

# Fibre optic interconnecting devices and passive components — Basic test and measurement procedures —

## Part 3-6: Examinations and measurements — Return loss

The European Standard EN 61300-3-6:1997, with the incorporation of amendments A1:1998 and A2:1999, has the status of a British Standard

ICS 33.180.20

# National foreword

This British Standard is the English language version of EN 61300-3-6:1997 including amendments A1:1998 and A2:1999. It is identical with IEC 61300-3-6:1997 including amendments 1:1998 and 2:1999.

The UK participation in its preparation was entrusted by Technical Committee EPL/86, Fibre optics, to Subcommittee EPL/86/2, Interconnecting devices and passive components, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/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.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

The start and finish of text introduced or altered by amendment is indicated in the text by tags **A1** **A1**. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

### Cross-references

Attention is drawn to the fact that Annex ZA lists normative references to international publications with their relevant Corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or using the “Find” facility of the BSI Standards Electronic Catalogue.

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### Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 21 and a back cover.

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# Fibre optic interconnecting devices and passive components — Basic test and measurement procedures — Part 3-6: Examinations and measurements — Return loss

(includes amendments A1:1998 and A2:1999)  
(IEC 61300-3-6:1997 + A1:1998 + A2:1999)

Dispositifs d'interconnexion et composants  
passifs à fibres optiques — Méthodes  
fondamentales d'essais et de mesures —  
Partie 3-6: Examens et mesures —  
Puissance réfléchie  
(inclut les amendements A1:1998 et A2:1999)  
(CEI 61300-3-6:1997 + A1:1998 + A2:1999)

Lichtwellenleiter-Verbindungselemente und  
passive Bauteile — Grundlegende Prüf- und  
Meßverfahren — Teil 3-6: Untersuchungen und  
Messungen — Rückflußdämpfung  
(enthält Änderungen A1:1998 und A2:1999)  
(IEC 61300-3-6:1997 + A1:1998 + A2:1999)

This European Standard was approved by CENELEC on 1997-03-11; amendment A1 was approved by CENELEC on 1998-04-01 and amendment A2 was approved by CENELEC on 1999-05-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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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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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B-1050 Brussels**

## Foreword

The text of document 86B/844/FDIS, future edition 1 of IEC 61300-3-6, prepared by SC 86B, *Fibre optic interconnecting devices and passive components*, of IEC TC 86, *Fibre optics*, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61300-3-6 on 1997-03-11.

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- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-12-01

Annexes designated “normative” are part of the body of the standard.

In this standard, Annex ZA is normative.

Annex ZA has been added by CENELEC.

## Endorsement notice

The text of the International Standard IEC 61300-3-6:1997 was approved by CENELEC as a European Standard without any modification.

## Foreword to amendment A1

The text of document 86B/1044/FDIS, future amendment 1 to IEC 61300-3-6:1997, prepared by SC 86B, *Fibre optic interconnecting devices and passive components*, of IEC TC 86, *Fibre optics*, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61300-3-6:1997 on 1998-04-01.

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## Endorsement notice

The text of amendment 1:1998 to the International Standard IEC 61300-3-6:1997 was approved by CENELEC as an amendment to the European Standard without any modification.

## Foreword to amendment A2

The text of document 86B/1178/FDIS, future amendment 2 to IEC 61300-3-6, prepared by SC 86B, *Fibre optic interconnecting devices and passive components*, of IEC TC 86, *Fibre optics*, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 61300-3-6:1997 on 1999-05-01.

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2002-05-01

## Endorsement notice

The text of amendment 2:1999 to the International Standard IEC 61300-3-6:1997 was approved by CENELEC as an amendment to the European Standard without any modification.

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## 1 General

### 1.1 Scope and object

This part of IEC 61300 presents procedures for the measurement of the return loss of a fibre optic device under test DUT. Return loss, as used in this standard, is the ratio of the power incident on, or entering the DUT, to the total power reflected by the DUT, expressed in decibels.

Return loss is a positive number.

**A1** The purpose of this procedure is to measure reflection profiles of single-mode optical devices with a micrometer spatial resolution and a high dynamic range by using optical low coherence interference. **A1**

**A2** The purpose of this procedure is to measure the return loss of single optical devices with a spatial resolution in the centimetre range and high dynamic range by using an optical frequency domain reflectometer. **A2**

### 1.2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of IEC 61300. At the time of publication, the edition indicated was valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61300 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. IEC 61300-1:1995, *Fibre optic interconnecting devices and passive components — Basic test and measurement procedures — Part 1: General and guidance*.

