IEC 62149-2

Edition 1.0 2009-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic active components and devices – Performance standards – Part 2: 850 nm discrete vertical cavity surface emitting laser devices

Composants et dispositifs actifs à fibres optiques – Normes de performance – Partie 2: Dispositifs discrets à laser 850 nm émettant en surface

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX

R

ICS 33.180.20

ISBN 978-2-88912-271-4

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 2: 850 nm discrete vertical cavity surface emitting laser devices

FOREWORD

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International Standard IEC 62149-2 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This bilingual version (2010-11) replaces the English version.

The text of this standard is based on the following documents:

FDIS	Report on voting
86C/886/FDIS	86C/914/RVD

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

The French version of this standard has not been voted upon.

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

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 publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

INTRODUCTION

Fibre optic laser devices are used to convert electrical signals into optical signals. This part of IEC 62149 covers the performance specification for 850-nm discrete vertical cavity surface emitting laser devices in fibre optic telecommunication and optical data transmission applications.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 2: 850 nm discrete vertical cavity surface emitting laser devices

1 Scope

This part of IEC 62149 covers the performance specification for 850-nm discrete vertical cavity surface emitting laser (VCSEL) devices of transverse multimode types used for the fibre optic telecommunication and optical data transmission application. The performance standard contains a definition of the product performance requirements together with a series of sets of tests and measurements with clearly defined conditions, severities, and pass/fail criteria. 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 then be controlled by a quality assurance/quality conformance program.

Depending on the modulation speeds, subcategorized specifications are defined. Types A1, A2 and A3 correspond to 1,25 Gbit/s, 2,5 Gbit/s and 4,25 Gbit/s VCSELs, respectively.

Each subcategorized specification is also defined by separate details depending on the device types, such as specifications for a VCSEL device without a monitor photodiode (Case a) and for a VCSEL device with a monitor photodiode (Case b).

2 Normative references

The following referenced documents are indispensable for the application 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 60749 (all parts), *Semiconductor devices – Mechanical and climatic test methods*

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

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

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

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

IEC 61300-2-48, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-48: Tests – Temperature-humidity cycling*

IEC Guide 107: 2009, *Electromagnetic compatibility – Guide to the drafting of electromagnetic compatibility publications*

3 Terms, definitions, symbols and abbreviated terms

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

NOTE The terminology concerning the *physical concepts*, the *types of devices*, the *general terms*, and those related to *ratings and characteristics* of semiconductor devices can be found in IEC 60747-5-1. In addition, the definition for the *essential ratings and characteristics* of the semiconductor optoelectronic devices for fibre optic system applications can be found in IEC 62007-1.

3.1 Terms and definitions

The following terms are defined for the specific characteristics of vertical cavity surface emitting laser devices.

3.1.1
operating wavelength
peak centre laser wavelength of the vertical cavity surface emitting laser device when it is operated at the normal operating conditions specified in the sectional specification of the VCSEL

3.1.2
transverse mode
cross-sectional profile of the optical beam intensity at the laser output of the VCSEL. Depending on the mode status between multi-mode and single-mode, the package type of the VCSEL devices is also defined

3.1.3
multi-mode
cross-section transverse mode of the laser beam profile with mode number greater than one, which means that the intensity profile has more than one spot, compared to the single-mode which corresponds to the cross-section transverse mode of the laser beam profile with mode number of one having the intensity profile of one circular spot

3.1.4
modulation speed
digital modulation speed with an optimum modulation amplitude between the operating current and threshold current level

3.1.5
submount
substrate upon which a laser is mounted for assembly into the further packaging

3.1.6
VCSEL device without a monitor photodiode
VCSEL packaged device without a monitor photodiode

3.1.7
VCSEL device with a monitor photodiode
VCSEL packaged device with a monitor photodiode

3.2 Symbols and abbreviated terms

λ_p peak laser wavelength
I_{th} threshold current
V_{th} threshold voltage
I_{op} operating current
V_f forward voltage at operating current

R_s	series resistance
η	slope efficiency
P_o	continuous laser output power (at connector output or pigtailed fibre output for packaged types)
$\Delta\lambda_T/\Delta T$	wavelength change over temperature
θ	beam divergence at $1/e^2$ intensity
t_r/t_f	rise and fall time from 20 % to 80 % of the peak intensity
$\Delta\lambda$	spectral width, RMS (at static condition)
RIN	relative intensity noise
$\Delta R_S/\Delta T$	series resistance temperature coefficient

4 Product parameters

4.1 Absolute limiting ratings

Absolute limiting (maximum and/or minimum) ratings imply that no catastrophic damage will occur if the product is subject 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 value of more than one parameter can be applied at any one time. The absolute maximum ratings of the subcategorized types A1, A2, and A3 for modulation speeds are listed in Annex A and Annex B, depending on the device types.

4.2 Operating environment

The operating environment of all the subcategorized types, A1, A2 and A3, is specified in Table 1.

Table 1 – Operating environment

Parameter	Symbol	Value		Unit
		Minimum	Maximum	
Operating temperature	T_{op}	0	70	°C

4.3 Functional specification

Functional specifications of all the subcategorized types, A1, A2 and A3, for modulation speeds are listed in Annex A and Annex B, depending on the device types.

