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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic active components and devices – Performance standards – Part 9: Seeded reflective semiconductor optical amplifier transceivers

Composants et dispositifs actifs à fibres optiques – Normes de performances – Partie 9: Émetteurs-récepteurs amplificateurs optiques à semiconducteurs réfléchissants répartis

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FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 9: Seeded reflective semiconductor optical amplifier transceivers

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

CDV	Report on voting
86C/1145/CDV	86C/1222/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.

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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 seeded reflective semiconductor optical amplifier (RSOA) transceivers in fibre optic telecommunication and optical data transmission applications. The optical performance criteria are generally well specified for a number of internationally agreed applications areas such as ITU-T Recommendation G.698.3. This standard aims to provide optical interface specifications toward the realization of transversely compatible seeded dense wavelength division multiplexing (DWDM) systems.

In seeded DWDM systems, seed light sources are used to generate broadband seed lights in C-band or L-band. After passing through DWDM DeMUXs in the link, the broadband seed lights are spectrum sliced according to the transmission characteristics of DWDM DeMUXs. To simplify link implementation, cyclic arrayed waveguide gratings (AWGs) are used as DWDM MUX/DeMUXs. A characteristic of the cyclic AWG is the periodicity of the frequencies routed from the common port to a given output port. This periodicity is called the free spectral range (FSR). The FSR is commonly specified for a centre channel of the AWG. The connection between the DWDM MUX/DeMUX and RSOA transceiver is bidirectional. Each spectrum sliced seed light is injected to a RSOA based transceiver. Consequently, an output signal wavelength of the RSOA transceiver can be determined by a wavelength of an injected seed light.

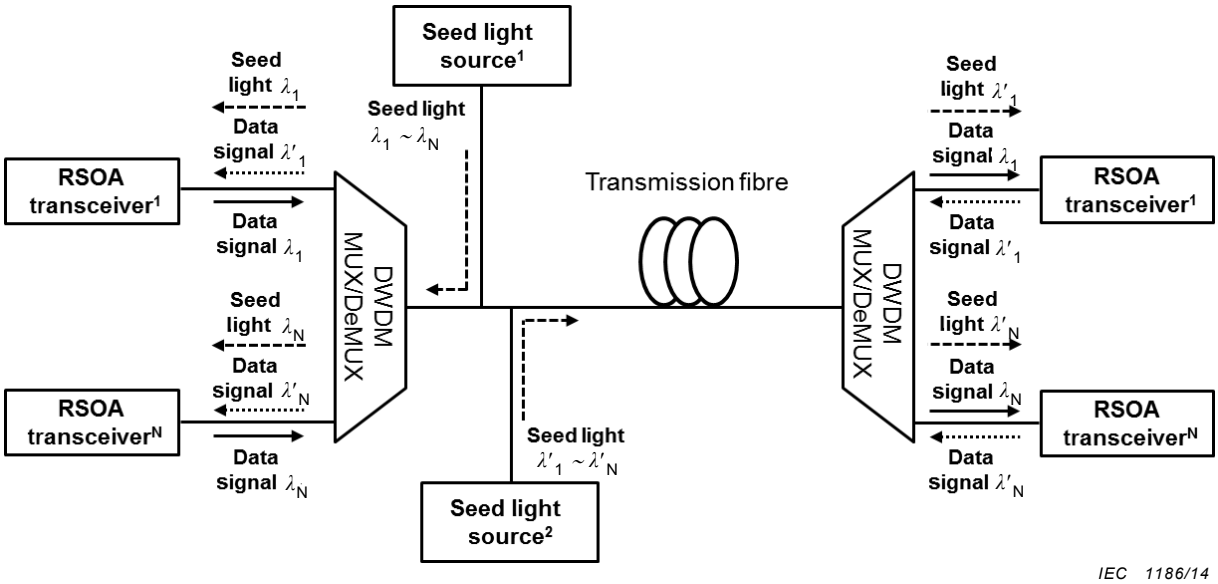

Figure 1 – Seeded DWDM transmission based on RSOA transceivers

Seeded RSOA transceivers for seeded DWDM systems are supplied by different manufacturers, but do not guarantee operation of seeded RSOA transceivers. Manufacturers using the standards 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 9: Seeded reflective semiconductor optical amplifier transceivers

1 Scope

This part of IEC 62149 covers the performance specification for seeded reflective semiconductor optical amplifier (RSOA) transceivers used for the 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.