## 2 General description

Two methods will be presented for measuring optical return loss:

- a) measurement with a branching device (BD);
- b) measurement with an optical time domain reflectometer (OTDR).

Measurement with a BD is the reference method.

**A1** This additional procedure describes the measurement of reflection profiles of single-mode optical devices with a spatial resolution of less than 1 mm and a dynamic range greater than 90 dB. The reflection profile is defined as a distribution of reflections at individual endfaces and/or connected points in single-mode optical devices. When the reflection at a particular point is  $-R$  (dB), the return loss at this point is given by  $R$  (dB). This procedure measures the reflection at a point by detecting the power of a beat signal produced by optical interference between the reflected light and the reference light. When a component with dispersed reflections is analysed, each reflection can be identified and located, provided their separation is greater than the spatial resolution of the measurement system. This method is called optical low coherence reflectometry (OLCR). **A1**

**A2** This additional procedure describes the measurement of the return loss of a single-mode optical device with an optical frequency domain reflectometer, OFDR.

One of the prime benefits of this technique is the ability to resolve spatially the desired reflection from undesired ones, such as those of all the connectors or unterminated ports on the DUT, without any dead zone. Moreover, the OFDR method is highly reliable and the apparatus can be compact so as to be maintenance free. (In Annex B a comparison of return loss detectable by four different methods is reported.)

The measurement concept of the OFDR technique can be described as follows. The intensity modulated signal from the lightwave source is transmitted through the optical medium, the DUT being most commonly made or connected by optical fibres, although it could be an open-beam environment. The optical signal incident upon the DUT is of the form:

$$f(t) = a(t) \cos(\omega t) \quad (1)$$

where

$a(t)$  is the RF modulation;

$\cos(\omega t)$  represents the lightwave carrier signal at a given wavelength.

The DUT acts on the amplitude of both the modulation envelope and the carrier signal identically and delays both signals by the same amounts, yielding the following relationships for the DUT output:

$$F(t) = |H| a(t + \Delta t) \cos(\omega(t + \Delta t)) \quad (2)$$

where

$|H|$  is the magnitude of the transfer function of the DUT;

$\Delta\varphi = \omega\Delta t$  is the phase variation of  $H$ .

The influence of the DUT is determined by measuring the modulation envelope.  $\square$

### 3 Apparatus and symbols

#### 3.1 Device under test DUT

The two optical ports of the DUT may be terminated with pigtails, or with connectors. Reference plugs with pigtails and, as required, reference adaptors are to be added to those ports with connector terminations so as to form complete connector assemblies with pigtails. All unused ports shall be terminated as stated in 3.2.5.

#### 3.2 Measurements with a branching device

The following is a list of the apparatus and components used in the measurement of return loss using a branching device.

##### 3.2.1 Branching device BD

The splitting ratio of the BD shall be stable. It shall also be insensitive to polarization. The directivity should be at least 10 dB higher than the maximum return loss to be measured.

##### 3.2.2 Detector $D_1$ , $D_2$ , and $D_3$

The detector consists of an optical detector, the associated electronics, and a means of connecting to an optic fibre. The optical connection may be a receptacle for an optical connector, a fibre pigtail or a bare fibre adapter.

The detector is linear. Since all of the measurements are differential, however, it is not necessary that the calibration be absolute. Attention should be taken to suppress the reflected power from the detector  $D_2$  during the measurement.

Where during the sequence of measurements, a detector is disconnected and reconnected, the coupling efficiency for the two measurements shall be maintained.

The following characteristics shall be specified in the detail specification:

- maximum sensitivity at the wavelength of the source;
- linearity;
- stability;
- type of optical connection.

##### 3.2.3 Source $S_1$ and $S_2$

The source consists of an optical emitter, associated drive electronics, an excitation unit, and a fibre connector or fibre pigtail. A second source  $S_2$  may be used for calibration, as illustrated in Figure 2. Where a second source is used, the central wavelength and spectral width of  $S_2$  shall be the same as  $S_1$ .

Unless otherwise specified the launch conditions shall be in accordance with Annex B of IEC 61300-1.

The following characteristics are to be specified in the detail specification:

- power output;
- power stability;
- central wavelength;
- spectral width.