4.4 Diagrams

Diagrams of all the VCSEL device types are included in Annex A and Annex B.

5 Testing

5.1 General

Initial characterisation 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

Characterisation shall be carried out on at least 20 products taken from at least three different manufacturing lots. The characteristics and conditions of laser diode are tested at the operating temperature and the operating current to satisfy the functional specifications defined in 4.3.

5.3 Performance testing

Performance testing is undertaken when characterization testing is complete. The performance test plan and recommended performance test failure criteria are specified in Annex A and Annex B, depending on the device types.

6 Environmental specifications

6.1 General safety

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

6.2 Laser safety

Fibre optic transmitter and transceiver using the laser diode specified in this document shall be class 3R laser certified under any condition of operation. This includes single fault conditions whether coupled into a fibre or out of an open bore. Fibre optic transmitter and transceiver using the laser diode specified in this document shall be certified to be in conformance with IEC 60825-1: *Safety of laser products – Part 1: Equipment classification and requirements*.

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 compatibility (EMC) requirements

Products defined in this specification shall comply with suitable requirements for electromagnetic compatibility (in terms of both emission and immunity), depending on particular usage/environment in which they are intended to be installed or integrated. Guidance to the drafting of such EMC requirements is provided in IEC Guide 107. Guidance for electrostatic discharge (ESD) is still under study.

Annex A
(normative)

Specifications for multimode 850-nm VCSEL device without a monitor photodiode (Case a)

A.1 Absolute limiting ratings

Absolute limiting (maximum and/or minimum) ratings (Table A.1) imply that no catastrophic damage will occur if the product is subject 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 a limiting value of more than one parameter can be applied at any one time.

Table A.1 – Absolute limiting ratings

Parameter	Symbol	Value		Unit
		Minimum	Maximum	
Storage temperature	T_{stg}	–40	100	^{O}C
Soldering condition	T_{sol}		260 ^{O}C, 10 s	
Laser diode				
Reverse bias voltage	V_{RB}		5	V
Continuous forward current	I_{FLD}		12	mA

A.2 Operating environment

The requirements of 4.2 shall be met.

A.3 Functional specification

Tables A.2 and A.3 contain the operating conditions for functional specifications and the functional specifications of 1,25/ 2,5/ 4,25 Gbit/s 850 nm VCSEL devices without a monitor photodiode at the operating conditions.

Table A.2 – Operating conditions for functional specification

Parameter	Symbol	Value		Unit	Note
		Minimum	Maximum		
Operating forward current	I_{op}		7	mA	
Operating forward bias voltage	V_f	1,6	2,2	V	

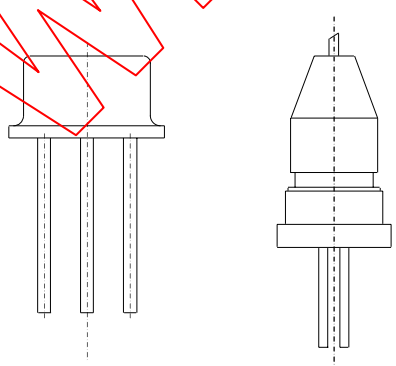
Table A.3 – Functional specification

Parameter	Symbol	Value		Unit	Note
		Minimum	Maximum		
Laser diode					
Laser wavelength	λ_p	840	860	nm	CW
Spectral bandwidth, RMS	$\Delta\lambda$		0,85	nm	CW
Threshold current	I_{th}		3,0	mA	
Threshold voltage	V_{th}		2,0	V	
Series resistance	R_s	20	65	Ω	I_{op}
Slope efficiency	η	0,2	0,7	mW/mA	I_{op}, TO
		0,03	0,2	mW/mA	I_{op}, TOSA & Pigtail
Continuous laser output power	P_O		5,0	mW	I_{op}, TO
			3.0	mW	I_{op}, TOSA & Pigtail
Wavelength change over temperature	$\Delta\lambda/\Delta T$		0,07	nm/°C	
Rise and fall time	t_r/t_f		300/300	ps	1,25 Gbit/s, Type A1a
			150/150	Ps	2,5 Gbit/s, Type A2a
			110/110	ps	4,25 Gbit/s, Type A3a
Relative intensity noise	RIN		-120	dB/Hz	[a]
Series resistance temperature coefficient	$\Delta R_S/\Delta T$		-4 000	ppm/°C	[b]

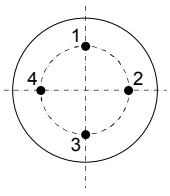
[a] For 1 GHz bandwidth and optical power specified (typically a negative value).

[b] Series resistance of laser diodes decreases as temperature increases and thus its thermal dependent parameter is typically a negative value.

A.4 Diagrams



a) b)



Bottom view

Pin mumber	Function
1	VCSEL anode
2	VCSEL cathode
3	Not used
4	Not used

IEC 1262/09

Figure A.1 – 850 nm VCSEL TO CAN a) and pigtailed b) devices without a monitor photodiode