BS EN 62149-8:2014

BSI Standards Publication

Fibre optic active components and devices — Performance standards

Part 8: Seeded reflective semiconductor optical amplifier devices

National foreword

This British Standard is the UK implementation of EN 62149-8:2014. It is identical to IEC 62149-8:2014.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/3, Fibre optic systems and active devices.

A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Fibre optic active components and devices - Performance standards - Part 8: Seeded reflective semiconductor optical amplifier devices (IEC 62149-8:2014)

Composants et dispositifs actifs à fibres optiques - Normes de performances - Partie 8: Dispositifs amplificateurs optiques à semiconducteurs réfléchissants répartis (CEI 62149-8:2014)

Aktive Lichtwellenleiterbauelemente und -geräte - Betriebsverhalten - Teil 8: Injizierte reflektierende optische Halbleiterverstärker (IEC 62149-8:2014)

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Foreword

The text of document 86C/1144/CDV, future edition 1 of IEC 62149-8, prepared by SC 86C, "Fibre optic systems and active devices", of IEC TC 86, "Fibre optics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62149-8:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-02-28
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-05-29

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IEC 60191 (all parts)	NOTE	Harmonized as EN 60191 (all parts).
IEC 60747-5-1	NOTE	Harmonized as EN 60747-5-1.
IEC 60749 (all parts)	NOTE	Harmonized as EN 60749 (all parts).
IEC 60825 (all parts)	NOTE	Harmonized as EN 60825 (all parts).
IEC 60874 (all parts)	NOTE	Harmonized as EN 60874 (all parts).
IEC 61290-1-3	NOTE	Harmonized as EN 61290-1-3.
IEC 62007-1	NOTE	Harmonized as EN 62007-1.
IEC 62007-2	NOTE	Harmonized as EN 62007-2.
IEC 62148-1	NOTE	Harmonized as EN 62148-1.
IEC 62149-1	NOTE	Harmonized as EN 62149-1.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu

Publication	Year	Title	EN/HD	Year
IEC 60749-6	-	Semiconductor devices - Mechanical and climatic test methods -- Part 6: Storage at high temperature	EN 60749-6	-
IEC 60749-7	-	Semiconductor devices - Mechanical and climatic test methods -- Part 7: Internal moisture content measurement and the analysis of other residual gases	EN 60749-7	-
IEC 60749-10	-	Semiconductor devices - Mechanical and climatic test methods -- Part 10: Mechanical shock	EN 60749-10	-
IEC 60749-11	-	Semiconductor devices - Mechanical and climatic test methods -- Part 11: Rapid change of temperature - Two-fluid-bath method	EN 60749-11	-
IEC 60749-12	-	Semiconductor devices - Mechanical and climatic test methods -- Part 12: Vibration, variable frequency	EN 60749-12	-
IEC 60749-25	-	Semiconductor devices - Mechanical and climatic test methods -- Part 25: Temperature cycling	EN 60749-25	-
IEC 60749-26	-	Semiconductor devices - Mechanical and climatic test methods -- Part 26: Electrostatic discharge (ESD) sensitivity testing - Human body model (HBM)	EN 60749-26	-
IEC 60825-1	-	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	-
IEC 60950-1	-	Information technology equipment - Safety -- Part 1: General requirements	EN 60950-1	-
IEC 61300-2-4	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-4: Tests - Fibre/cable retention	EN 61300-2-4	-

Publication	Year	Title	EN/HD	Year
IEC 61300-2-19	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-19: Tests - Damp heat (steady state)	EN 61300-2-19	-
IEC 61300-2-48	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures -- Part 2-48: Tests - Temperature-humidity cycling	EN 61300-2-48	-
IEC Guide 107	-	Electromagnetic compatibility - Guide to the drafting of electromagnetic compatibility publications	-	-

CONTENTS

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) devices 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 towards the realization of transversely compatible seeded dense wavelength division multiplexing (DWDM) systems.

In the seeded DWDM system, 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. Each spectrum sliced seed light is injected into a RSOA transmitter based on a RSOA device. Consequently, an output signal wavelength of a RSOA transmitter can be determined by a wavelength of an injected seed light.

