité 86C: Systèmes et dispositifs actifs à fibres optiques, du comité d'études 86 de l'IEC: Fibres optiques.

Cette troisième édition annule et remplace la seconde édition parue en 2009 et constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) les descriptions des types à l'Article 4 ont été supprimées;
b) les titres des documents de référence ont été actualisés.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
86C/1667/FDIS	86C/1678/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62149, publiées sous le titre général *Composants et dispositifs actifs fibroniques – Normes de performances*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Les émetteurs-récepteurs fibroniques sont utilisés pour convertir les signaux électriques en signaux optiques et vice versa. Les critères de performances optiques sont généralement bien spécifiés pour un certain nombre de domaines d'application ayant fait l'objet d'un accord au niveau international, comme la Recommandation UIT-T G.983.1 et l'IEEE 802.3. Le présent document vise à assurer l'interchangeabilité des performances des divers émetteurs-récepteurs fibroniques pour systèmes de réseau optique passif en mode de transfert asynchrone (ATM-PON), fournis par les différents fabricants, mais ne constitue pas une garantie au niveau du fonctionnement entre émetteurs-récepteurs fibroniques.

Les fabricants utilisant le présent document sont tenus de satisfaire aux exigences de performance et/ou à l'assurance de fiabilité et de qualité dans le cadre d'un plan reconnu.

COMPOSANTS ET DISPOSITIFS ACTIFS FIBRONIQUES – NORMES DE PERFORMANCES –

Partie 5: Émetteurs-récepteurs ATM-PON avec programme de gestion LD et CI CDR

1 Domaine d'application

La présente partie de l'IEC 62149 spécifie les performances applicables aux modules d'émetteurs-récepteurs pour les systèmes de réseau optique passif en mode de transfert asynchrone (ATM-PON), recommandées par l'Union internationale des télécommunications (UIT) dans la Recommandation UIT-T G.983.1.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-6, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-27, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60332-3-24, *Essais des câbles électriques et des câbles à fibres optiques soumis au feu – Partie 3-24: Essai de propagation verticale de la flamme des fils ou câbles montés en nappes en position verticale – Catégorie C*

IEC 60825-1, *Sécurité des appareils à laser – Partie 1: Classification des matériels et exigences*

IEC 60950-1, *Matériels de traitement de l'information – Sécurité – Partie 1: Exigences générales*

IEC 61000-6-3, *Compatibilité électromagnétique (CEM) – Partie 6-3: Normes génériques – Norme sur l'émission pour les environnements résidentiels, commerciaux et de l'industrie légère*

IEC 61280-1-1, *Procédures d'essai de base des sous-systèmes de télécommunication à fibres optiques – Partie 1-1: Procédures d'essai des sous-systèmes généraux de télécommunication – Mesure de la puissance optique des émetteurs couplés à des câbles à fibres optiques unimodales*

IEC 61280-1-3, *Procédures d'essai des sous-systèmes de télécommunication à fibres optiques – Partie 1-3: Sous-systèmes généraux de télécommunication – Mesure de la longueur d'onde centrale et de la largeur spectrale*

IEC 61280-2-2, *Fibre optic communication subsystem test procedures – Part 2-2: Digital systems – Optical eye pattern, waveform and extinction ratio measurement* (disponible en anglais seulement)

IEC 61300-2-4, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-4: Essais – Rétention de la fibre ou du câble*

IEC 61300-2-17, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-17: Essais – Froid*

IEC 61300-2-18, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-18: Essais – Chaleur sèche – Résistance à haute température*

IEC 61300-2-19, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-19: Essais – Chaleur humide (état continu)*

IEC 61300-2-22, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 2-22: Essais – Variations de température*

IEC 61300-3-6, *Dispositifs d'interconnexion et composants passifs à fibres optiques – Méthodes fondamentales d'essais et de mesures – Partie 3-6: Examens et mesures – Affaiblissement de réflexion*

IEC 61753-1, *Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance – Partie 1: Généralités et recommandations*

IEC 62148-1, *Composants et dispositifs actifs fibroniques – Normes de boîtier et d'interface – Partie 1: Généralités et recommandations*

IEC 62150-2, *Composants et dispositifs actifs à fibres optiques – Procédures d'essais et de mesures – Partie 2: Emetteurs-récepteurs ATM-PON*

Recommandation UIT-T G.957:2006, *Interfaces optiques pour les équipements et les systèmes relatifs à la hiérarchie numérique synchrone*

Recommandation UIT-T G.983.1:2005, *Systèmes d'accès optique à large bande basés sur les réseaux optiques passifs*

3 Termes, définitions et termes abrégés

3.1 Termes et définitions

Pour les besoins du présent document, les termes, définitions et termes abrégés suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

NOTE La terminologie supplémentaire concernant les concepts physiques relatifs, les types de dispositifs, les termes généraux, ainsi que les termes relatifs aux valeurs assignées et aux caractéristiques peut être consultée dans l'IEC 61931. Voir également la Recommandation UIT-T G.983.1.

