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REDLINE VERSION

INTERNATIONAL STANDARD

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Fibre optic active components and devices – Performance standards – Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62149-4:2010. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 62149-4 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

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

a) the normative references are updated;
b) the condition "for short periods" in 4.1 is removed;
c) the absolute limiting rating for soldering temperature in Table 1 is modified;
d) the maximal optical output power (multimode fibre) in Table 4 is increased from −3,5 dBm to −3 dBm, to align value with the referenced document;
e) a note is added to Table 7 to clarify that out-of-specification products are not allowed to pass the performance tests.

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

Draft	Report on voting
86C/1800/CDV	86C/1826/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the 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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Fibre optic transceivers are used to convert electrical signals into optical signals and vice versa. This document specifies performance standards for 1 300 nm fibre optic transceivers for Gigabit Ethernet application. The ISO/IEC/IEEE 8802-3 Gigabit Ethernet standard is used as the basis for determining the optical characteristics of the transceiver, which operates at a line rate of 1,25 Gbit/s.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

1 Scope

This part of IEC 62149 defines performance specifications for 1 300 nm fibre optic transceiver modules used for the ISO/IEC/IEEE 8802-3 Gigabit Ethernet application. This document contains definitions for product performance requirements as well as a series of tests and measurements, for which clearly defined conditions, severities and pass/fail criteria are provided. The tests are intended to be run on a "once-off" basis to prove any product's ability to satisfy the performance standard's requirements.

A product that has been shown to meet all the requirements of a performance standard can be declared as complying with the performance standard but ~~should~~ will then be controlled by a quality assurance/quality conformance program.

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 60068-2-20, *Environmental testing – Part 2-20: Tests – Test ~~T~~ Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

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

IEC 60068-2-38, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC ~~60028~~ 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60749-25, *Semiconductor devices – Mechanical and climatic test methods – Part 25: Temperature cycling*

IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*

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

IEC 60938-1, *Fixed inductors for electromagnetic interference suppression – Part 1: Generic specification*

IEC 60950-1~~:2001~~, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61300-2-47, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-47: Tests – Thermal shocks*

~~ISO/IEC 8802-3:2000, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*~~

ISO/IEC/IEEE 8802-3:2021, *Telecommunications and exchange between information technology systems – Requirements for local and metropolitan area networks – Part 3: Standard for Ethernet*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

3.2 Symbols

E_r	extinction ratio
~~I_{IH}~~ I_{ih}	data input current – high
~~I_{IL}~~ I_{il}	data input current – low
I_{out}	output current
P_a	alarm off level
P_d	alarm on level
P_o	optical output power
P_{opt}	optical input power
~~RH~~	~~relative humidity~~
~~R_{DL}~~ R_{dl}	data output load
S	receiver sensitivity
T_{amb}	ambient operating temperature
TD	transmit disable function
T_f	~~data~~ optical output fall time
T_r	~~data~~ optical output rise time
T_{stg}	storage temperature
V_{cc}	~~power~~ supply voltage
~~V_{IH}~~ $V_{ih} – V_{cc}$	data input voltage – high
~~V_{IL}~~ $V_{il} – V_{cc}$	data input voltage – low
V_{nom}	nominal operating voltage
V_{oh}	alarm output high voltage

$V_{oh} - V_{cc}$ data output voltage – high

V_{ol} alarm output low voltage

$V_{ol} - V_{cc}$ data output voltage – low

V_{pp} transmitter differential input voltage swing

ΔP_o optical output power change from pre-test value to post-test value

ΔS receiver sensitivity change from pre-test value to post-test value

$\Delta\lambda$ spectral width (RMS)

λ_{ce} central wavelength

3.3 Abbreviated terms

BER bit error ratio

ECL emitter-coupled logic

EO electro-optical

ESD electrostatic discharge

HBM human body model

LVTTL low voltage transistor-transistor logic

NRZ non-return-to-zero

PECL pseudo emitter-coupled logic

PRBS pseudo random bit sequence

RH relative humidity

SD signal detect

TTL transistor-transistor logic

TTL/CMOS transistor-transistor logic/complementary metal-oxide-semiconductor

4 Product parameters

4.1 Absolute limiting ratings

Absolute limiting (maximum and/or minimum) ratings, as shown in Table 1, 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 can be applied at any one time.

Table 1 – Absolute limiting ratings

Parameter	Symbol or abbreviated term	Minimum	Maximum	Unit
Storage temperature	T_{stg}	−40	+85	°C
Ambient operating temperature	T_{amb}	−10	+80	°C
Lead soldering temperature (minimum distance to case specified)			+260 (for 10 s)	°C/s
Output current	I_{out}	0	50	mA
Data input voltage		−0,5	V_{cc}	V
Transmitter differential input voltage swing	V_{pp}	0,30	1,40	V
Supply voltage [a]		−0,5	(V_{nom} + 40 %) %	V
Relative humidity [b]	RH	5	85	%
[a] Nominal operating voltages (V_{nom}) of 5 V and 3,3 V apply. Refer to Annex A for variant references.				
[b] No condensation allowed.				

4.2 Operating environment

The parameters for the operating environment are shown in Table 2.

Table 2 – Operating environment

Parameter	Symbol or abbreviated term	Minimum	Maximum	Unit
Supply voltage [a]	V_{cc}	(V_{nom} − 5 %) %	(V_{nom} + 5 %) %	V
Ambient operating temperature	T_{amb}	0	70	°C
Relative humidity [b]	RH	5	85	%
[a] For a nominal operating voltage (V_{nom}) of 5 V. For 3,3 V nominal operating voltage limits are, the minimum value is 3,15 V to and the maximum value is 3,45 V.				
[b] No condensation allowed.				

4.3 Functional specification

The specifications in Table 3 and Table 4 describe the functional requirements required to meet the ISO/IEC/IEEE 8802-3 PHY specifications.

Table 3 – Receiver section: functional specification

Parameter	Symbol	Minimum	Maximum	Unit
Receiver sensitivity [a]	S		−19	dBm
Maximum optical input power		−3		dBm
Optical return loss		12		dB
Alarm on level [f]	P_d	−45	−20	dBm
Alarm off level [f]	P_a		−19	dBm
Hysteresis		0,5	4,0	dB
Alarm response time			600	µs

Parameter	Symbol	Minimum	Maximum	Unit
Alarm output high voltage (option 1) [b]	V_{oh}	−1,1	−0,8	V
Alarm output low voltage (option 1) [b]	V_{ol}	−2,0	−1,6	V
Alarm output high voltage (option 2) [c]	V_{oh}	2	V_{cc}	V
Alarm output low voltage (option 2) [c]	V_{ol}	0	0,8	V
Data output voltage – low [d]	$V_{ol} - V_{cc}$	−1,950	−1,620	V
Data output voltage – high [d]	$V_{oh} - V_{cc}$	−1,045	−0,740	V
Data output load [e] [g]	R_{dl}	50		Ω

NOTE Refer to Table 2 for operating environment.