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 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: 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 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*

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

Recommendation ITU-T G.698.3:2012, *Multichannel seeded DWDM applications with single-channel optical interfaces*

Recommendation ITU-T G.691:2006, *Optical interface for single channel STM-64 and other SDH systems with optical amplifiers*

3 Terms, definitions, symbols and abbreviations

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

NOTE Terminology concerning *physical concepts, types of devices, general terms,* and *ratings and characteristics* of semiconductor devices can be found in IEC 60747-5-1. In addition, the definitions for *essential ratings and characteristics* of 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 seeded RSOA transceivers.

3.1.1
central wavelength
central wavelength of the seeded RSOA transceiver when it is operated at the normal operating conditions which are specified in the sectional specification of the seeded RSOA transceiver

3.1.2
modulation speed
digital modulation speed with an optimum modulation amplitude between the operating current and threshold current level

3.1.3
seed light
light used to determine output wavelength of RSOA transceiver

3.2 Symbols and abbreviations

E_r	extinction ratio
P_s	seed light power
I_{IL}	data input current – low
I_{IH}	data input current – high
I_{out}	output current
P_o	optical output power
P_d	alarm on level
P_a	alarm off level
R_{DL}	data output load
S	receiver sensitivity
TD	transmit disable function
T_{amb}	ambient operating temperature
T_{stg}	storage temperature

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T_r optical output rise time
T_f optical output fall time
V_{cc} power supply voltage
$V_{IL} - V_{cc}$ data input voltage – low
$V_{IH} - V_{cc}$ data input voltage – high
V_{oh} alarm output high voltage
V_{ol} alarm output low voltage
$V_{ol} - V_{cc}$ data output voltage – low
$V_{oh} - V_{cc}$ data output voltage – high
V_{pp} transmitter differential input voltage swing
λ_{ce} central wavelength
$\Delta\lambda$ spectral width (r.m.s)

Abbreviation	Term
AWG	arrayed waveguide grating
DeMUXs	demultiplexers
DWDM	dense wavelength division multiplexing
ESD	electrostatic discharge
FSR	free spectral range
HBM	human body model
RH	relative humidity
MUX	multiplexer
RSOA	reflective semiconductor optical amplifier

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 1,25 Gb/s signalling speed type is listed in Annex A.

4.2 Operating environment

The operating environment of the seeded RSOA transceivers is specified in Table 1.

Table 1 – Operating environment

Parameter	Symbol	Value		Unit
		Minimum	Maximum	
Operating temperature	T_{op}	–10	+80	°C

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4.3 Functional specification

Functional specifications of 1,25 Gb/s modulation speed and application area are listed in Annex A.

5 Testing

5.1 General

Qualification maintenance is carried using periodic testing programs. Test conditions for all tests, unless otherwise stated, are 25 °C ± 2 °C.

5.2 Characterization testing

Characterization shall be carried out on at least 20 products taken from at least three different manufacturing lots. The characteristics and conditions of the RSOA 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.

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 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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Annex A
(normative)

Specifications for seeded RSOA transceivers

A.1 Absolute limiting ratings

Absolute limiting (maximum and/or minimum) ratings, as shown in 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 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	+85	°C
Ambient operating temperature	T_{amb}	–10	+80	°C
Lead soldering temperature			260/10	°C/s
Output current	I_{out}	–25	+25	mA
Data input voltage		0	V_{cc}	V
Transmitter differential input voltage swing	V_{pp}	0,30	1,40	V
Supply voltage [a]	V_{cc}		(V_{nom} + 10 %)	V
Relative humidity [b]	RH	5	85	%

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

[b] No condensation allowed.

A.2 Operating environment

The requirements of 4.2 shall be met.

A.3 Functional specification

The specifications in Tables A.2 and A.3 describe the functional requirements required to meet ITU-T Recommendation G.698.3 specifications.

Table A.2 – Receiver section: functional specification

Parameter	Symbol	Value		Unit	Note
		Minimum	Maximum		
Bit rate/line coding			1,25	Gb/s	NRZ
Receiver sensitivity	S		–28	dBm	
Optical input power			–10	dBm	
Optical return loss		12		dB	
Alarm on level [a]	P_d	-31	–29	dBm	
Alarm off level [a]	P_a		–27	dBm	
Hysteresis		2,0	4,0	dB	

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