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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Optical amplifiers –
Part 2: Single channel applications – Performance specification template

Amplificateurs optiques –
Partie 2: Applications à un seul canal – Modèle de spécifications de performances

IEC 61291-2:2016-02(en-fr)

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OPTICAL AMPLIFIERS –

Part 2: Single channel applications – Performance specification template

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International Standard IEC 61291-2 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics.

This fourth edition cancels and replaces the third edition published in 2012. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the title of this standard has been changed from digital applications to single channel applications;
b) the scope has been changed and, as a result, the titles of tables have been changed;
c) Terms and definitions have been revised;

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d) three tables regarding the minimum list of relevant parameters of power amplifiers, pre-amplifiers and line amplifiers based on semiconductor optical amplifier (SOA) components have been added;

e) transient parameters have been added in the minimum list of relevant parameters of pre-amplifiers and line amplifiers based on optical fibre amplifier (OFA) module.

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

CDV	Report on voting
86C/1318/CDV	86C/1365/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 in the IEC 61291 series, published under the general title *Optical amplifiers*, 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 website 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- withdrawn,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.

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INTRODUCTION

This International Standard is devoted to the subject of optical amplifiers. The technology of optical amplifiers is still rapidly evolving, hence amendments and new additions to this standard can be expected. Each abbreviation introduced in this standard is generally explained in the text the first time it appears. However, for an easier understanding of the whole text, a list of all abbreviations used in this standard is given in Clause 3.

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OPTICAL AMPLIFIERS –

Part 2: Single channel applications – Performance specification template

1 Scope

This part of IEC 61291 provides a performance specification template which applies to optical amplifiers (OAs) to be used in single channel applications. Multichannel applications are covered in IEC 61291-4.

The object of this performance specification template is to provide a frame for the preparation of performance standards and/or product specifications on the performance of OA devices to be used in single channel applications. In the performance standards or product specifications, other specifications such as ratings, operating conditions, tests and pass/fail criteria could be included in addition to the requirements based on this performance specification template.

Product specification writers may add specification parameters and/or groups of specification parameters for particular applications. However, product specification writers should not remove specification parameters specified in this standard.

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 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61290-1 (all parts), *Optical amplifiers – Test methods – Part 1: Power and gain parameters*

IEC 61290-3 (all parts), *Optical amplifiers – Test methods – Part 3: Noise figure parameters*

IEC 61290-4-3, *Optical amplifiers – Test methods – Part 4-3: Power transient parameters –. Single channel optical amplifiers in output power control*

IEC 61290-5 (all parts), *Optical amplifiers – Test methods – Part 5: Reflectance parameters*

IEC 61290-6-1, *Optical fibre amplifiers – Basic specification – Part 6-1: Test methods for pump leakage parameters – Optical demultiplexer*

IEC 61290-11 (all parts), *Optical amplifiers – Test methods – Part 11-1: Polarization mode dispersion parameter*

IEC 61291-1, *Optical amplifiers – Part 1: Generic specification*

IEC 61291-5-2, *Optical amplifiers – Part 5-2: Qualification specifications – Reliability qualification for optical fibre amplifiers*

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IEC TS 62538:2008, *Categorization of optical devices*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61291-1, IEC TS 62538 and the following apply.

NOTE Possible supplementary definitions specific to OAs for single channel applications can be given in product specifications.

3.1.1
optical amplifier
OA
optical waveguide device containing a suitably pumped, active medium which is able to amplify an optical signal

[SOURCE: IEC TR 61931:1998, 2.7.75]

3.1.2
optical fibre amplifier
OFA
optical amplifier made of active optical fibre which is doped with rare-earth ions, or which presents non-linear optical effects in order to obtain optical amplification

3.1.3
semiconductor optical amplifier
SOA
optical amplifier in which the active optical waveguide is formed by a semiconductor laser diode structure, which will be electrically pumped

[SOURCE: IEC TR 61931:1998, 2.7.77]

3.1.4
optical element
unpackaged or partially packaged optical basic unit, typically non repairable and non-re-workable (at least by users)

Note 1 to entry: Examples of optical elements include laser chips or laser diodes, photodiodes, lenses, prisms, optical collimators, grating chips and filter chips.

[SOURCE: IEC TS 62538:2008, 2.2.1]

3.1.5
optical component
packaged unit comprising at least one optical element, typically non repairable and non-re-workable (at least by users), suitably pigtailed or connectorized

Note 1 to entry: Examples of optical components include packaged lasers, photodiodes, optical splitters, couplers, attenuators, isolators, MEMS's and modulators.

