

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Optical amplifiers –
Part 4: Multichannel applications – Performance specification template**

**Amplificateurs optiques –
Partie 4: Applications aux canaux multiples – Modèle de spécification de
fonctionnement**

IEC 61291-4:2008

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

OPTICAL AMPLIFIERS –

**Part 4: Multichannel applications –
Performance specification template**

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International Standard IEC 61291-4 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 2003 and constitutes a technical revision. The main significant changes are the following:

- a) the applicability has been extended to all commercially available optical amplifiers, not just optical fibre amplifiers;
- b) Clause 7, EMC, has been added.
- c) references to applicable test methods have been updated.

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

| CDV | Report on voting |
|-------------|------------------|
| 86C/774/CDV | 86C/822A/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.

This standard shall be used in conjunction with IEC 61291-1. It was established on the basis of the second (2006) edition of that standard.

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 maintenance result date indicated on the IEC web site 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- withdrawn,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.

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 editions to this standard can be expected. Each abbreviation introduced in this International Standard is generally explained in the text the first time it appears. However, for an easier understanding of the whole text, a list of abbreviations used in this International Standard is given in 3.3.

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OPTICAL AMPLIFIERS –

Part 4: Multichannel applications – Performance specification template

1 Scope

This part of IEC 61291 applies to optical amplifier (OA) devices and sub-systems to be used in multichannel applications.

The object of this performance specification template is to provide a frame for the preparation of detail specifications on the performances of OA devices and sub-systems to be used in multichannel applications.

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

2 Normative references

The following referenced documents are indispensable for the application 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 60825-1, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 61290 (all parts), *Optical amplifiers – Test methods*

IEC 61291-1:2006, *Optical amplifiers – Part 1: Generic specification*

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

NOTE A list of informative references is given in the bibliography.

3 Terms, definitions and abbreviations

3.1 Terms and definitions

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

3.2 Overview of multichannel definitions

Parameters specified for optical devices are those characterizing the transmission, operation, reliability and environmental properties of the OA device, which is seen as a black box from a general point of view as defined in the generic specification IEC 61291-1.

Each test method (OA test methods, IEC 61290 series) is generally given for the measurement of a group of homogeneous parameters. The grouping of the homogeneous parameters is given in Table 1 of the generic specification, IEC 61291-1, together with the corresponding test method specification number.

Safety characteristics of optical amplifiers described in the present standard are provided in IEC 60825-1.

A typical configuration of an OA in a multichannel application is reported in Figure 1. At the transmitting side, m signals, coming from m optical transmitters, Tx1, Tx2, . . . Tx m , each with a unique wavelength, $\lambda_1, \lambda_2, \dots, \lambda_m$, respectively, are combined by an optical multiplexer (OM). At the receiving side, the m signals at $\lambda_1, \lambda_2, \dots, \lambda_m$, are separated with an optical demultiplexer (OD) and routed to separate optical receivers, Rx1, Rx2, . . . Rx m , respectively. To characterize the OA in this multichannel application an input reference plane and an output reference plane are defined at the OA input and output ports, respectively, as shown in Figure 1.

