**SLOVENSKI STANDARD**
**oSIST prEN IEC 61290-1:2022**

**01-februar-2022**

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**Optični ojačevalniki - Preskusne metode - 1. del: Parametri moči in ojačenja (IEC 61290-1:2014)**

Optical amplifiers - Test methods - Part 1: Power and gain parameters

Prüfverfahren für Lichtwellenleiter-Verstärker - Teil 1: Optische Leistungs- und Verstärkungsparameter

Amplificateurs optiques - Méthodes d'essai - Partie 1: Paramètres de puissance et de gain



**Ta slovenski standard je istoveten z: prEN IEC 61290-1:2021**



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**ICS:**

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|---|---|---|
| 33.180.30 | Optični ojačevalniki | Optic amplifiers |

**oSIST prEN IEC 61290-1:2022** **en**

# 86C/1746/CDV

COMMITTEE DRAFT FOR VOTE (CDV)

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|---|---|
| PROJECT NUMBER:<br>**IEC 61290-1 ED2** | |
| DATE OF CIRCULATION:<br>**2021-11-26** | CLOSING DATE FOR VOTING:<br>**2022-02-18** |
| SUPERSEDES DOCUMENTS:<br>**86C/1728/CD, 86C/1745/CC** | |

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|---|---|
| IEC SC 86C : FIBRE OPTIC SYSTEMS AND ACTIVE DEVICES | |
| SECRETARIAT:<br>United States of America | SECRETARY:<br>Mr Fred Heismann |
| OF INTEREST TO THE FOLLOWING COMMITTEES: | PROPOSED HORIZONTAL STANDARD:<br>☐<br>Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary. |
| FUNCTIONS CONCERNED:<br>☐ EMC ☐ ENVIRONMENT | ☒ QUALITY ASSURANCE ☐ SAFETY |
| ☒ SUBMITTED FOR CENELEC PARALLEL VOTING<br><br>**Attention IEC-CENELEC parallel voting**<br><br>The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.<br><br>The CENELEC members are invited to vote through the CENELEC online voting system. | ☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING |



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TITLE:

**Optical amplifiers - Test methods - Part 1: Power and gain parameters**

PROPOSED STABILITY DATE: 2025

NOTE FROM TC/SC OFFICERS:

CONTENTS

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# OPTICAL AMPLIFIERS –
# TEST METHODS –
# Part 1: Power and gain parameters

## FOREWORD

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IEC 61290-1 has been prepared by subcommittee 86C: Fibre optic systems and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

a) Specification of gain ripple as a new parameter;
b) Specification of test method and test report for gain ripple measurements;
c) Use of the term "measurement uncertainty" instead of "measurement accuracy".

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

| Draft | Report on voting |
|---|---|
| XX/XX/FDIS | XX/XX/RVD |

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 http://www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

# OPTICAL AMPLIFIERS – TEST METHODS – Part 1: Power and gain parameters

## 1 Scope

This part of IEC 61290 applies to all commercially available optical amplifiers (OAs) and optically amplified subsystems. It applies to OAs using optically pumped fibres (OFAs based on either rare-earth doped fibres or on the Raman effect), semiconductors (SOAs), and waveguides (POWAs). It is specifically directed to single-channel amplifiers. Test methods for multichannel amplifiers are defined in the IEC 61290-10 series.

This standard establishes uniform requirements for accurate and reliable measurements of the following OA parameters, as defined in Clause 3 of IEC 61291-1:

a) nominal output signal power;
b) gain;
c) reverse gain;
d) maximum gain;
e) maximum gain wavelength;
f) maximum gain variation with temperature;
g) gain wavelength band;
h) gain wavelength variation;
i) gain stability;
j) polarization-dependent gain;
k) gain ripple (SOA only);
l) large-signal output stability;
m) saturation output power;
n) maximum output signal power;
o) maximum total output power.



NOTE 1 The applicability of the test methods described in the present standard to distributed Raman amplifiers is still under study.

NOTE 2 All numerical values followed by (‡).are suggested values for which the measurement is assured. Other values are acceptable if verified.