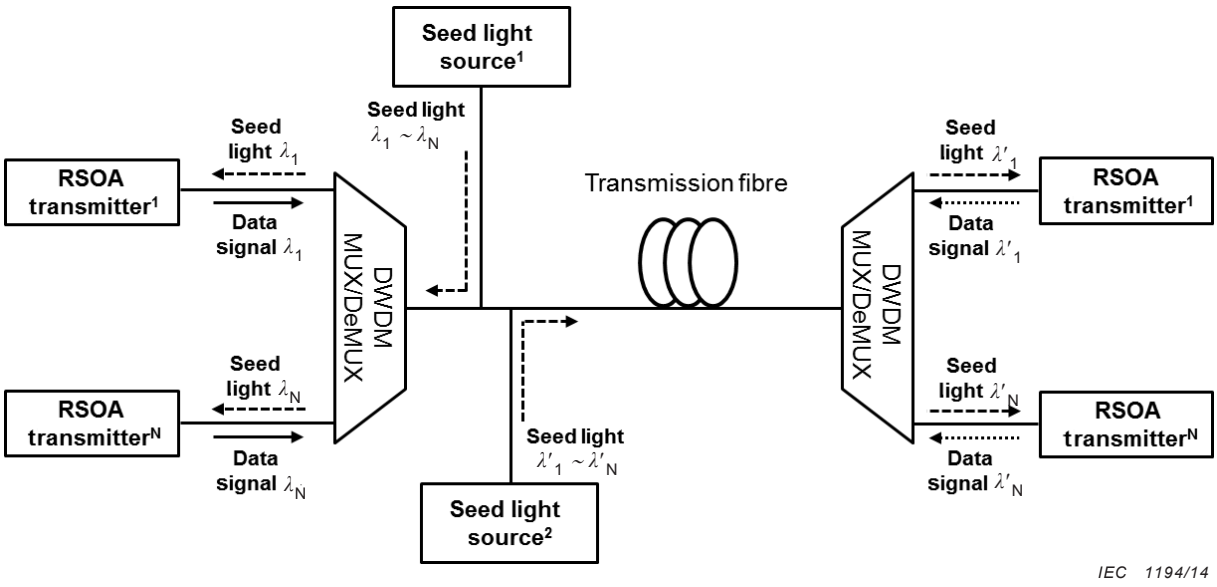

Figure 1 – Seeded DWDM transmission based on RSOA devices

Seeded RSOA devices for seeded DWDM systems are supplied by different manufacturers, but do not guarantee operation of seeded RSOA devices. Manufacturers using the standards are responsible for meeting the required performance and/or reliability and quality assurance under a recognized scheme.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 8: Seeded reflective semiconductor optical amplifier devices

1 Scope

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

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 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 those 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.

3.1 Terms and definitions

The following terms are defined for the specific characteristics of RSOA devices

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

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 device

3.1.4
submount
substrate upon which a RSOA is mounted for assembly into further packaging

3.2 Symbols and abbreviations

M_s modulation speed

λ_{ce} central wavelength

P_s seed light power

P_o optical output power

R reflectance

I_{th} threshold current

V_{th} threshold voltage

η slope efficiency (at I_{op} in a TOSA and pigtailed package)

P_O continuous laser output power (at I_{op} in a TOSA and pigtailed package)

ΔT TEC capability
I_{TEC} TEC current
V_{TEC} TEC voltage
R_{therm} thermistor
I_m monitor current
I_{mR0} dark current
C_{tot} capacitance

Abbreviation	Term
DWDM	dense wavelength division multiplexing
PDG	Polarization dependent gain
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 modulation speed are listed in Annex A.

4.2 Operating environment

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

Table 1 – Operating environment

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

4.3 Functional specification

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

5 Testing

5.1 General

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 an 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 the 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 seeded RSOA devices

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, 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
Soldering condition	T_{sol}		260 °C, 10 s	
Laser diode				
Forward bias voltage	V_{RB}		3	V
Continuous forward current	I_{FLD}		120	mA
Monitor photodiode				
Reverse bias voltage	V_{mR}		3,3	V
Forward current	I_{mF}		2	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-Gbit/s seeded RSOA devices with a monitor photodiode at the operating conditions.

Table A.2 – Operating conditions for functional specification

Parameter	Symbol	Value		Unit
		Minimum	Maximum	
Operating forward current	I_{op}		50	mA
Operating forward bias voltage	V_f	1,6	2,5	V

Table A.3 – Functional specification

Parameter	Symbol	Value		Unit	Note
		Minimum	Maximum		
Laser diode					
Modulation speed	M_s		1,25	Gb/s	
Central wavelength	λ_{ce}	1 520	1 570	nm	
Seed light power	P_s	–18		dBm	
Optical output power	P_o	–2,5	2,5	dBm	
Polarization dependent gain	PDG		1,5	dB	
Reflectance	R		45	dB	
Threshold current	I_{th}		20	mA	T_0 = 25 °C
Threshold voltage	V_{th}	0,8	1,2	V	
Slope efficiency (at I_{op} in a TOSA and pigtailed package)	η	0.5		mW/mA	
Continuous laser output power (at I_{op} in a TOSA and pigtailed package)	P_O		3	dBm	
TEC capability	ΔT		40	°C	
TEC current	I_{TEC}		1,5	A	
TEC voltage	V_{TEC}		3,3	V	
Thermistor	R_{therm}		10	kΩ	NTC type
Monitor photodiode		[a]			
Monitor current	I_m	0,1		mA	
Dark current	I_{mR0}		100	nA	P_{op} = 0 mW, V_{rev} = 3 V
Capacitance	C_{tot}		100	pF	V_{rev} = 0 V, 1 MHz

[a] This part applies only to RSOAs with monitor photodiode at a room temperature condition of 25 °C.

