

INTERNATIONAL STANDARD

**Optical amplifiers - Test methods -
Part 3-2: Noise figure parameters - Electrical spectrum analyzer method**

CONTENTS

FOREWORD	2
INTRODUCTION	4
1 Scope	5
2 Normative references	5
3 Terms, definitions, abbreviated terms, and symbols	5
3.1 Terms and definitions	5
3.2 Abbreviated terms	5
3.3 Symbols	5
4 General	7
5 Apparatus	7
6 Test specimen	9
7 Procedure	9
7.1 General remark	9
7.2 Frequency-scanning technique: calibration	9
7.3 Frequency-scanning technique: measurement	11
7.4 Selected-frequency technique: calibration and measurement	12
7.5 Measurement accuracy limitations	12
8 Calculation	12
8.1 General	12
8.2 Calculation of calibration results	13
8.3 Calculation of test results for the frequency-scanning technique	13
8.4 Calculation of test results for the selected-frequency technique	14
9 Test results	15
Bibliography	16
Figure 1 – Scheme of a measurement set-up	8

INTERNATIONAL ELECTROTECHNICAL COMMISSION

Optical amplifiers - Test methods - Part 3-2: Noise figure parameters - Electrical spectrum analyzer method

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61290-3-2 has been prepared by subcommittee 86C: Fibre optic systems, sensing and active devices, of IEC technical committee 86: Fibre optics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

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

- a) shortening and clarification of the scope in [Clause 1](#);
- b) update of the normative references in [Clause 2](#);
- c) deletion of duplicate instructions in [7.2](#) to measure the time-average input power;
- d) deletion of unused symbols in [3.3](#) and addition of new symbol.

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

Draft	Report on voting
86C/2027/FDIS	86C/2032/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 http://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at <http://www.iec.ch/publications>.

A list of all parts of the [IEC 61290 series \[1\]](#), published under the general title *Optical amplifiers - Test methods*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

This part of IEC 61290 covers the noise figure measurements of optical amplifiers using the electrical spectrum analyser method.

Each symbol and abbreviated term introduced in this document is generally explained in the text the first time it appears. However, for an easier understanding of the whole text, a list of all symbols and abbreviated terms used in this document is given in [Clause 3](#).

1 Scope

This part of IEC 61290 applies to all commercially available optical amplifiers (OAs), including OAs using optically pumped fibres (i.e. optical fibre amplifiers (OFAs) based on either rare-earth doped fibres or on the Raman effect), semiconductor optical amplifiers (SOAs), and planar waveguide optical amplifiers (PWOAs).

This document defines requirements for accurate and reliable measurements of the noise figure parameters of OAs by means of the electrical spectrum analyser (ESA) method. The noise figure parameters of OAs are defined in IEC 61291-1 [2].

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

Bibliography

- [1] IEC 61290 series, *Optical amplifiers - Test methods*
 - [2] IEC 61291-1, *Optical amplifiers - Part 1: Generic specification*
 - [3] IEC 61290-3 series, *Optical amplifiers - Test methods - Part 3: Noise figure parameters*
 - [4] IEC 61290-3, *Optical amplifiers - Test methods - Part 3: Noise figure parameters*
 - [5] IEC 60728-6, *Cable networks for television signals, sound signals and interactive services - Part 6: Optical equipment*
 - [6] IEC TR 61292-2, *Optical amplifier technical reports - Part 2: Theoretical background for noise figure evaluation using the electrical spectrum analyzer*
-