

Optical amplifiers — Test methods —

Part 10-3: Multichannel parameters — Probe methods

The European Standard EN 61290-10-3:2003 has the status of a
British Standard

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National foreword

This British Standard is the official English language version of EN 61290-10-3:2003. It is identical with IEC 61290-10-3:2002.

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, which has the responsibility to:

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- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

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**Optical amplifiers -
Test methods
Part 10-3: Multichannel parameters -
Probe methods
(IEC 61290-10-3:2002)**

Amplificateurs optiques -
Méthodes d'essai
Partie 10-3: Paramètres à canaux
multiples -
Méthodes par sondage
(CEI 61290-10-3:2002)

Prüfverfahren für
Lichtwellenleiter-Verstärker
Teil 10-3: Mehrkanalparameter -
Sondenmessverfahren
(IEC 61290-10-3:2002)

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 86C/459/FDIS, future edition 1 of IEC 61290-10-3, 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 was approved by CENELEC as EN 61290-10-3 on 2003-02-01.

This standard shall be read in conjunction with EN 61291-1:1998 and EN 61290-3:2000

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2004-02-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-02-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annex ZA is normative and annexes A and B are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61290-10-3:2002 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60825-1	NOTE	Harmonized as EN 60825-1:1994 (not modified).
IEC 60825-2	NOTE	Harmonized as EN 60825-2:2000 (not modified).
IEC 60874-1	NOTE	Harmonized as EN 60874-1:1999 (not modified).

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INTRODUCTION

Each abbreviation introduced in this International Standard is explained in the text at least the first time that it appears. However, for an easier understanding of the whole text, a list of all abbreviations used in this International Standard is given in Annex A.

OPTICAL AMPLIFIERS – TEST METHODS –

Part 10-3: Multichannel parameters – Probe methods

1 Scope and object

This part of IEC 61290 applies to commercially available optical fibre amplifiers (OFAs) using active fibres containing rare-earth dopants as described in the following.

The object of this international standard is to establish uniform requirements for accurate and reliable measurements of the multichannel gain and noise parameters as defined in IEC 61291-4.

The test methods described in this standard use small-signal probes to obtain the multichannel gain and noise parameters while one or more lasers set the saturation condition for the OFA. These methods are classified as *indirect* in that there is not a laser source at each wavelength of the multichannel plan. Multichannel parameters are estimated from the probe data. IEC 61290-10-1 and IEC 61290-10-2 are test methods for measuring noise parameters using pulse techniques. These methods are *direct* in that the multichannel source is required to have a laser at each wavelength for which multichannel parameters are to be measured.

Probe techniques provide clear advantages for measuring multichannel gain characteristics in that a simple source configuration can provide parameters for a wide range of multichannel plans. Either a small-signal laser or a broadband noise source serves as the probe signal, and single or multiple lasers are used to set the OFA saturation condition. Pulse modulation of the saturating sources may optionally be used to measure ASE at or near the saturating laser wavelengths without the contaminating effect of source spontaneous emission. If pulse modulation is not used, the source spontaneous emission must be measured, and its effect removed from the measured result. For a multichannel source with high spontaneous emission or at high total input power, the source noise subtraction method can lead to large uncertainty.

The probe techniques described herein are indirect in that laser sources are not required at each channel frequency. A measurement error results from inhomogeneous effects that are DUT dependent. The main source of this error is spectral hole burning (see [1]¹ [2] and [4]).

The applicability of pulse modulation of the saturating signal(s) and the selection of the modulation rate are dependent on the optical fibre amplifier's characteristics, specifically its time response. They may be unsuitable for amplifiers with active automatic level control (ALC) or automatic gain control (AGC) circuits. They may also be unsuitable for praseodymium-doped OFAs that have gain relaxation times that are much faster than erbium-doped designs. For erbium-doped fibre amplifiers (EDFAs), inaccuracy due to modulation is generally small. Refer to IEC 61290-10-2 for a discussion of inaccuracy due to pulse repetition rate.

¹ Numbers in brackets refer to the bibliography.

In order to predict multichannel parameters by probe methods it is necessary to properly set the output level of the saturating signal(s) to simulate the saturation effect of a specified multichannel plan. Clause 5 describes a methodology to accomplish this under the assumption of homogeneous behavior within a wavelength region. This methodology has the limitation that the wavelength dependence of any output coupling circuit from the active fibre to the output port is assumed to be zero within defined regions.

Parameters measured with the methods described herein include channel gain, channel signal-spontaneous noise figure, and amplified spontaneous emission (ASE).

Values marked with(*) indicate preliminary values. Final values are under study.

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 61290-3, *Optical fibre amplifiers – Basic specification – Part 3: Test methods for noise figure parameters*

IEC 61290-10-1, *Optical amplifiers – Test methods – Part 10-1: Multichannel parameters – Pulse method using an optical switch and optical spectrum analyzer*

IEC 61290-10-2, *Optical amplifiers – Test methods – Part 10-2: Multichannel parameters – Pulse method using a gated optical spectrum analyzer*

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

IEC 61291-4, *Optical amplifiers – Part 4: Multichannel applications – Performance specification template*

3 Apparatus

The probe methods require two sources. The first establishes the inversion (saturation) level of the optical amplifier and consists of one or more lasers. The second source is the small-signal probe and may consist of a laser or broadband noise source. In either case, care must be taken that the probe does not effect amplifier inversion. The laser source module may be pulse modulated in order to extinguish the source for more-accurate noise measurement as described in IEC 61290-10-1 or IEC 61290-10-2. For the probe methods described herein, modulation is optional.

Both laser and noise probe methods can provide similar measurement uncertainty. The noise probe method is generally faster so is preferred when measurement throughput is important.