A.4 Testing

A.4.1 Characterization testing

The requirements of 5.2 shall be met.

A.4.2 Performance testing

Performance testing is undertaken when characterization testing is complete.

Table A.4 – Performance test plan

No.	Test	Reference	Conditions	Sample size
1	Endurance tests			
1.1	Package			
1.1.1	High temperature storage	IEC 60749-6	Temperature: $T = T_{stg\ max}$ Duration: 1 000 h	11
1.1.2	Low temperature storage		Temperature: $T = T_{stg\ min}$ Duration: > 2 000 h	11
1.1.3	Temperature cycling	IEC 60749-25	Temperature: $T_A = T_{stg\ min}$ $T_B = T_{stg\ max}$ Number of cycles = 100	11
1.1.4	Damp heat	IEC 61300-2-19	T = +40 °C + 2 °C RH: 93 % + 2 % 96 h duration	11
1.1.5	Temperature-humidity cycling	IEC 61300-2-48, method A	–40 °C ± 2 °C to +85 °C ± 2 °C 85 ± 5 % RH at the maximum temperature 1 h minimum duration at extremes ≥1 °C/min rate of change 42 cycles	11
1.1.6	Fibre pull [a]	IEC 61300-2-4	5 N ± 0,5 N at 0,5 N/s 60 s duration for buffered fibres	11
1.2	Laser diode (submount)		Temperature: at least two test temperatures: φe specified, constant power $T_{s1} = T_s$ max $T_{s2} = <(T_{s1} – 20\ °C)$ Duration: >5 000 h	b
1.3	Photodiode (in representative package		Temperature: at least two test temperatures: V_r or I_r specified T_{s1}= 125 °C min. $T_{s2} = <(T_{s1}\text{-}30°C)$ Duration: >1 000 h	b
2	Mechanical shock	IEC 60749-10	1500 G, 0,5 ms 5 times/axis	11
3	Vibration	IEC 60749-12	20 G, 20 Hz – 2 000 Hz, 4 min./cycle, 4cycle/axis	11
4	Rapid change of temperature	IEC 60749-11	ΔT=100 °C, Temperature change time < 10 s, dwell time> 2 min. temperature reach time < 5min. 15 cyles	11
5	ESD	IEC 60749-26	Human body model, positive and negative voltage pulses with a pulse interval of 300 ms	3

No.	Test	Reference	Conditions	Sample size
6	Internal moisture	IEC 60749-7	$\leq$ 5 000 $\times 10^{-6}$ water vapour	11
[a] Applied to fibre pigtailed packages.				
[b] These parameters can be determined from negotiation between manufacturer and user.				

Table A.5 – Recommended performance test failure criteria

Devices	Parameter	Failure criterion	Measurement condition
Laser diode	Operating current	50 % increase [a]	25 °C or life test temperature
	Slope efficiency	10 % change [a]	25 °C or life test temperature
	Forward voltage	10 % change [a]	25 °C or life test temperature
	Kinks in L/I curve	Kink-free within 1,2 × P_{nom} (linearity change ≤10 %) [a]	$T_{op\ min}$, 25 °C, $T_{op\ max}$
Photodiode	Dark current	USL or 10 nA increase	25 °C
Laser package	Operating current	50 % increase [a]	25 °C or life test temperature
	Fibre or connector output power	10 % change	Life test temperature I_{mon} set to initial value
	Kinks in L/I curve	Kink-free within 1,2 × P_{nom} (linearity change ≤10 %) [a]	$T_{op\ min}$, 25 °C, $T_{op\ max}$
	Tracking ratio		$T_{op\ min}$ ~ $T_{op\ max}$
	(I_{mon} / P_{fibre})	< LSL ≥ USL	At rated power level
	Photodiode dark current	USL or 10 nA increase [a]	25 °C
[a] Change of pre- and post-test values in the detail specification.			

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

IEC 60874 (all parts), *Fibre optic interconnecting devices and passive components – Connectors for optical fibres and cables*

IEC 61290-1-3, *Optical amplifiers – Test methods – Part 1-3: Power and gain parameters – Optical power meter method*

IEC 62007-1, *Semiconductor optoelectronic devices for fibre optic system applications – Part 1: Specification template for essential ratings and characteristics*

IEC 62007-2, *Semiconductor optoelectronic devices for fibre optic system applications – Part 2: Measuring methods*

IEC 62148-1, *Fibre optic active components and devices – Package and interface standards – Part 1: General and guidance*

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

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

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