

INTERNATIONAL STANDARD



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

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 61190-4:2022 RVV

INTERNATIONAL STANDARD



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.180.20

ISBN 978-2-8322-6312-9

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	3
INTRODUCTION	2
1 Scope	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviated terms	7
3.1 Terms and definitions	7
3.2 Symbols	7
3.3 Abbreviated terms	8
4 Product parameters	7
4.1 Absolute limiting ratings	8
4.2 Operating environment	9
4.3 Functional specification	9
4.4 Diagrams	11
4.5 Labelling	11
5 Testing	12
5.1 General	12
5.2 Characterization testing	12
5.3 Performance testing	13
5.3.1 Sequence of testing	13
5.3.2 Sample size, sequencing and groupings	13
6 Environmental specifications	15
6.1 General safety	15
6.2 Laser safety	15
6.3 Electromagnetic emission	15
Annex A (normative) Sample size, sequencing and grouping requirements	16
Figure 1 – Receiver section schematic	11
Figure 2 – Transmitter section schematic	11
Table 1 – Absolute limiting ratings	9
Table 2 – Operating environment	9
Table 3 – Receiver section: functional specification	9
Table 4 – Transmitter section: functional specification	10
Table 5 – Transmitter section characterization tests	12
Table 6 – Receiver section characterization tests	12
Table 7 – Performance test plan	14
Table A.1 – Sample size, sequencing and grouping requirements	16

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES –
PERFORMANCE STANDARDS –****Part 4: 1 300 nm fibre optic transceivers
for Gigabit Ethernet application**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature, whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV

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:~~2004~~, *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	$(V_{\text{nom}} + 40\%)$	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}	$(V_{\text{nom}} - 5\%)$	$(V_{\text{nom}} + 5\%)$	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 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 LVTTTL 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.

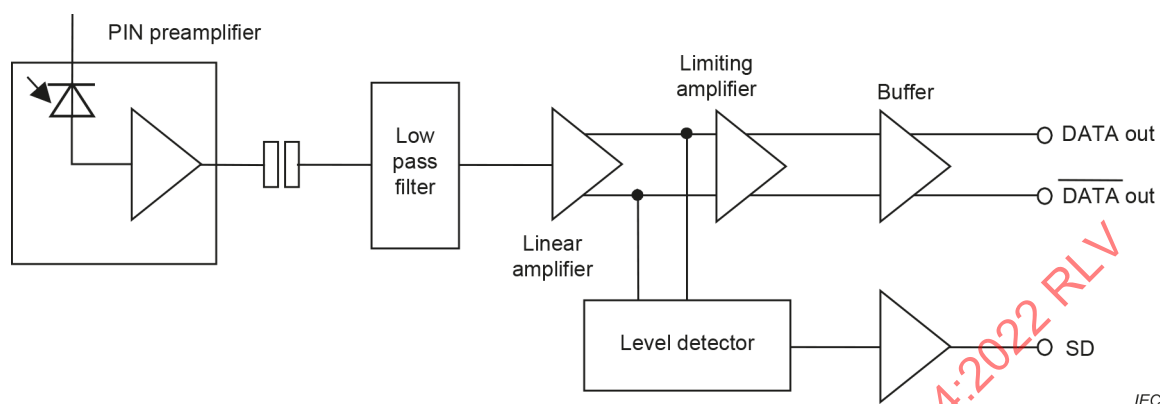


Figure 1 – Receiver section schematic

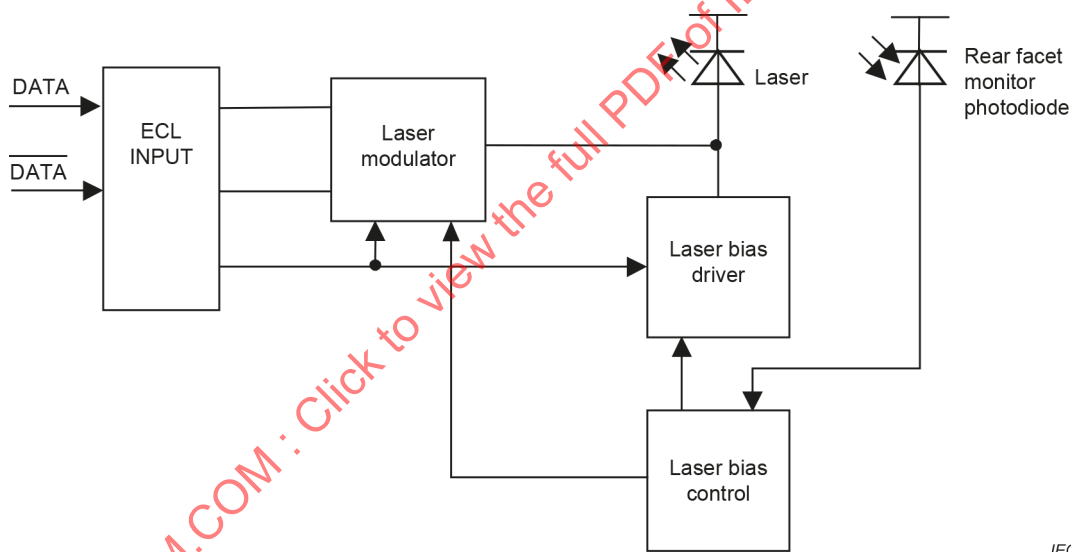


Figure 2 – Transmitter section schematic

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:

- this document reference, including variant type;
- 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 $25\text{ °C} \pm 2\text{ °C}$.