[a] Minimum sensitivity and saturation levels for 1E-12 BER measured with a 9 dB extinction ratio source and (2^7 – 1) PRBS test signal.

[b] These voltages are measured with respect to V_{cc}.

[c] Outputs compatible with TTL and LVTTL inputs.

[d] Outputs compatible with 10K, 10KH, 100K ECL and PECL inputs.

[e] Outputs terminated to V_{cc}– 2 V.

[f] Alarm triggered when receive sensitivity is below that specified. Hysteresis value specified as $P_a - P_d$.

[g] Basic value.

Table 4 – Transmitter section: functional specification

Parameter	Symbol	Minimum	Maximum	Unit
Central wavelength	λ_{ce}	1 270	1 355	nm
Spectral width (RMS)	$\Delta\lambda$		4	nm
Optical output power (single-mode fibre) [a]	P_o	−11,0	−3,0	dBm
Optical output power (multimode fibre) [a] [e]	P_o	−11,5	−~~3,5~~ 3,0	dBm
Extinction ratio	E_r	9		dB
Optical output rise time (20 % – 80 %) [e]	T_r		0,26	ns
Optical output fall time (80 % – 20 %) [e]	T_f		0,26	ns
Output eye [b]				
Transmit disable function (optional) [d]	TD			
Data input current – low	I_{il}	−350		µA
Data input current – high	I_{ih}		350	µA
Data input voltage – low [c]	$V_{il} - V_{cc}$	−1,810	−1,475	V
Data input voltage – high [c]	$V_{ih} - V_{cc}$	−1,165	−0,880	V
Transmitter differential input voltage swing	V_{pp}	0,3		V

NOTE Refer to Table 2 for operating environment.

[a] Output eye is power coupled into a single-mode fibre, 62,5/125 multimode fibre, or 50/125 multimode fibre.

[b] Compliant with ISO/IEC/IEEE 8802-3.

[c] Compatible with 10K, 10KH, 100K ECL, and PECL signals.

[d] Optional transmit disable function. Normal TTL function. Transmitter output enabled with no signal present. With logic "high" input, transmitter output is disabled.

[e] Measured at the output of a mode conditioning patchcord as specified in ISO/IEC/IEEE 8802-3:2021, 38.11.4.

4.4 Diagrams

The diagrams in Figure 1 and Figure 2 are representative examples for the receiver section and transmitter section.

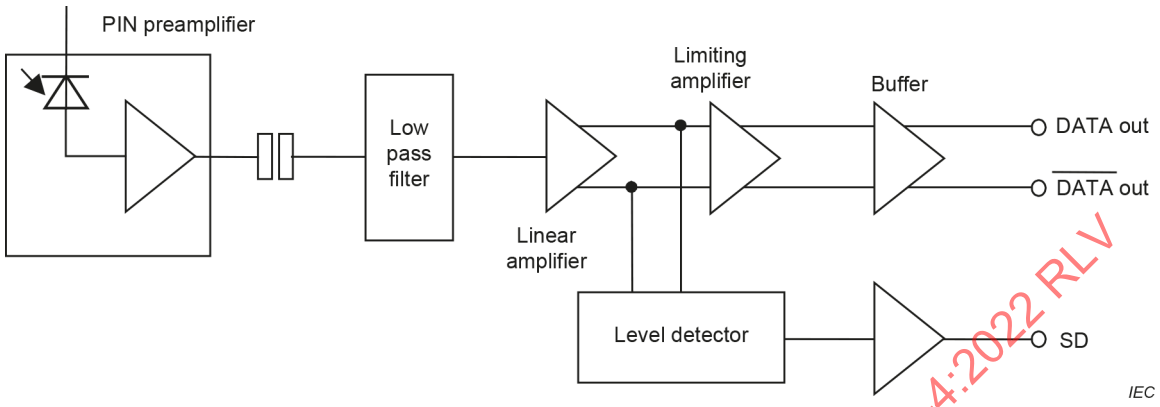

Figure 1 – Receiver section schematic

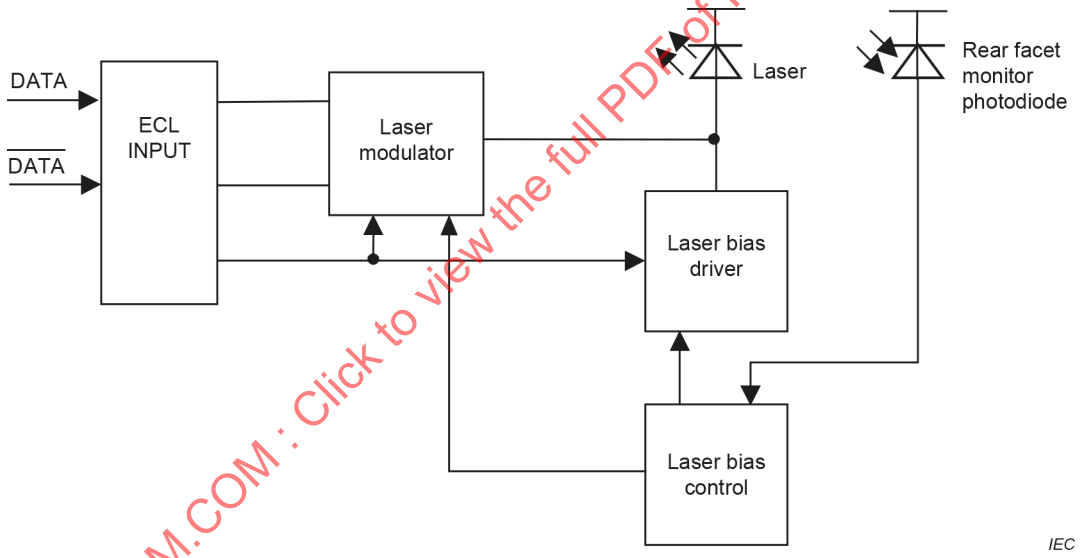

Figure 2 – Transmitter section schematic

4.5 Labelling

It is recommended that each transceiver (and supporting documentation) be labelled in a manner visible to the user with at least the following data:

a) this document reference, including variant type;

b) applicable safety warnings.

