

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 performances –
Partie 2: Dispositifs discrets à laser 850 nm à cavité verticale émettant
en surface**



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

The significant technical changes with respect to the previous edition include the introduction of the performance standards for 10 Gbit/s 850-nm wavelength, vertical cavity surface emitting laser (VCSEL) devices and the deletion of the package diagrams and pin configurations in Clause A.4 and Clause B.4 by citing the VCSEL package standard IEC 62148-15 instead.

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

CDV	Report on voting
86C/1146/CDV	86C/1229/RVC

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

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.

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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.

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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 fibre optic telecommunication and optical data transmission applications. 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, sub-categorized specifications are defined. Types A1, A2, A3 and A4 correspond to 1,25 Gbit/s, 2,5 Gbit/s, 4,25 Gbit/s and 10 Gbit/s VCSELs, respectively.

Each sub-categorized 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60749-6, *Semiconductor devices – Mechanical and climatic test methods – Part 6: Storage at high temperature*

IEC 60749-7, *Semiconductor devices – Mechanical and climatic test methods – Part 7: Internal moisture content measurement and the analysis of other residual gases*

IEC 60749-10, *Semiconductor devices – Mechanical and climatic test methods – Part 10: Mechanical shock*

IEC 60749-11, *Semiconductor devices – Mechanical and climatic test methods – Part 11: Rapid change of temperature – Two-fluid-bath method*

IEC 60749-12, *Semiconductor devices – Mechanical and climatic test methods – Part 12: Vibration, variable frequency*

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 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 62148-15, *Fibre optic active components and devices – Package and interface standards – Part 15: Discrete vertical cavity surface emitting laser packages*

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

3 Terms, definitions, symbols and abbreviations

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

NOTE Terminology concerning *physical concepts, types of devices, general terms*, and that related to *ratings and characteristics* of semiconductor devices, can be found in IEC 60747-5-1. In addition, definitions for *essential ratings and characteristics* of semiconductor optoelectronic devices for fibre optic system applications can be found in IEC 62007-1. Terminology and test methods for laser wavelength and spectral width of VCSEL devices are also found in IEC 61280-1-3.

3.1 Terms and definitions

The following terms are defined for the specific characteristics of VCSEL 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

electromagnetic mode of a laser diode characterized by its power or field distribution in a section perpendicular to the direction of propagation, and in the direction perpendicular to the junction

Note 1 to entry: Depending on the mode behaviour (multi-mode or single-mode), the package type of the VCSEL device 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 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 abbreviations

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
$\Delta\lambda_{rms}$	spectral width, RMS (at static condition)
RIN	relative intensity noise
$\Delta R_s/\Delta T$	series resistance temperature coefficient

Abbreviation	Term
VCSEL	Vertical cavity surface emitting laser

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, A3 and A4 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 sub-categorized types, A1, A2, A3 and A4, 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 sub-categorized types, A1, A2, A3 and A4, 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 characterization and qualification shall be undertaken when a build standard has been completed and frozen. Qualification maintenance is carried out 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 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 transmitters and transceivers using the laser diode specified in this standard shall be class 3R laser or lower class (class 1 or 1M) 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 transmitters and transceivers using the laser diode specified in this standard shall be certified to be in conformance with 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 compatibility (EMC) requirements

Products defined in this standard 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.

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