3.1.1
réseau d'accès optique
OAN
jeu des liaisons d'accès partageant les mêmes interfaces côté réseau et supporté par des systèmes de transmission d'accès optique

Note 1 à l'article: L'OAN peut inclure un certain nombre d'ODN connectés à la même OLT.

Note 2 à l'article: Le terme abrégé "OAN" est dérivé du terme anglais développé correspondant "optical access network".

3.1.2
réseau de distribution optique
ODN
appareillage ou composant qui fournit les moyens de transmission optique depuis l'OLT vers les utilisateurs, et vice versa

Note 1 à l'article: L'ODN utilise des composants optiques passifs.

Note 2 à l'article: Le terme abrégé "ODN" est dérivé du terme anglais développé correspondant "optical distribution network".

3.1.3
terminaison de ligne optique
OLT
appareillage qui fournit l'interface côté réseau de l'OAN, et est connecté à un ou plusieurs ODN

Note 1 à l'article: Le terme abrégé "OLT" est dérivé du terme anglais développé correspondant "optical line termination".

3.1.4
unité de réseau optique
ONU
appareillage qui fournit (directement ou à distance) l'interface côté utilisateur de l'OAN, et est connecté à l'ODN

Note 1 à l'article: Le terme abrégé "ONU" est dérivé du terme anglais développé correspondant "optical network unit".

3.2 Termes abrégés

ATM-PON	réseau optique passif en mode de transfert asynchrone (ATM-based broadband passive optical network)
ATT	affaiblisseur (attenuator)
BER	taux d'erreur binaire (bit error ratio)
CDR	récupération d'horloge et de données (clock and data recovery)
CMOS	semiconducteurs à oxyde métallique complémentaires (complementary metal-oxide semiconductor)
DUT	dispositif soumis à essai (device under test)
CI	circuit intégré
LD	diode laser (laser diode)
MLM	mode longitudinal multiple (multi-longitudinal mode)
RMS	valeur efficace (root mean square)
SLM	mode longitudinal unique (single longitudinal mode)

4 Classification

Les modules d'émetteurs-récepteurs fibroniques sont classés en différents types de formes, en fonction de la combinaison de types d'accouplement des interfaces électriques et optiques (pour plus d'informations, voir l'IEC 62148-1).

5 Définition de produit

5.1 Description du module d'émetteur-récepteur

Les informations sur les dispositifs suivants constituant le module d'émetteur-récepteur optique doivent être mentionnées. Cet énoncé doit comprendre des détails sur les technologies. Par exemple, les technologies utilisées pour les CI, telles que les circuits CMOS, les transistors bipolaires, etc., doivent être décrites.

- Pour un émetteur:
  - diode laser (dans cette description, le type SLM ou MLM doit être spécifié);
  - photodiode de contrôle;
  - CI de commande;
  - capteur thermique (le cas échéant).
- Pour un récepteur:
  - photodiode;
  - CI préamplificateur;
  - CI de récupération de données/d'horloge.
- Pour un dispositif multiplexeur à division de longueur d'onde:
  - technologie utilisée pour ce dispositif.
- Pour un boîtier:
  - se référer à la série IEC 62148.

5.2 Description de la forme appliquée

Conformément à la Recommandation UIT-T G.983.1, la forme appliquée du débit binaire nominal, la classe (classe B ou classe C), l'unité appliquée (ONU ou OLT) et le nombre de fibres (une pour un fonctionnement duplex et deux pour un fonctionnement simplex) doivent être indiqués.

5.3 Schéma fonctionnel

Le schéma fonctionnel ou les informations de circuit équivalentes sur le module d'émetteur-récepteur optique doivent être fournis (voir Figure 1).

Les bornes suivantes peuvent être distinguées:

- bornes d'alimentation, c'est-à-dire les bornes destinées à être connectées aux alimentations électriques;
- bornes d'entrée et de sortie, c'est-à-dire les bornes vers et depuis lesquelles les signaux transitent.

Le terme "signal" inclut à la fois les formes d'onde à impulsions et celles qui sont plus complexes, ainsi que les impulsions de commande ou les impulsions stroboscopiques.