Labelling requirements for class 1 lasers are given in the laser safety standards referenced in 6.2.

5 Testing

5.1 General

Initial characterization and qualification shall be undertaken when a build standard has been completed and frozen. Qualification maintenance is carried using periodic testing programs. Test conditions for all tests unless otherwise stated are 25 °C ± 2 °C.

5.2 Characterization testing

Characterization shall be carried out on at least 20 products taken from at least three different manufacturing lots. The test and test limits are given in Table 5 and Table 6.

Table 5 – Transmitter section characterization tests

Parameter	Test conditions [a] ~~As a minimum 20 devices to be measured at 0 °C, 25 °C and 70 °C (±2 °C) and V_{cc} at (V_{nom} – 5 %) V and (V_{nom}) V and (V_{nom} + 5 %) V~~	Test limit minimum	Test limit maximum	Unit
Optical output power	Single-mode fibre, PRBS 2^7 – 1 at 1,25 Gbit/s modulation	−11,0	−3,0	dBm
Centre wavelength	PRBS 2^7 – 1 at 1,25 Gbit/s modulation	1 270	1 355	nm
Spectral width	PRBS 2^7 – 1 at 1,25 Gbit/s modulation		4	nm
Extinction ratio	250 Mbit/s square wave	9		dB
Eye mask test	~~ANSI × 3,230 filter,~~ PRBS 2^7 – 1 at 1,25 Gbit/s modulation ISO/IEC/IEEE 8802-3:2021, 38.6.5	No hits	No hits	
Relative intensity noise (RIN)	~~ISO/IEC8802-3ae, Subclause 52.8.5~~ ISO/IEC/IEEE 8802-3:2021, 38.6.4		−120	dB/Hz
Rise and fall time	20 % to 80 %		0,26	ns

[a] A minimum of 20 devices to be measured at T_{amb} of 0 °C, 25 °C, and 70 °C ± 2 °C and with V_{cc} set at minimum operating voltage, at nominal operating voltage (V_{nom}), and at maximal operating voltage. Refer to Table 2 for minimum and maximum operating voltages.

Table 6 – Receiver section characterization tests

Parameter	Test conditions [a] ~~As a minimum 20 devices to be measured at 0 °C, 25 °C and 70 °C (±2 °C) and V_{cc} at (V_{nom} – 5 %) V and (V_{nom}) V and (V_{nom} + 5 %) V~~	Test limit minimum	Test limit maximum	Unit
Sensitivity at 1E-12 BER	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source		−19	dBm
Alarm level high	TTL/CMOS compatible logic level "1"			
Alarm level low	TTL/CMOS compatible logic level "0"			
Alarm on threshold	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source		−20,0	dBm
Alarm hysteresis	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source	0,5	4	dB
Maximum input errors	P_{opt} set to −2,4 dBm gate for 3 s using 9 dB extinction ratio source		3	

[a] A minimum of 20 devices to be measured at T_{amb} of 0 °C, 25 °C, and 70 °C ± 2 °C and with V_{cc} set at minimum operating voltage, at nominal operating voltage (V_{nom}), and at maximal operating voltage. Refer to Table 2 for minimum and maximum operating voltages.

5.3 Performance testing

5.3.1 Sequence of testing

Performance testing is undertaken when characterization testing is complete.

5.3.2 Sample size, sequencing and groupings

The performance test plan is given in Table 7 and the sample sizes, sequencing and grouping to be used for the tests are as defined in Annex A. Samples may either be a new product or sourced from a previous test.

A total of 96 products (95 + 1 control) are required for performance testing. Control devices are used to determine measurement repeatability.

Table 7 – Performance test plan

No.	Test	Requirements[a]					Test methods and conditions
0	Full EO testing per characterization test requirements	Meets specification					Tests carried out at 0 °C, 25 °C, 70 °C
1	Solderability	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-20 Steam ageing not required
			ΔS	+0,7	−0,7	dB	
		Visual inspection	ΔP_o	+0,5	−0,5	dB	
2	Connector mate/demate	EO test 25 °C		Max.	Min.	Unit	500 cycles. Clean and measure transmit side every 50 cycles. Same connector
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
3	ESD	EO test		Max.	Min.	Unit	IEC 60749-26, method HBM 500 V
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
4	Flammability						Class UL94-V
5	Mechanical shock	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-27 ~~1 500 g~~ 15 000 m/s^2, 1,0 ms, 5 times per axis
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
6	Vibration	EO test		Max.	Min.	Unit	IEC 60068-2-6 ~~20 g 20-2 000 Hz~~ 200 m/s^2, 20 Hz to 2 000 Hz, 4 min per cycle, 4 cycles per axis
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
7	Cyclic moisture	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-38 10 cycles
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
8	Resistance to soldering heat	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-20, test Tb, method ~~1B~~ 2, 350 °C 3,5 s
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
9	Thermal shock	EO test 25 °C		Max.	Min.	Unit	IEC 61300-2-47 delta temperature 100 °C
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
10	Fast temperature cycle 500 cycles	EO test		Max.	Min.	Unit	IEC 60749-25 lower soak temperature −40 °C, upper soak temperature +85 °C, 500 cycles
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
11	Fast temperature cycle 1 000 cycles	EO test		Max.	Min.	Unit	As test 10, further 500 cycles
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
12	High temperature endurance 500 h	EO test 25 °C		Max.	Min.	Unit	70 °C, ~~$V_{cc} = (V_{op} + 5\ \% V_{op})$~~ V_{cc} at maximum operating voltage (refer to Table 2)
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
13	High temperature endurance 1 000 h	EO test		Max.	Min.	Unit	As test 12, further 500 h
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
14	High temperature endurance 2 000 h	EO test		Max.	Min.	Unit	As test 13, further 1 000 h
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	

No.	Test	Requirements[a]				Test methods and conditions
15	High temperature endurance 5 000 h	EO test 0 °C, 25 °C, 70 °C				As test 14, further 3 000 h Information only
16	Cold storage 500 h	EO test 25 °C		Max.	Min. Unit	−40 °C
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
17	Cold storage 1 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min. Unit	As test 16, further 500 h
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
18	Cold storage 2 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min. Unit	As test 17, further 1 000 h
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
19	Damp heat 168 h	EO test 25 °C		Max.	Min. Unit	IEC 60068-2-78 40 °C / 95 % RH ~~$V_{cc} = (V_{op} + 5\ \% \ V_{op})$~~ V_{cc} at maximum operating voltage (refer to Table 2)
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
20	Damp heat 500 h	EO test 25 °C		Max.	Min. Unit	As test 19, further 332 h
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
21	Damp heat 1 000 h	EO test 25 °C		Max.	Min. Unit	As test 20, further 500 h
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	
22	Damp heat 1 344 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min. Unit	As test 21, further 344 h
			ΔS	+0,7	−0,7 dB	
			ΔP_o	+0,5	−0,5 dB	

[a] For tests 1 to 22, except for tests 4 and 15, pre- and post-test values of receiver sensitivity (S) and optical output power (P_o) shall meet the characterization test limits specified in Table 5 and Table 6.