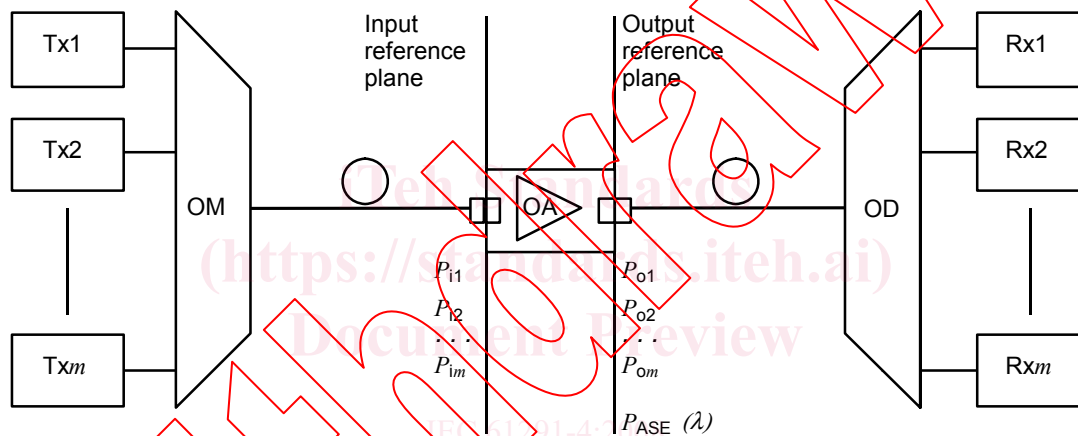


Figure 1 – An optical amplifier in a multichannel application

At the input reference plane, m input signals at the m wavelengths are considered, each with a unique power level, $P_{i1}, P_{i2}, \dots, P_{im}$, respectively. At the output reference plane, m output signals at the m wavelengths, resulting from the optical amplification of the corresponding m input signals, are considered, each with power level $P_{o1}, P_{o2}, \dots, P_{om}$, respectively. Moreover, the amplified spontaneous emission, ASE, with a noise power spectral density, $P_{ASE}(\lambda)$, is also to be considered at the OA output port.

Most definitions of relevant parameters given in the generic specification IEC 61291-1 can be suitably extended to multichannel applications. When this extension is straight forward, the word “channel” will be added to the pertinent parameter. In particular, the noise figure and the signal-spontaneous noise figure as defined in IEC 61291-1 may be extended to multichannel applications, channel by channel, by considering the value of $P_{ASE}(\lambda)$ at each channel wavelength and the channel signal bandwidth. For each channel wavelength there will be a unique value of noise figure that will be a function of the input power level of all signals. In this case the parameters, channel noise figure and channel signal-spontaneous noise figure, are introduced.