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 ($\pm 2\text{ °C}$) 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 x 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/IEC 8802-3ae, 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 $\pm 2\text{ °C}$ 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 ($\pm 2\text{ °C}$) 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 $\pm 2\text{ °C}$ 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.

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV

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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	IEC 60749-26, method HBM 500 V
			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 0 °C, 25 °C, 70 °C		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
			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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	IEC 60749-25 lower soak temperature -40 °C, upper soak temperature +85 °C, 500 cycles
			ΔS	+0,7	-0,7	dB	
			ΔP_o	+0,5	-0,5	dB	
11	Fast temperature cycle 1 000 cycles	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 10, further 500 cycles
			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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 12, further 500 h
			ΔS	+0,7	-0,7	dB	
			ΔP_o	+0,5	-0,5	dB	
14	High temperature endurance 2 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 13, further 1 000 h
			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.

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**

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV

CONTENTS

FOREWORD	3
INTRODUCTION	5
1 Scope	6
2 Normative references	6
3 Terms, definitions, symbols and abbreviated terms	7
3.1 Terms and definitions	7
3.2 Symbols	7
3.3 Abbreviated terms	8
4 Product parameters	8
4.1 Absolute limiting ratings	8
4.2 Operating environment	9
4.3 Functional specification	9
4.4 Diagrams	10
4.5 Labelling	11
5 Testing	11
5.1 General	11
5.2 Characterization testing	11
5.3 Performance testing	12
5.3.1 Sequence of testing	12
5.3.2 Sample size, sequencing and groupings	12
6 Environmental specifications	14
6.1 General safety	14
6.2 Laser safety	14
6.3 Electromagnetic emission	14
Annex A (normative) Sample size, sequencing and grouping requirements	15
Figure 1 – Receiver section schematic	10
Figure 2 – Transmitter section schematic	11
Table 1 – Absolute limiting ratings	8
Table 2 – Operating environment	9
Table 3 – Receiver section: functional specification	9
Table 4 – Transmitter section: functional specification	10
Table 5 – Transmitter section characterization tests	12
Table 6 – Receiver section characterization tests	12
Table 7 – Performance test plan	13
Table A.1 – Sample size, sequencing and grouping requirements	15

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES –
PERFORMANCE STANDARDS –****Part 4: 1 300 nm fibre optic transceivers
for Gigabit Ethernet application**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature, whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV

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 LVTTTL 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 $P_a - P_d$.

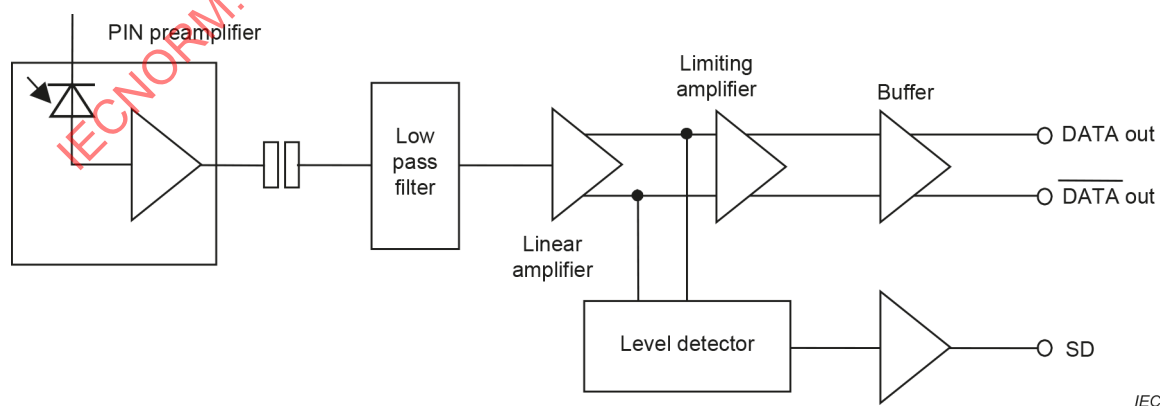
^g Basic value.