6 Environmental specifications

6.1 General safety

All transceivers meeting this document shall conform to IEC 60950-1~~:2001~~.

6.2 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.

6.3 Electromagnetic emission

Products defined in this document shall comply with IEC 60938-1 for the limitation of electromagnetic interference.

Annex A
(normative)

Sample size, sequencing and grouping requirements

Table A.1 shows sample size, sequencing and grouping requirements.

Table A.1 – Sample size, sequencing and grouping requirements

	Test	Sample size	Source
0	Initial testing	95	New
1	Solderability	11	Test 0
2	Connector mate/demate	11	Test 1
3	ESD	6	Test 2
4	Flammability	5	Test 2
5	Mechanical shock	11	Test 0
6	Vibration	11	Test 5
7	Cyclic moisture	11	Test 0
8	Resistance to solder heat	11	Test 7
9	Thermal shock	11	Test 8
10	Fast temperature cycle 500 cycles	11	Test 0
11	Fast temperature cycle 1 000 cycles	11	Test 10
12	High temperature endurance 500 h	25	Test 0
13	High temperature endurance 1 000 h	25	Test 12
14	High temperature endurance 2 000 h	25	Test 13
15	High temperature endurance 5 000 h	25	Test 14
16	Cold storage 500 h	11	Test 0
17	Cold storage 1 000 h	11	Test 16
18	Cold storage 2 000 h	11	Test 17
19	Damp heat 168 h	11	Test 0
20	Damp heat 500 h	11	Test 19
21	Damp heat 1 000 h	11	Test 20
22	Damp heat 1 344 h	11	Test 21

The tests of Table A.1 are each intended to be performed individually and in parallel on products, although products from a previous test may be used if desired. Mechanical tests may also be carried out on parts of an identical build or structure but intended for use at different bit rates.

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IEC 62149-4

Edition 3.0 2022-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic active components and devices – Performance standards – Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

Composants et dispositifs actifs fibroniques – Normes de performance – Partie 4: Émetteurs-récepteurs fibroniques de 1 300 nm pour application Gigabit Ethernet

IEC 62149-4:2022-12(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

FOREWORD

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IEC 62149-4 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2010. This edition constitutes a technical revision.

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

a) the normative references are updated;
b) the condition "for short periods" in 4.1 is removed;
c) the absolute limiting rating for soldering temperature in Table 1 is modified;
d) the maximal optical output power (multimode fibre) in Table 4 is increased from −3,5 dBm to −3 dBm, to align value with the referenced document;

e) a note is added to Table 7 to clarify that out-of-specification products are not allowed to pass the performance tests.

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

Draft	Report on voting
86C/1800/CDV	86C/1826/RVC

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the 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 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. This document specifies performance standards for 1 300 nm fibre optic transceivers for Gigabit Ethernet application. The ISO/IEC/IEEE 8802-3 Gigabit Ethernet standard is used as the basis for determining the optical characteristics of the transceiver, which operates at a line rate of 1,25 Gbit/s.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 4: 1 300 nm fibre optic transceivers for Gigabit Ethernet application

1 Scope

This part of IEC 62149 defines performance specifications for 1 300 nm fibre optic transceiver modules used for the ISO/IEC/IEEE 8802-3 Gigabit Ethernet application. This document contains definitions for product performance requirements as well as a series of tests and measurements, for which clearly defined conditions, severities and pass/fail criteria are provided. The tests are intended to be run on a "once-off" basis to prove any product's ability to satisfy the performance standard's requirements.

A product that has been shown to meet all the requirements of a performance standard can be declared as complying with the performance standard but will then be controlled by a quality assurance/quality conformance program.

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 60068-2-20, *Environmental testing – Part 2-20: Tests – Test Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

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

IEC 60068-2-38, *Environmental testing – Part 2-38: Tests – Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60749-25, *Semiconductor devices – Mechanical and climatic test methods – Part 25: Temperature cycling*

IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*

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

IEC 60938-1, *Fixed inductors for electromagnetic interference suppression – Part 1: Generic specification*

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

IEC 61300-2-47, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-47: Tests – Thermal shocks*

ISO/IEC/IEEE 8802-3:2021, *Telecommunications and exchange between information technology systems – Requirements for local and metropolitan area networks – Part 3: Standard for Ethernet*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

No terms and definitions are listed in this document.

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

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

3.2 Symbols

E_r	extinction ratio
I_{ih}	data input current – high
I_{il}	data input current – low
I_{out}	output current
P_a	alarm off level
P_d	alarm on level
P_o	optical output power
P_{opt}	optical input power
R_{dl}	data output load
S	receiver sensitivity
T_{amb}	ambient operating temperature
TD	transmit disable function
T_f	optical output fall time
T_r	optical output rise time
T_{stg}	storage temperature
V_{cc}	supply voltage
$V_{ih} - V_{cc}$	data input voltage – high
$V_{il} - V_{cc}$	data input voltage – low
V_{nom}	nominal operating voltage
V_{oh}	alarm output high voltage
$V_{oh} - V_{cc}$	data output voltage – high
V_{ol}	alarm output low voltage
$V_{ol} - V_{cc}$	data output voltage – low
V_{pp}	transmitter differential input voltage swing

ΔP_o optical output power change from pre-test value to post-test value

ΔS receiver sensitivity change from pre-test value to post-test value

$\Delta\lambda$ spectral width (RMS)

λ_{ce} central wavelength

3.3 Abbreviated terms

BER bit error ratio

ECL emitter-coupled logic

EO electro-optical

ESD electrostatic discharge

HBM human body model

LVTTL low voltage transistor-transistor logic

NRZ non-return-to-zero

PECL pseudo emitter-coupled logic

PRBS pseudo random bit sequence

RH relative humidity

SD signal detect

TTL transistor-transistor logic

TTL/CMOS transistor-transistor logic/complementary metal-oxide-semiconductor

4 Product parameters

4.1 Absolute limiting ratings

Absolute limiting (maximum and/or minimum) ratings, as shown in Table 1, 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 can be applied at any one time.