[SOURCE: IEC TS 62538:2008, 2.2.2]

3.1.6
optical module
packaged integration of optical component and/or elements, accomplishing defined functionality, typically repairable and re-workable

Note 1 to entry: An optical module may comprise electronic components.

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Note 2 to entry: An optical module is to be used as it is; users are not normally enabled to re-arrange inner components or add other components inside.

[SOURCE: IEC TS 62538:2008-2.2.5]

3.1.7
OFA component
fibre-pigtailed optical component that consists of fibre based gain medium such as an erbium-doped fibre, one or more optical isolator(s), optical couplers for the wavelength-selector or the power monitor, a package and fibres

Note 1 to entry: An OFA component may include an optical filter, such as a gain equalizing filter or ASE rejection filter, and other possible components.

3.1.8
OFA module
fibre-pigtailed optical module that consists of an OFA component, pump laser component(s) with driving circuit, monitor photodiode component(s) with driving circuit and a control circuit

3.1.9
SOA element
optical element of SOA that consists of a semiconductor chip

3.1.10
SOA component
fibre-pigtailed optical component that consists of an SOA element, lenses, optical isolator(s) (if necessary), a thermoelectric cooler (TEC), a thermistor, a package and fibres

3.2 Abbreviated terms

EMC electromagnetic compatibility

OA optical amplifier

OFA optical fibre amplifier

SOA semiconductor optical amplifier

TEC thermoelectric cooler

4 Performance specification template for power amplifiers

The following template contains minimum performance parameters to be included in specifications of OFA components or modules (see Table 1) and SOA components (see Table 2) to be used as power amplifiers in single channel applications, together with their specification criteria (that is in terms of the maximum value, minimum value or both), and the indication of the corresponding standard test method. Note that the list of the minimum parameters for SOAs (see Table 2) covers SOA components only, because most SOA products are currently traded in the form of the component using a package, such as a butterfly-type package.

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Table 1 – Minimum relevant parameters for power amplifiers based on OFA components or modules using active fibre specified for single channel applications

	Parameters		Unit	Minimum values	Maximum values	IEC test method
Transmission characteristics	Input power range		dBm			IEC 61290-1 series
	Output power range[a]		dBm			IEC 61290-1 series
	Gain[a]		dB			IEC 61290-1 series
	Wavelength band		nm			IEC 61290-1 series
	Signal-spontaneous noise figure		dB	n/a		IEC 61290-3 series
	Polarization dependent gain		dB	n/a		IEC 61290-1 series
	Reverse amplified spontaneous emission power level		dBm	n/a		IEC 61290-3 series
	Input reflectance[b]		dB	n/a		IEC 61290-5 series
	Return loss[b]		dB		N/A	IEC 61290-3 series
	Maximum reflectance tolerable at input		dB	n/a		IEC 61290-5 series
	Maximum reflectance tolerable at output		dB	n/a		IEC 61290-5 series
	Pump leakage to input		dBm	n/a		IEC 61290-6-1
	Pump leakage to output		dBm	n/a		IEC 61290-6-1
	Maximum total output power		dBm	n/a		IEC 61290-1 series
Environmental and reliability parameters	Operating temperature		°C	See IEC 61291-5-2	See IEC 61291-5-2	
	Maximum operating relative humidity		%	n/a	See IEC 61291-5-2	
	Maximum operating vibration severity	Range of frequencies	Hz	See IEC 61291-5-2	See IEC 61291-5-2	
		Amplitude peak-to-peak	mm	n/a	See IEC 61291-5-2	
		Duration	s	n/a	See IEC 61291-5-2	
	Storage temperature		°C	See IEC 61291-5-2	See IEC 61291-5-2	
	Maximum storage relative humidity		%	n/a	See IEC 61291-5-2	
	Maximum shock severity, free drop	Drop height	mm	n/a	See IEC 61291-5-2	
	Failure rate		FIT	n/a	See IEC 61291-5-2	

[a] Either output power range, gain, or both shall be stated.