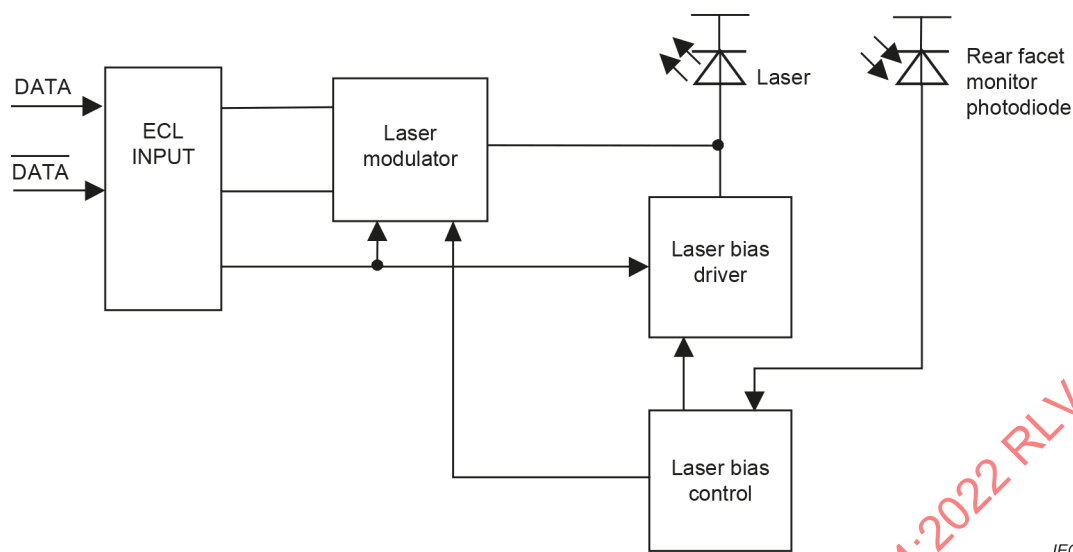
Table 4 – Transmitter section: functional specification

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**



IEC

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 $25\text{ °C} \pm 2\text{ °C}$.

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					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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	IEC 60749-26, method HBM 500 V
			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 0 °C, 25 °C, 70 °C		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
			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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	IEC 60749-25 lower soak temperature -40 °C, upper soak temperature +85 °C, 500 cycles
			ΔS	+0,7	-0,7	dB	
				ΔP_o	+0,5	-0,5	dB
11	Fast temperature cycle 1 000 cycles	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 10, further 500 cycles
			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, I_{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 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 12, further 500 h
			ΔS	+0,7	-0,7	dB	
				ΔP_o	+0,5	-0,5	dB
14	High temperature endurance 2 000 h	EO test 0 °C, 25 °C, 70 °C		Max.	Min.	Unit	As test 13, further 1 000 h
			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.

SOMMAIRE

AVANT-PROPOS	17
INTRODUCTION	19
1 Domaine d'application	20
2 Références normatives	20
3 Termes, définitions, symboles et abréviations	21
3.1 Termes et définitions	21
3.2 Symboles	21
3.3 Abréviations	22
4 Paramètres relatifs au produit	22
4.1 Valeurs limites absolues	22
4.2 Environnement de fonctionnement	23
4.3 Spécification fonctionnelle	23
4.4 Schémas	25
4.5 Etiquetage	26
5 Essais	26
5.1 Généralités	26
5.2 Essais de caractérisation	26
5.3 Essais de performance	27
5.3.1 Séquence d'essais	27
5.3.2 Nombre, séquences et groupements d'échantillons	27
6 Spécifications relatives à l'environnement	30
6.1 Sécurité générale	30
6.2 Sécurité du laser	30
6.3 Emission électromagnétique	30
Annex A (normative) Exigences relatives aux nombre, séquences et groupements d'échantillons	31
Figure 1 – Schéma de section du récepteur	25
Figure 2 – Schéma de section de l'émetteur	26
Tableau 1 – Valeurs limites absolues	23
Tableau 2 – Environnement de fonctionnement	23
Tableau 3 – Section du récepteur: spécification fonctionnelle	24
Tableau 4 – Section de l'émetteur: spécification fonctionnelle	25
Tableau 5 – Essais de caractérisation de la section d'émetteur	27
Tableau 6 – Essais de caractérisation de la section du récepteur	27
Tableau 7 – Plan d'essais de performance	28
Tableau A.1 – Exigences relatives aux nombre, séquences et groupements d'échantillons	31

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**COMPOSANTS ET DISPOSITIFS ACTIFS FIBRONIQUES –
NORMES DE PERFORMANCE –****Partie 4: Émetteurs-récepteurs fibroniques de 1 300 nm
pour application Gigabit Ethernet**

AVANT-PROPOS

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 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.

IECNORM.COM : Click to view the full PDF of IEC 62149-4:2022 RLV

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-oxyle-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	$V_{\text{nom}} + 40\%$	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}	$V_{\text{nom}} - 5\%$	$V_{\text{nom}} + 5\%$	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.