Table 1 – Absolute limiting ratings

Parameter	Symbol or abbreviated term	Minimum	Maximum	Unit
Storage temperature	T_{stg}	−40	+85	°C
Ambient operating temperature	T_{amb}	−10	+80	°C
Lead soldering temperature (minimum distance to case specified)			+260 (for 10 s)	°C
Output current	I_{out}	0	50	mA
Data input voltage		−0,5	V_{cc}	V
Transmitter differential input voltage swing	V_{pp}	0,30	1,40	V
Supply voltage [a]		−0,5	V_{nom} + 40 %	V
Relative humidity [b]	RH	5	85	%

[a] Nominal operating voltages (V_{nom}) of 5 V and 3,3 V apply.

[b] No condensation allowed.

4.2 Operating environment

The parameters for the operating environment are shown in Table 2.

Table 2 – Operating environment

Parameter	Symbol or abbreviated term	Minimum	Maximum	Unit
Supply voltage [a]	V_{cc}	V_{nom} − 5 %	V_{nom} + 5 %	V
Ambient operating temperature	T_{amb}	0	70	°C
Relative humidity [b]	RH	5	85	%

[a] For a nominal operating voltage (V_{nom}) of 5 V. For 3,3 V nominal operating voltage, the minimum value is 3,15 V and the maximum value is 3,45 V.

[b] No condensation allowed.

4.3 Functional specification

The specifications in Table 3 and Table 4 describe the functional requirements required to meet the ISO/IEC/IEEE 8802-3 PHY specifications.

Table 3 – Receiver section: functional specification

Parameter	Symbol	Minimum	Maximum	Unit
Receiver sensitivity [a]	S		−19	dBm
Maximum optical input power		−3		dBm
Optical return loss		12		dB
Alarm on level [f]	P_d	−45	−20	dBm
Alarm off level [f]	P_a		−19	dBm
Hysteresis		0,5	4,0	dB
Alarm response time			600	µs
Alarm output high voltage (option 1) [b]	V_{oh}	−1,1	−0,8	V
Alarm output low voltage (option 1) [b]	V_{ol}	−2,0	−1,6	V
Alarm output high voltage (option 2) [c]	V_{oh}	2	V_{cc}	V
Alarm output low voltage (option 2) [c]	V_{ol}	0	0,8	V
Data output voltage – low [d]	$V_{ol} - V_{cc}$	−1,950	−1,620	V
Data output voltage – high [d]	$V_{oh} - V_{cc}$	−1,045	−0,740	V
Data output load [e] [g]	R_{dl}	50		Ω

NOTE Refer to Table 2 for operating environment.

[a] Minimum sensitivity and saturation levels for 1E-12 BER measured with a 9 dB extinction ratio source and (2^7 – 1) PRBS test signal.

[b] These voltages are measured with respect to V_{cc}.

[c] Outputs compatible with TTL and LVTTL inputs.

[d] Outputs compatible with 10K, 10KH, 100K ECL and PECL inputs.

[e] Outputs terminated to V_{cc} – 2 V.

[f] Alarm triggered when receive sensitivity is below that specified. Hysteresis value specified as $P_a - P_d$.

[g] Basic value.

Table 4 – Transmitter section: functional specification

Parameter	Symbol	Minimum	Maximum	Unit
Central wavelength	λ_{ce}	1 270	1 355	nm
Spectral width (RMS)	$\Delta\lambda$		4	nm
Optical output power (single-mode fibre) [a]	P_o	−11,0	−3,0	dBm
Optical output power (multimode fibre) [a e]	P_o	−11,5	−3,0	dBm
Extinction ratio	E_r	9		dB
Optical output rise time (20 % – 80 %) [e]	T_r		0,26	ns
Optical output fall time (80 % – 20 %) [e]	T_f		0,26	ns
Output eye [b]				
Transmit disable function (optional) [d]	TD			
Data input current – low	I_{il}	−350		µA
Data input current – high	I_{ih}		350	µA
Data input voltage – low [c]	$V_{il} - V_{cc}$	−1,810	−1,475	V
Data input voltage – high [c]	$V_{ih} - V_{cc}$	−1,165	−0,880	V
Transmitter differential input voltage swing	V_{pp}	0,3		V
NOTE Refer to Table 2 for operating environment.				

a Output eye is power coupled into a single-mode fibre, 62,5/125 multimode fibre, or 50/125 multimode fibre.

b Compliant with ISO/IEC/IEEE 8802-3.

c Compatible with 10K, 10KH, 100K ECL, and PECL signals.

d Optional transmit disable function. Normal TTL function. Transmitter output enabled with no signal present. With logic "high" input, transmitter output is disabled.

e Measured at the output of a mode conditioning patchcord as specified in ISO/IEC/IEEE 8802-3:2021, 38.11.4.

4.4 Diagrams

The diagrams in Figure 1 and Figure 2 are representative examples for the receiver section and transmitter section.

