

INTERNATIONAL STANDARD

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**Fibre optic active components and devices – Performance standards –
Part 12: Distributed feedback laser diode device for analogue radio over fibre
systems**

**Composants et dispositifs actifs fibroniques – Normes de performances –
Partie 12: Dispositif à diode laser à rétroaction répartie pour systèmes radio
analogiques sur fibre**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES –
PERFORMANCE STANDARDS –****Part 12: Distributed feedback laser diode device
for analogue radio over fibre systems**

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

Draft	Report on voting
86C/1808/CDV	86C/1840/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.

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- withdrawn,
- replaced by a revised edition, or
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INTRODUCTION

Distributed feedback laser diode (DFB-LD) devices for analogue radio over fibre (A-RoF) systems are used to convert electrical radio signals into optical signals. This document covers the performance specification for DFB-LD devices in A-RoF systems. The optical and electrical performance criteria are generally well specified for a number of internationally agreed upon application areas, such as ITU-T Recommendation G.9803 and IEC 62149-10. This document provides optical and electrical performance specifications for RoF transceivers. These transceivers are necessary for operation of A-RoF systems, because the RoF transmitter requires a light source such as a DFB-LD device. DFB-LD devices for RoF transceivers are supplied by different manufacturers. However, they do not guarantee the operation of DFB-LD devices in A-RoF systems. Manufacturers using this document are responsible for meeting the required performance and/or reliability and quality assurance under a recognized scheme.

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FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 12: Distributed feedback laser diode device for analogue radio over fibre systems

1 Scope

This part of IEC 62149 defines performance specifications for distributed feedback laser diode (DFB-LD) devices used in analogue radio over fibre (RoF) systems. It defines product performance requirements together with a series 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 a product's ability to satisfy the performance requirements.

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 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 – Device and subassembly*

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 or 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 62149-1, *Fibre optic active components and devices – Performance standards – Part 1: General and guidance*

3 Terms, definitions, symbols and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62149-1 and the following apply.

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>

3.1.1

relative intensity noise

RIN

<DFB-LD for RoF> instability in the power level of a laser output power, which is the noise normalized to the average power level

3.1.2

third order inter-modulation distortion

IMD3

<DFB-LD for RoF> amplitude modulation of signals containing two or more different frequencies, caused by nonlinearities or time variance in a system

Note 1 to entry: Each individual signal frequency, including original signals at frequencies f_1 and f_2 and the second-order intermodulation products at $f_1 + f_2$, $|f_2 - f_1|$, $2f_1$ and $2f_2$, will add to and subtract from other frequency components to give rise to more signal components.

Note 2 to entry: The two intermodulation products at frequencies $|2f_1 - f_2|$ and $|2f_2 - f_1|$ in particular can be troublesome and can cause interference, as their frequencies are close to the frequencies of the original signals.

3.2 Symbols

E_r	tracking error
I_d	dark current
I_f	forward current
I_{fd}	forward current for photodiode
I_m	monitor current
I_{op}	operating current
I_{th}	threshold current
I_{rl}	reverse current for photodiode
P_f	optical output power
P_{th}	optical output power at threshold current
S_r	side mode suppression ratio
T_C	operating case temperature

T_{stg}	storage temperature
V_{op}	operating voltage
V_{rd}	reverse voltage for photodiode
V_{rl}	reverse voltage for laser diode
η	slope efficiency
$\Delta\eta$	delta slope efficiency
λ_{c}	light-emission central wavelength
λ_{ct}	wavelength temperature coefficient

3.3 Abbreviated terms

APC	automatic power control
A-RoF	analogue radio over fibre
CW	continuous wave
CWDM	coarse wavelength division multiplexing
DFB-LD	distributed feedback laser diode
DS	data sheet
LSL	lower specification limit
OMI	optical modulation index
RH	relative humidity
RoF	radio over fibre
USL	upper specification limit

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 of time, provided each limiting parameter is in isolation and all other parameters have values within the normal performance parameters. It should not be assumed that the limiting value of more than one parameter can be applied at any one time. The absolute limiting ratings are listed in Table A.1.

4.2 Operating environment

The operating environment of DFB-LD devices for A-RoF systems is specified in Table 1.

Table 1 – Operating case environment

Parameter	Symbol	Value		Unit
		Minimum	Maximum	
Operating case temperature	T_c	–20	+60	°C

4.3 Functional specifications

The functional specifications and operating conditions for DFB-LD devices for A-RoF systems are provided in Clause A.3.

5 Testing

5.1 General

Clause 5 defines the characterization and performance testing as well as some important test conditions. The detailed test parameters, test conditions, test plans, and test failure criteria are specified in Annex A.

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

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 DFB-LD devices for A-RoF systems are tested at the operating case temperature listed in Table A.2 and the operating conditions listed in Table A.3 to satisfy the functional specifications defined in Clause A.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 Clause A.4.

6 Environmental specifications

6.1 General safety

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

6.2 Laser safety

Fibre optic active devices including the DFB-LD 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. DFB-LD device specified in this document shall be certified to be in conformance with IEC 60825-1.

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

6.3 Electromagnetic compatibility (EMC) requirements

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

Annex A (normative)

Specifications for DFB-LD devices for analogue RoF systems

A.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 of time, provided each limiting parameter is in isolation and all other parameters have values within the normal performance parameters. It should not be assumed that the limiting rating values of more than one parameter can be applied at any one time.

Table A.1 – Absolute limiting ratings

Parameter		Symbol	Conditions	Minimum	Maximum	Unit
Laser diode	Optical output power from fibre end	P_f	CW	-	10	mW
	Forward current	I_f	CW	-	150	mA
	Reverse voltage	V_{rl}	-	-	2	V
Photodiode	Forward current	I_{fd}	-	-	2	mA
	Reverse voltage	V_{rd}	-	-	20	V
Operating case temperature		T_c	-	-20	60	°C
Storage temperature		T_{stg}	-	-40	85	°C

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A.2 Operating environment

The requirements of 4.2 shall be met.

A.3 Functional specifications

Table A.2 and Table A.3 list the operating conditions and functional specifications for DFB-LD devices with a monitor photodiode.

Table A.2 – Operating conditions for functional specifications

Parameter	Symbol	Value	Unit
Operating case temperature	T_c	25	°C