## 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 61290-1-1, *Optical amplifiers – Test methods – Part 1-1: Power and gain parameters – Optical spectrum analyzer method*

IEC 61290-1-2, *Optical amplifiers – Test methods – Part 1-2: Power and gain parameters – Electrical spectrum analyzer method*

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

IEC 61291-1:2018, *Optical amplifiers – Part 1: Generic specification*

# 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 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

## 3.2 Abbreviated terms

| | |
|---|---|
| ASE | amplified spontaneous emission |
| FWHM | full width at half maximum |
| OA | optical amplifier |
| OFA | optical fibre amplifier |
| OSA | optical spectrum analyzer |
| POWA | planar optical waveguide amplifier |
| SOA | semiconductor optical amplifier |



# 4 Optical power and gain test method

Three commonly practised procedures for quantifying the optical power and gain of an OA are considered in this standard.

The aim of the first procedure (see IEC 61290-1-1) is to determine the optical power and gain by means of the optical spectrum analyzer test method.

The aim of the second procedure (see IEC 61290-1-2) is to determine the optical power and gain by means of an optical detector and an electrical spectrum analyzer.

The aim of the third procedure (see IEC 61290-1-3) is to determine the optical power and gain by means of an optical power meter and an optical bandpass filter.

# 5 Optical power and gain parameters

The parameters listed below are required for gain and power:

a) Nominal output signal power: The nominal output signal power is given by the minimum output signal optical power for an input signal optical power specified in the relevant detail specification and under nominal operating conditions given in the relevant detail specification. To find this minimum value, input and output signal power levels shall be continuously monitored for a given duration of time and in presence of changes in the state of polarization and other instabilities, as specified in the relevant detail specification. The measurement procedures and calculations are described in each test method.

b) Gain: The measurement procedures and calculations are described in each test method.

c) Reverse gain: As in b), but with the OA operating with the input port used as an output port and vice-versa.

d) Maximum gain: As in b), but use a wavelength-tuneable optical source and repeat all procedures at different wavelengths in such a way as to cover the wavelength range specified in the relevant detail specification.

Unless otherwise specified, the wavelength should be changed by steps smaller than 1 nm (‡) around the wavelength where the ASE spectral profile, observed (e.g. with an optical spectrum analyzer or a monochromator) without the input signal, takes its maximum value.

NOTE 1 A wavelength measurement uncertainty of 0,01 nm, within the operating wavelength range of the OA, is attainable with commercially available wavelength meters based on interference-fringes counting techniques. Some tuneable external-cavity laser-diode instruments provide a wavelength measurement uncertainty of 0,2 nm.

The gain values are measured at the different wavelengths as described in b) above. The maximum gain shall be given by the highest of all these gain values at nominal operating condition. Figure 1 shows the typical behaviour of the gain as a function of the input signal power.

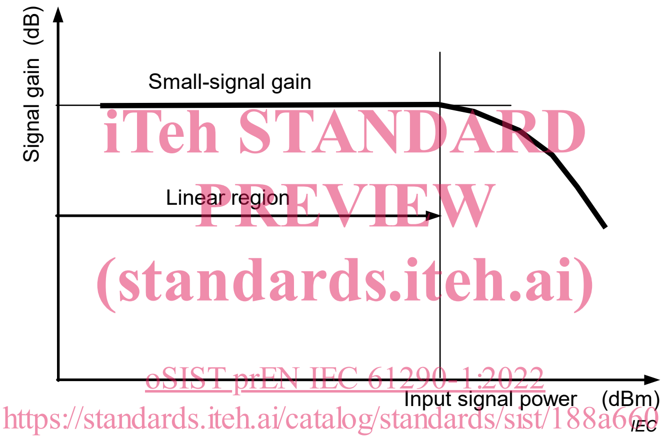




**Figure 1 – Typical behaviour of the gain as a function of input signal power**

e) Maximum gain wavelength: As in d), the maximum gain wavelength shall be the wavelength at which the maximum gain occurs. Refer to Figure 2 for typical gain behaviour for different wavelengths.