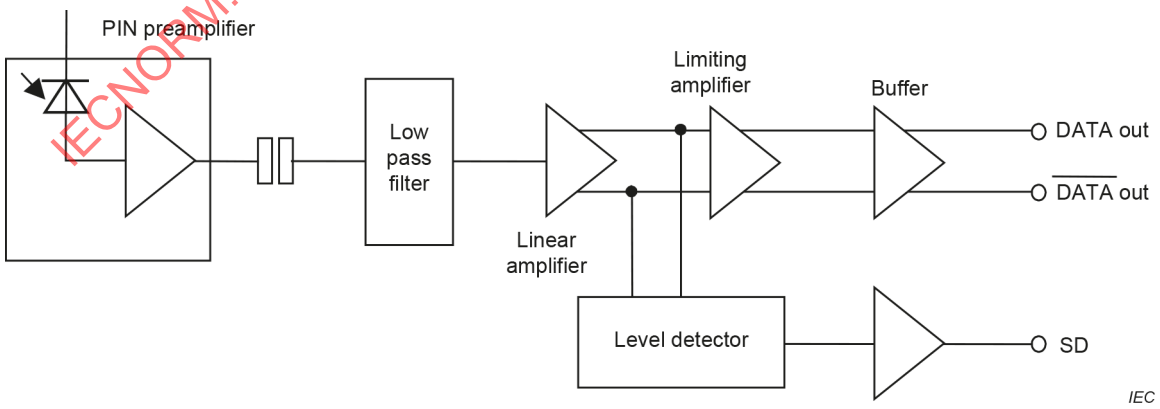

Figure 1 – Receiver section schematic

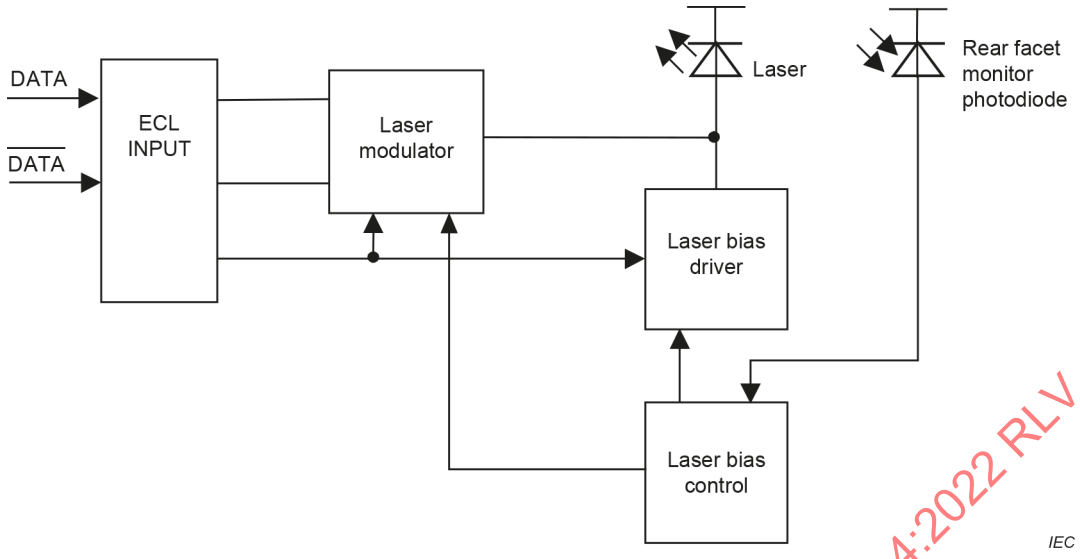

Figure 2 – Transmitter section schematic

4.5 Labelling

It is recommended that each transceiver (and supporting documentation) be labelled in a manner visible to the user with at least the following data:

a) this document reference, including variant type;

b) applicable safety warnings.

Labelling requirements for class 1 lasers are given in the laser safety standards referenced in 6.2.

5 Testing

5.1 General

Initial characterization and qualification shall be undertaken when a build standard has been completed and frozen. Qualification maintenance is carried using periodic testing programs. Test conditions for all tests unless otherwise stated are 25 °C ± 2 °C.

5.2 Characterization testing

Characterization shall be carried out on at least 20 products taken from at least three different manufacturing lots. The test and test limits are given in Table 5 and Table 6.

Table 5 – Transmitter section characterization tests

Parameter	Test conditions[a]	Test limit minimum	Test limit maximum	Unit
Optical output power	Single-mode fibre, PRBS 2^7 – 1 at 1,25 Gbit/s modulation	−11,0	−3,0	dBm
Centre wavelength	PRBS 2^7 – 1 at 1,25 Gbit/s modulation	1 270	1 355	nm
Spectral width	PRBS 2^7 – 1 at 1,25 Gbit/s modulation		4	nm
Extinction ratio	250 Mbit/s square wave	9		dB
Eye mask test	PRBS 2^7 – 1 at 1,25 Gbit/s modulation ISO/IEC/IEEE 8802-3:2021, 38.6.5	No hits	No hits	
Relative intensity noise (RIN)	ISO/IEC/IEEE 8802-3:2021, 38.6.4		−120	dB/Hz
Rise and fall time	20 % to 80 %		0,26	ns

[a] A minimum of 20 devices to be measured at T_{amb} of 0 °C, 25 °C, and 70 °C ± 2 °C and with V_{cc} set at minimum operating voltage, at nominal operating voltage (V_{nom}), and at maximal operating voltage. Refer to Table 2 for minimum and maximum operating voltages.

Table 6 – Receiver section characterization tests

Parameter	Test conditions[a]	Test limit minimum	Test limit maximum	Unit
Sensitivity at 1E-12 BER	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source		−19	dBm
Alarm level high	TTL/CMOS compatible logic level "1"			
Alarm level low	TTL/CMOS compatible logic level "0"			
Alarm on threshold	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source		−20,0	dBm
Alarm hysteresis	PRBS modulation NRZ at 1,25 Gbit/s assuming 9 dB extinction ratio source	0,5	4	dB
Maximum input errors	P_{opt} set to −2,4 dBm gate for 3 s using 9 dB extinction ratio source		3	

[a] A minimum of 20 devices to be measured at T_{amb} of 0 °C, 25 °C, and 70 °C ± 2 °C and with V_{cc} set at minimum operating voltage, at nominal operating voltage (V_{nom}), and at maximal operating voltage. Refer to Table 2 for minimum and maximum operating voltages.

5.3 Performance testing

5.3.1 Sequence of testing

Performance testing is undertaken when characterization testing is complete.

5.3.2 Sample size, sequencing and groupings

The performance test plan is given in Table 7 and the sample sizes, sequencing and grouping to be used for the tests are as defined in Annex A. Samples may either be a new product or sourced from a previous test.

A total of 96 products (95 + 1 control) are required for performance testing. Control devices are used to determine measurement repeatability.