[b] Either input reflectance or return loss shall be specified.

n/a: not applicable

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Table 2 – Minimum relevant parameters for power amplifiers based on SOA components specified for single channel applications

	Parameters		Unit	Minimum values	Maximum values	IEC test method
Transmission characteristics[a]	Input power range		dBm			IEC 61290-1 series
	Output power range[b]		dBm			IEC 61290-1 series
	Gain[b]		dB	n/a		IEC 61290-1 series
	Saturation output power		dBm	n/a		IEC 61290-1 series
	Wavelength band		nm			IEC 61290-1 series
	Gain ripple[c]		dB	n/a		Under consideration
	Signal-spontaneous noise figure		dB	n/a		IEC 61290-3 series
	Polarization dependent gain		dB	n/a		IEC 61290-1 series
	Forward amplified spontaneous emission power level		dBm	n/a		IEC 61290-3 series
	Reverse amplified spontaneous emission power level		dBm	n/a		IEC 61290-3 series
	Input reflectance		dB	n/a		IEC 61290-5 series
	Maximum reflectance tolerable at input		dB	n/a		IEC 61290-5 series
	Maximum reflectance tolerable at output		dB	n/a		IEC 61290-5 series
	Maximum total output power		dBm	n/a		IEC 61290-1 series
Environmental and reliability parameters[d]	Operating temperature		°C			
	Maximum operating relative humidity		%	n/a		
	Maximum operating vibration severity	Range of frequencies	Hz			
		Amplitude peak-to-peak	mm	n/a		
		Duration	s	n/a		
	Storage temperature		°C			
	Maximum storage relative humidity		%	n/a		
	Maximum shock severity, free drop	Drop height	mm	n/a		
	Failure rate		FIT	n/a		

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	Parameters	Unit	Minimum values	Maximum values	IEC test method
Operating condition[a,e]	Forward current	mA			
	Forward bias voltage	V			
	Gain peak wavelength	nm			
	TEC current	A			
	TEC voltage	V			
	Thermistor resistance	Ω			
	Thermistor constant				

[a] Detailed information about SOA characteristics for saturation output power, gain, gain ripple, signal-spontaneous noise figure, polarization dependent gain, maximum total output power, and operating conditions are described in IEC TR 61292-9.

[b] Either output power range, gain, or both shall be stated.

[c] Measurement method should be defined in other documents.

[d] There are no IEC publications regarding SOA reliability. There are two documents regarding reliability of fibre optic active components and devices. These are IEC TR 62572-2 and IEC 62572-3, which deal with laser modules.

[e] Operating conditions of a TEC and thermistor are commonly specified in IEC 62149-3, which covers the performance standard for 2,5 Gb/s modulator-integrated laser diode modules.

5 Performance specification template for pre-amplifiers

The following template contains minimum performance parameters to be included in specifications of OFA components or modules (see Table 3) and SOA components (see Table 4) to be used as pre-amplifiers in single channel applications, together with their specification criteria (that is in terms of the maximum value, minimum value, or both) and the indication of the corresponding standard test method. Note that the list of the minimum parameters for SOAs (see Table 4) covers SOA components only, because most SOA products are currently traded in the form of the component using a package, such as a butterfly-type package.

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Table 3 – Minimum relevant parameters for pre-amplifiers based on OFA components or modules using active fibre specified for single channel applications

	Parameters	Unit	Minimum values	Maximum values	IEC test method
Transmission characteristics	Input power range	dBm			IEC 61290-1 series
	Output power range[a]	dBm			IEC 61290-1 series
	Gain[a]	dB			IEC 61290-1 series
	Wavelength band	nm			IEC 61290-1 series
	Available signal wavelength band	nm			IEC 61290-1 series
	Signal-spontaneous noise figure	dB	n/a		IEC 61290-3 series
	Polarization dependent gain	dB	n/a		IEC 61290-1 series
	Forward amplified spontaneous emission power level	dBm	n/a		IEC 61290-3 series
	Reverse amplified spontaneous emission power level	dBm	n/a		IEC 61290-3 series
	Input reflectance[b]	dB	n/a		IEC 61290-5 series
	Return loss[b]	dB		n/a	IEC 61290-3 series
	Maximum reflectance tolerable at input	dB	n/a		IEC 61290-5 series
	Maximum reflectance tolerable at output	dB	n/a		IEC 61290-5 series
	Pump leakage to input	dBm	n/a		IEC 61290-6-1
	Pump leakage to output	dBm	n/a		IEC 61290-6-1
	Maximum total output power	dBm	n/a		IEC 61290-1 series
Transient parameters[c]	Transient power response	dB	n/a		IEC 61290-4-3
	Transient power response time	s	n/a		IEC 61290-4-3
	Transient power overcompensation response	dB	n/a		IEC 61290-4-3
	Steady state power offset	dB	n/a		IEC 61290-4-3

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