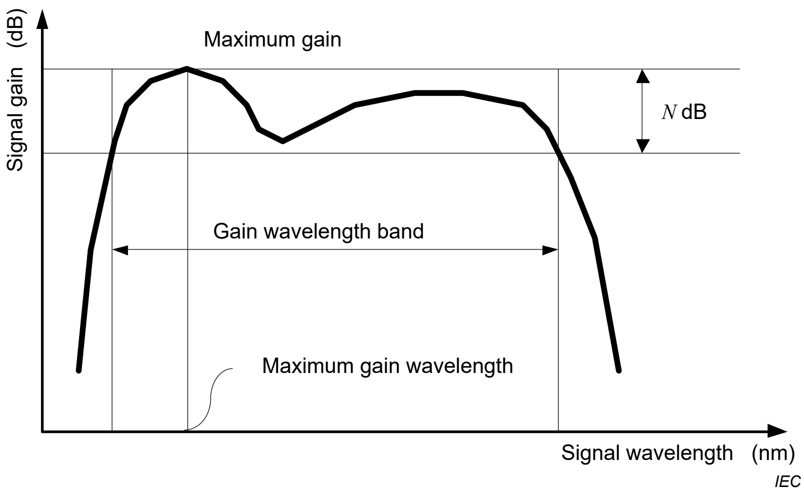


**Figure 2 – Typical behaviour of the gain as a function of wavelength**

f) Maximum gain variation with temperature: The maximum change of signal gain for a certain specified temperature range. The measurement procedures and calculations described below shall be followed, with reference to the measurement set-up and procedure for each test method:

1) As described in b), measure the maximum gain $G_{\text{max-tmp}}$ within the variation of temperature, as specified in the relevant detail specification;

2) As described in b), measure the minimum gain $G_{\text{min-tmp}}$ within the variation of temperature, as specified in the relevant detail specification;

3) Maximum gain variation with temperature $\Delta G_{\text{tmp}}$ is given by Formula (1):

$$\Delta G_{\text{tmp}} = G_{\text{max-tmp}} - G_{\text{min-tmp}} \text{ (dB)} \qquad (1)$$

Refer to Figure 3.

Gain variation with temperature may depend on the signal wavelength, owing to its active fibre characteristics. The wavelength at which the parameter is specified and measured should be stated.

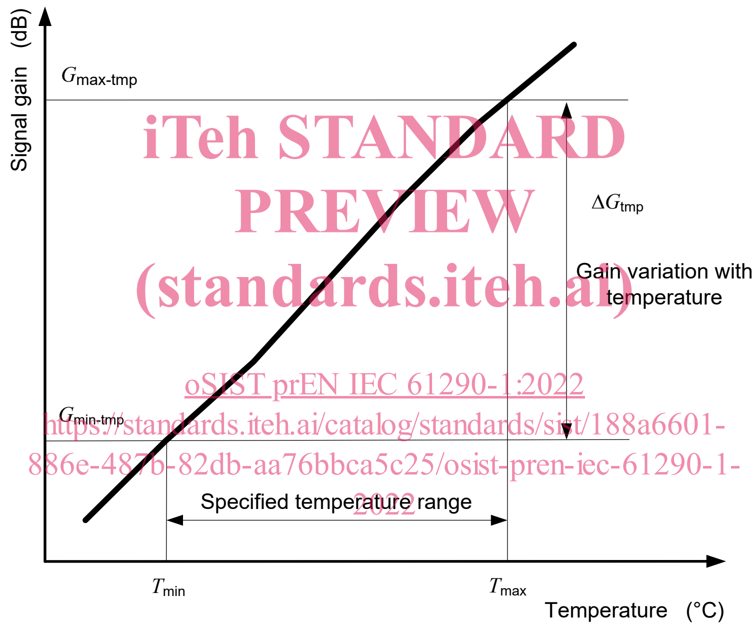




**Figure 3 – Typical behaviour of the gain as a function of temperature**

g) Gain wavelength band: Measure the maximum gain as described in d). Identify those wavelengths at which the gain is $N$ dB below the maximum gain. The gain wavelength band shall be given by the wavelength interval(s) that comprise those wavelengths at which the gain is between the maximum gain value and the value $N$ dB below the maximum gain. Calculations are processed according to the following procedure:

1) Plot the gain at each wavelength as a function of wavelength, as shown in Figure 2;

2) Draw a horizontal line $N$ dB below the maximum gain value;

3) The two or more intersection points of this line with the gain profile plotted in 1) yield two (or more) $N$-dB-down wavelengths, which define the range of the gain wavelength band. The wavelength interval with the minimum difference in $N$-dB-down wavelengths is the gain wavelength band.

NOTE 2 A value of $N$ = 3 is typically applied.

h) Gain wavelength variation: Measure the maximum gain and minimum gain over the specified measurement wavelength range as described in d). The gain variation shall be