Table 7 – Performance test plan

No.	Test	Requirements[a]		Max.	Min.	Unit	Test methods and conditions
0	Full EO testing per characterization test requirements	Meets specification					Tests carried out at 0 °C, 25 °C, 70 °C
1	Solderability	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-20 Steam ageing not required
			ΔS	+0,7	−0,7	dB	
		Visual inspection	ΔP_o	+0,5	−0,5	dB	
2	Connector mate/demate	EO test 25 °C		Max.	Min.	Unit	500 cycles. Clean and measure transmit side every 50 cycles. Same connector
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
3	ESD	EO test		Max.	Min.	Unit	IEC 60749-26, method HBM 500 V
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
4	Flammability						Class UL94-V
5	Mechanical shock	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-27 15 000 m/s^2, 1,0 ms, 5 times per axis
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
6	Vibration	EO test		Max.	Min.	Unit	IEC 60068-2-6 200 m/s^2, 20 Hz to 2 000 Hz, 4 min per cycle, 4 cycles per axis
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
7	Cyclic moisture	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-38 10 cycles
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
8	Resistance to soldering heat	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-20, test Tb, method 2, 350 °C 3,5 s
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
9	Thermal shock	EO test 25 °C		Max.	Min.	Unit	IEC 61300-2-47 delta temperature 100 °C
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
10	Fast temperature cycle 500 cycles	EO test		Max.	Min.	Unit	IEC 60749-25 lower soak temperature −40 °C, upper soak temperature +85 °C, 500 cycles
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
11	Fast temperature cycle 1 000 cycles	EO test		Max.	Min.	Unit	As test 10, further 500 cycles
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
12	High temperature endurance 500 h	EO test 25 °C		Max.	Min.	Unit	70 °C, V_{cc} at maximum operating voltage (refer to Table 2)
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
13	High temperature endurance 1 000 h	EO test		Max.	Min.	Unit	As test 12, further 500 h
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
14	High temperature endurance 2 000 h	EO test		Max.	Min.	Unit	As test 13, further 1 000 h
		0 °C, 25 °C, 70 °C	ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	

No.	Test	Requirements[a]					Test methods and conditions
15	High temperature endurance 5 000 h	EO test 0 °C, 25 °C, 70 °C					As test 14, further 3 000 h Information only
16	Cold storage 500 h	EO test 25 °C		Max.	Min.	Unit	−40 °C
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
17	Cold storage 1 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 16, further 500 h
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
18	Cold storage 2 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 17, further 1 000 h
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
19	Damp heat 168 h	EO test 25 °C		Max.	Min.	Unit	IEC 60068-2-78 40 °C / 95 % RH V_{cc} at maximum operating voltage (refer to Table 2)
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
20	Damp heat 500 h	EO test 25 °C		Max.	Min.	Unit	As test 19, further 332 h
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
21	Damp heat 1 000 h	EO test 25 °C		Max.	Min.	Unit	As test 20, further 500 h
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	
22	Damp heat 1 344 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 21, further 344 h
			ΔS	+0,7	−0,7	dB	
			ΔP_o	+0,5	−0,5	dB	

[a] For tests 1 to 22, except for tests 4 and 15, pre- and post-test values of receiver sensitivity (S) and optical output power (P_o) shall meet the characterization test limits specified in Table 5 and Table 6.

6 Environmental specifications

6.1 General safety

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

6.2 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.

6.3 Electromagnetic emission

Products defined in this document shall comply with IEC 60938-1 for the limitation of electromagnetic interference.

Annex A
(normative)

Sample size, sequencing and grouping requirements

Table A.1 shows sample size, sequencing and grouping requirements.

Table A.1 – Sample size, sequencing and grouping requirements

	Test	Sample size	Source
0	Initial testing	95	New
1	Solderability	11	Test 0
2	Connector mate/demate	11	Test 1
3	ESD	6	Test 2
4	Flammability	5	Test 2
5	Mechanical shock	11	Test 0
6	Vibration	11	Test 5
7	Cyclic moisture	11	Test 0
8	Resistance to solder heat	11	Test 7
9	Thermal shock	11	Test 8
10	Fast temperature cycle 500 cycles	11	Test 0
11	Fast temperature cycle 1 000 cycles	11	Test 10
12	High temperature endurance 500 h	25	Test 0
13	High temperature endurance 1 000 h	25	Test 12
14	High temperature endurance 2 000 h	25	Test 13
15	High temperature endurance 5 000 h	25	Test 14
16	Cold storage 500 h	11	Test 0
17	Cold storage 1 000 h	11	Test 16
18	Cold storage 2 000 h	11	Test 17
19	Damp heat 168 h	11	Test 0
20	Damp heat 500 h	11	Test 19
21	Damp heat 1 000 h	11	Test 20
22	Damp heat 1 344 h	11	Test 21

The tests of Table A.1 are each intended to be performed individually and in parallel on products, although products from a previous test may be used if desired. Mechanical tests may also be carried out on parts of an identical build or structure but intended for use at different bit rates.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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COMPOSANTS ET DISPOSITIFS ACTIFS FIBRONIQUES – NORMES DE PERFORMANCE –

Partie 4: Émetteurs-récepteurs fibroniques de 1 300 nm pour application Gigabit Ethernet

AVANT-PROPOS

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9) L'attention est attirée sur le fait que certains des éléments du présent document de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets.

L'IEC 62149-4 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. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2010. Cette édition constitue une révision technique.

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

a) mise à jour des références normatives;
b) suppression de la condition "pour de courtes périodes" au 4.1;
c) modification des valeurs limites absolues pour la température de brasage au Tableau 1;

d) augmentation de la puissance de sortie optique maximale (fibre multimodale) du Tableau 4, de −3,5 dBm à −3 dBm, afin d'aligner la valeur par rapport au document de référence;

e) ajout d'une note au Tableau 7, pour clarifier le fait que les produits non conformes à la spécification ne sont pas autorisés à réussir les essais de performance.

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

Projet	Rapport de vote
86C/1800/CDV	86C/1826/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications/.

Une liste de toutes les parties de la série IEC 62149, publiées sous le titre général *Composants et dispositifs actifs fibroniques – Normes de performance,* se trouve 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 webstore.iec.ch dans les données relatives au document recherché. À 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. Le présent document spécifie les normes de performance pour les émetteurs-récepteurs fibroniques de 1 300 nm pour application Gigabit Ethernet. La norme Gigabit Ethernet ISO/IEC/IEEE 8802-3 est utilisée comme base pour déterminer les caractéristiques optiques de l'émetteur-récepteur, qui fonctionne à une vitesse de 1,25 Gbit/s.

COMPOSANTS ET DISPOSITIFS ACTIFS FIBRONIQUES – NORMES DE PERFORMANCE –

Partie 4: Émetteurs-récepteurs fibroniques de 1 300 nm pour application Gigabit Ethernet

1 Domaine d'application

La présente partie de l'IEC 62149 définit les spécifications de performance pour les modules d'émetteur-récepteur fibroniques de 1 300 nm utilisés pour l'application Gigabit Ethernet de l'ISO/IEC/IEEE 8802-3. Ce document contient des définitions des exigences de performance de produit ainsi qu'une série d'essais et de mesures, pour lesquels des conditions, sévérités et critères de réussite/d'échec clairement définis sont fournis. Chaque essai est destiné à être effectué une seule fois pour prouver la capacité des produits à satisfaire aux exigences des normes de performance.