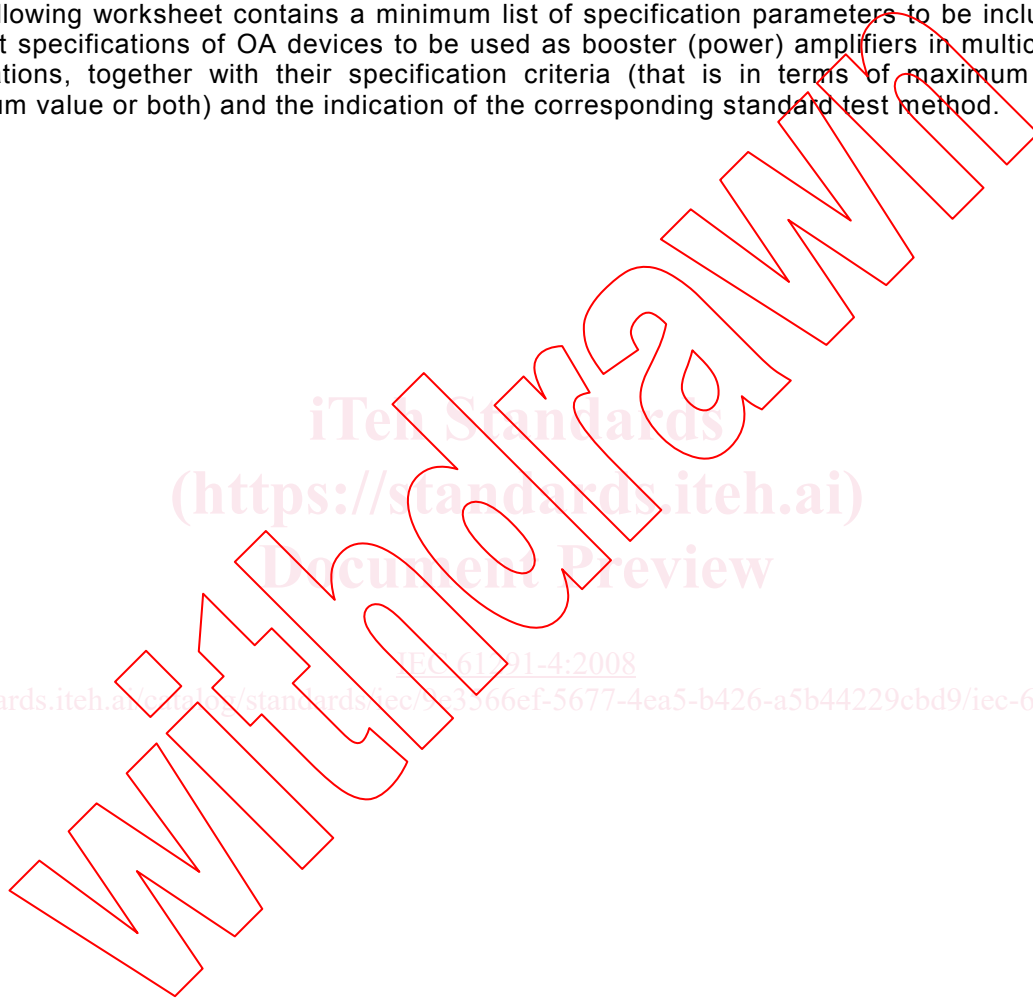
3.3 Abbreviations

| | |
|-----|--------------------------------|
| ASE | Amplified spontaneous emission |
| BA | Booster (power) amplifier |

| | |
|-----|------------------------------|
| LA | Line amplifier |
| na | Not applicable |
| OA | Optical amplifier |
| OFA | Optical fibre amplifier |
| PA | Pre-amplifier |
| PMD | Polarization mode dispersion |

4 Product specification worksheet for booster (power) amplifiers (BA)

The following worksheet contains a minimum list of specification parameters to be included in product specifications of OA devices to be used as booster (power) amplifiers in multichannel applications, together with their specification criteria (that is in terms of maximum value, minimum value or both) and the indication of the corresponding standard test method.



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Table 1 – Minimum list of relevant parameters of BA amplifiers to be specified for multichannel applications

| | Parameters | Unit | Minimum value | Maximum value | Test method | |
|--------------------------------------|--|-----------------------------|---------------|---------------|---------------------|---------------|
| Transmission characteristics | Channel allocation | nm or THz | | | Under consideration | |
| | Channel input power range | dBm | | | IEC 61290-10 series | |
| | Total input power range | dBm | | | IEC 61290-10 series | |
| | Channel output power range | dBm | | | IEC 61290-10 series | |
| | Maximum total output power | dBm | na | | IEC 61290-10 series | |
| | Channel addition/removal gain transient response | dB | na | | Under consideration | |
| | Multichannel gain variation (gain flatness) | dB | na | | IEC 61290-10 series | |
| | Channel signal-spontaneous noise figure (channel noise figure) | dB | na | | IEC 61290-3 series | |
| | Input reflectance | dB | na | | IEC 61290-5 series | |
| | Output reflectance | dB | na | | IEC 61290-5 series | |
| | Pump leakage to input (for OFA only) | dBm | na | | IEC 61290-6 series | |
| | Environmental parameters | Operating temperature range | °C | | | IEC 61291-5-2 |
| Maximum operating relative humidity | | % | na | | IEC 61291-5-2 | |
| Maximum operating vibration severity | | Range of frequencies | Hz | | | IEC 61291-5-2 |
| | | Amplitude Peak-to-peak | mm p-p | na | | |
| | | Duration | s | na | | |
| Storage temperature range | | °C | | | IEC 61291-5-2 | |
| Maximum storage relative humidity | | % | na | | IEC 61291-5-2 | |
| Maximum shock severity, free drop | Drop height | mm | na | | IEC 61291-5-2 | |
| Safety parameters | Safety laser classification | | na | na | IEC 60825-1 | |

5 Product specification worksheet for pre-amplifiers (PA)

The following worksheet contains a minimum list of specification parameters to be included in product specifications of OA devices to be used as pre-amplifiers in multichannel applications, together with their specification criteria (that is in terms of maximum value, minimum value or both) and the indication of the corresponding standard test method.