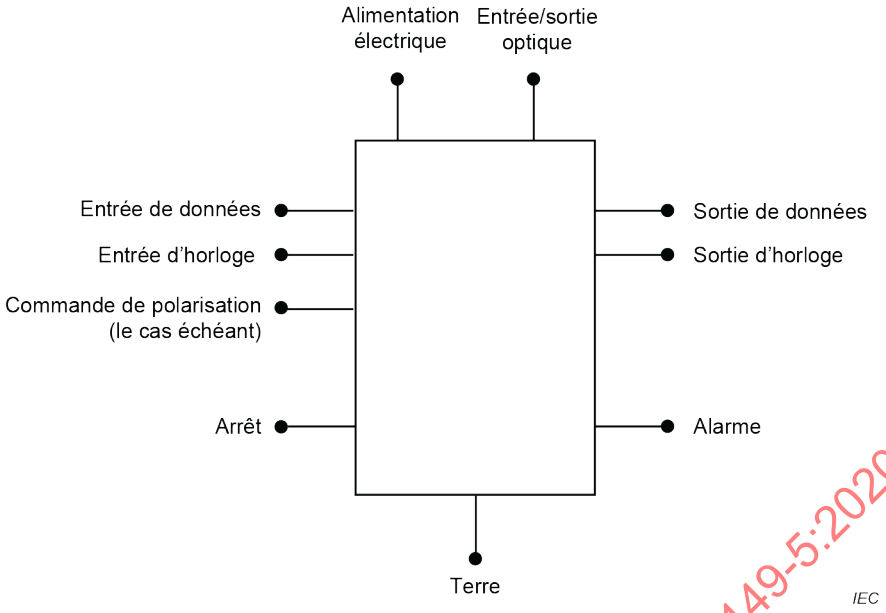

Figure 1 – Schéma fonctionnel (exemple)

5.4 Valeurs limites absolues

Les valeurs limites absolues (maximales) impliquent l'absence de dommage catastrophique si le produit est soumis à ces valeurs limites, à condition que chaque paramètre en limite soit considéré isolément et que tous les autres paramètres présentent des valeurs s'inscrivant dans les paramètres de performance conventionnels. Il convient de ne pas présumer que les valeurs limites de plusieurs paramètres puissent être appliquées simultanément.

Tableau 1 – Valeurs limites absolues maximales

Paramètre	Condition	Symbole	Exigences		Unité
			Valeur minimale	Valeur maximale	
Température de stockage [a]		T_{stg}	–40	85	°C
Humidité relative de stockage		H_{stg}	5	95	%
Rayon de courbure des fibres amorces pour les émetteurs-récepteurs (à une distance spécifiée du boîtier) [b]		r	30		mm
Chocs [c]	Dureé de pouls: 18 ms 3 fois/axe			300	m/s^2
Vibrations [d]	De 10 Hz à 55 Hz, 3 axes, 1,5 mm, 2 h			100	m/s^2
Force de traction sur les dispositifs avec fibre amorce Fibre sous revêtement protecteur [e] Fibre renforcée [e]		F		5 100	N
Valeurs électriques limites					
– Tension d'alimentation électrique		U_{SUPmax}	−0,5	4,0	V
– Tension d'entrée		U_{INmax}	−0,5	U_{sup}	V
– Tension de sortie		U_{OUTmax}	0	U_{sup} + 0,5	V
– Courant de sortie Interface PECL (positive emitter-coupled logic) Interface LVTTL (low-voltage transistor-transistor logic)		I_{OUTmax}	0 −20	50 20	mA
Valeurs optiques limites					
– Puissance d'entrée admissible		P_{in}		−5	dBm

[a] L'humidité et la température ambiantes pour une unité ONU extérieure font actuellement l'objet d'études complémentaires dans le cadre de la Recommandation UIT-T G.983.1. Ces spécifications sont donc susceptibles d'être modifiées à l'avenir.

[b] Il doit être fait référence à l'IEC 62148-1 pour plus d'informations.

[c] Il doit être fait référence à l'IEC 60068-2-27 pour plus d'informations.

[d] Il doit être fait référence à l'IEC 60068-2-6 pour plus d'informations.

[e] Les exigences de l'IEC 61753-1 doivent être appliquées.

5.5 Spécification fonctionnelle

Les caractéristiques électro-optiques, définies pour les différents paramètres du Tableau 3, doivent être respectées dans les conditions d'environnement de fonctionnement spécifiées dans le Tableau 2. Il convient que les caractéristiques optiques spécifiées dans la Recommandation UIT-T G.983.1 soient satisfaites.

Chacune des caractéristiques électriques et optiques mentionnées en 5.5 doit être mesurée dans les conditions spécifiées pour chaque référence.

Chacune des caractéristiques électriques et optiques mentionnées en 5.5 doit être indiquée dans les conditions les plus défavorables spécifiées, par rapport à la plage des conditions de fonctionnement recommandée. Chacune des caractéristiques électriques et optiques mentionnées dans le Tableau 3 doit être mesurée en se fondant sur la méthode indiquée dans la norme citée en référence sur la ligne correspondante.

Tableau 2 – Environnement de fonctionnement

Paramètre	Symbole	Exigences			Unité
		Valeur minimale	Valeur type	Valeur maximale	
Tension d'alimentation	U_{SUP}	3,135	3,3	3,465	V
Température du boîtier en fonctionnement [a]	T_{case}	–5		75	°C
Humidité relative ambiante [a]	HR	5		95	%

[a] L'humidité et la température de boîtier de fonctionnement pour une unité ONU extérieure font actuellement l'objet d'études complémentaires dans le cadre de la Recommandation UIT-T G.983.1. Ces spécifications sont donc susceptibles d'être modifiées à l'avenir.