Un produit dont la conformité à toutes les exigences d'une norme de performance a été démontrée peut être déclaré conforme à la norme de performance, mais il sera ensuite contrôlé selon un programme d'assurance de la qualité/de conformité de la qualité.

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 60068-2-20, *Essais d'environnement – Partie 2-20: Essais – Essais Ta et Tb: Méthodes d'essai de la brasabilité et de la résistance à la chaleur de brasage des dispositifs à broches*

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

IEC 60068-2-38, *Essais d'environnement – Partie 2-38: Essais – Essai Z/AD: Essai cyclique composite de température et d'humidité*

IEC 60068-2-78, *Essais d'environnement – Partie 2-78: Essais – Essai Cab: Chaleur humide, essai continu*

IEC 60749-25, *Dispositifs à semiconducteurs – Méthodes d'essais mécaniques et climatiques – Partie 25: Cycles de température*

IEC 60749-26, *Dispositifs à semiconducteurs – Méthodes d'essais mécaniques et climatiques – Partie 26: Essai de sensibilité aux décharges électrostatiques (DES) – Modèle du corps humain (HBM)*

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

IEC 60938-1, *Inductances fixes d'antiparasitage – Partie 1: Spécification générique*

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

IEC 61300-2-47, *Dispositifs d'interconnexion et composants passifs fibroniques – Procédures fondamentales d'essais et de mesures – Partie 2-47: Essais – Chocs thermiques*

ISO/IEC/IEEE 8802-3:2021, *Telecommunications and exchange between information technology systems – Requirements for local and metropolitan area networks – Part 3: Standard for Ethernet* (disponible en anglais seulement)

3 Termes, définitions, symboles et abréviations

3.1 Termes et définitions

Aucun terme n'est défini dans le présent document.

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

3.2 Symboles

E_r	rapport d'extinction
I_{ih}	courant d'entrée de données – haut
I_{il}	courant d'entrée de données – bas
I_{out}	courant de sortie
P_a	niveau de disparition d'alarme
P_d	niveau d'alarme en marche
P_o	puissance de sortie optique
P_{opt}	puissance d'entrée optique
R_{dl}	charge de sortie de données
S	sensibilité du récepteur
T_{amb}	température de fonctionnement ambiante
TD	fonction d'incapacité d'émission
T_f	temps de descente de sortie optique
T_r	temps de montée de sortie optique
T_{stg}	température de stockage
V_{cc}	tension d'alimentation
$V_{ih} – V_{cc}$	tension d'entrée de données – haute
$V_{il} – V_{cc}$	tension d'entrée de données – basse
V_{nom}	tension de fonctionnement nominale
V_{oh}	haute tension de sortie d'alarme
$V_{oh} – V_{cc}$	tension de sortie de données – haute
V_{ol}	basse tension de sortie d'alarme

$V_{ol} - V_{cc}$ tension de sortie de données – basse

V_{pp} excursion de la tension d'entrée différentielle de l'émetteur

ΔP_o variation de la puissance de sortie optique, de la valeur d'avant essai à la valeur d'après essai

ΔS variation de la sensibilité du récepteur, de la valeur d'avant essai à la valeur d'après essai

$\Delta\lambda$ largeur spectrale (valeur efficace)

λ_{ce} longueur d'onde centrale

3.3 Abréviations

BER (bit error ratio) taux d'erreur binaire

ECL (emitter-coupled logic) logique couplée à l'émetteur

EO électro-optique

DES décharge électrostatique

HBM (human body model) modèle du corps humain

LVTTL (low voltage transistor-transistor logic) logique transistor-transistor à basse tension

NRZ non-retour à zéro

PECL (pseudo emitter-coupled logic) logique couplée au pseudo-émetteur

PRBS (pseudo random bit sequence) séquence binaire pseudo-aléatoire

HR humidité relative

SD (signal detect) détection du signal

TTL (transistor-transistor logic) logique transistor-transistor

TTL/CMOS (transistor-transistor logic/complementary metal-oxide-semiconductor) logique transistor-transistor/métal-oxyde-semiconducteur complémentaire

4 Paramètres relatifs au produit

4.1 Valeurs limites absolues

Les valeurs limites (maximales et/ou minimales) absolues, telles que présentées dans le Tableau 1, impliquent qu'aucun dommage catastrophique n'a lieu si le produit est soumis à ces valeurs limites, à condition que chaque paramètre limite soit en isolement et que tous les autres paramètres possèdent des valeurs dans les paramètres de performance normale. Il convient de ne pas présumer que les valeurs limites de plus d'un paramètre puissent être appliquées en une fois.

Tableau 1 – Valeurs limites absolues

Paramètre	Symbole ou abréviation	Minimum	Maximum	Unité
Température de stockage	T_{stg}	−40	+85	°C
Température de fonctionnement ambiante	T_{amb}	−10	+80	°C
Température de brasage au plomb (distance minimale par rapport au boîtier spécifiée)			+260 (pendant 10 s)	°C
Courant de sortie	I_{out}	0	50	mA
Tension d'entrée de données		−0,5	V_{cc}	V
Excursion de la tension d'entrée différentielle de l'émetteur	V_{pp}	0,30	1,40	V
Tension d'alimentation [a]		−0,5	V_{nom} + 40 %	V
Humidité relative [b]	HR	5	85	%

[a] Les tensions de fonctionnement nominales (V_{nom}) de 5 V et de 3,3 V s'appliquent.

[b] Pas de condensation autorisée.

4.2 Environnement de fonctionnement

Les paramètres relatifs à l'environnement de fonctionnement sont présentés dans le Tableau 2.

Tableau 2 – Environnement de fonctionnement

Paramètre	Symbole ou abréviation	Minimum	Maximum	Unité
Tension d'alimentation [a]	V_{cc}	V_{nom} – 5 %	V_{nom} + 5 %	V
Température de fonctionnement ambiante	T_{amb}	0	70	°C
Humidité relative [b]	HR	5	85	%

[a] Pour une tension de fonctionnement nominale (V_{nom}) de 5 V. Pour une tension de fonctionnement nominale de 3,3 V, la valeur minimale est de 3,15 V et la valeur maximale est de 3,45 V.

[b] Pas de condensation autorisée.

4.3 Spécification fonctionnelle

Les spécifications présentées dans le Tableau 3 et le Tableau 4 décrivent les exigences fonctionnelles exigées pour satisfaire aux spécifications PHY de l'ISO/IEC/IEEE 8802-3.