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INTERNATIONAL STANDARD

Fibre optic interconnecting devices and passive components – Basic test and measurement procedures –
Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components

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FOREWORD

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International Standard IEC 61300-3-7 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition published in 2000. It constitutes a technical revision.

Changes from the previous edition of this standard are to reflect changes made to IEC 61300-1 and covers unidirectional and bi-directional methods of measurement.

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

FDIS	Report on voting
86B/2771/FDIS	86B/2803/RVD

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.

A list of all parts of IEC 61300 series, published under the general title, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*, 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- withdrawn,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.

A bilingual version of this standard may be issued at a later date.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – BASIC TEST AND MEASUREMENT PROCEDURES –

Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss of single mode components

1 Scope

This part of IEC 61300-3 describes the various methods available to measure the wavelength dependence of attenuation $A(\lambda)$ and return loss $RL(\lambda)$, of single-mode passive optical components (POC) used in fibre-optic (FO) telecommunications. It is not, however, applicable to dense wavelength division multiplexing (DWDM) devices. Measurement methods of wavelength dependence of attenuation of DWDM devices are described in IEC 61300-3-29. Definition of WDM device types is given in IEC 62074-1.

Three measurement cases are herein considered:

- Measurement of $A(\lambda)$ only;
- Measurement of $RL(\lambda)$ only;
- Measurement of $A(\lambda)$ and $RL(\lambda)$ at the same time.

These measurements may be performed in one direction (unidirectional) or bi-directionally.

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 (including any amendments) applies.

IEC 61300-3-29, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-29: Examinations and measurements – Measurement techniques for characterising the amplitude of the spectral transfer function of DWDM components*

IEC 62074-1, *Fibre optic WDM devices – Part 1: Generic specification*

3 Abbreviations and acronyms

For the purposes of this document, the following abbreviations and acronyms apply:

A attenuation

$A(\lambda)$ wavelength dependent attenuation

ASE amplified spontaneous emission

BBD broadband detection

BBS broadband source

BD	branching devices
CWDM	coarse wavelength division multiplexing
DFB	distributed feedback (laser)
DOP	degree of polarization
DUT	device under test
DWDM	dense wavelength division multiplexing
DWS	discrete wavelength source
ECL	external cavity (tuneable) laser
EDFL	erbium-doped fibre laser
FA	fibre amplifier
FP	Fabry-Perot (laser)
$G(\lambda)$	test system constant
IL	insertion loss
$IL(\lambda)$	wavelength dependent insertion loss
λ	wavelength
NLS	narrowband light sources
OPM	optical power meter
OSA	optical spectrum analyser
$P_i(\lambda)$	wavelength dependent power incident on the DUT
$P_r(\lambda)$	wavelength dependent power reflected by the DUT (from the input port of the DUT)
$P_t(\lambda)$	wavelength dependent power transmitted through the DUT
$P_G^{RL}(\lambda)$	wavelength dependent reflected power measured for the determination of the test set-up constant
$P_{Gi}^{RL}(\lambda)$	wavelength dependent incident power measured for the determination of the test set-up constant
$P_i^A(\lambda)$	wavelength dependent power incident on the DUT in case of the wavelength dependent attenuation measurement

$P_{i}^{RL}(\lambda)$	wavelength dependent power incident on the DUT in case of the wavelength dependent return loss measurement
PDL	polarization dependent loss
POC	passive optical components
PON	passive optical network
RBD	reference branching device
RBW	resolution bandwidth
RL	return loss
$RL(\lambda)$	wavelength dependent return loss
RTM	reference test method
SMSR	side mode suppression ratio
SOA	semiconductor amplifier
SOP	state of polarization
T	termination
TJ	temporary joint
TND	tuneable narrowband detection (system)
TLS	tuneable narrowband light source
TN-OTDR	tuneable OTDR
WDM	wavelength division multiplexing

4 General

4.1 General description

$A(\lambda)$ and $RL(\lambda)$ are expressed in decibels (dB), transmitted by or reflected from a device under test (DUT) resulting from its insertion within a fibre-optic (FO) telecommunication system. $A(\lambda)$ and $RL(\lambda)$ are obtained by comparing the optical power incident on the DUT with the optical power

- transmitted at the output port of the DUT;
- reflected from the input port of the DUT.

The DUT is inverted in order to get a bi-directional measurement. Measurements should be taken in both directions and averaged expect where the device is intentionally not bidirectional no averaging shall be done.

The term "return loss" should not be used as equivalent to reflectance. Both have completely different meanings.

4.2 Spectral conditions

$A(\lambda)$ and $RL(\lambda)$ measurements are made over a wavelength range defined in the DUT specifications. The DUT spectral characteristics also defined in the DUT specifications should be used in turn to define the spectral characteristics of the measurement system, such as its wavelength resolution (spectral difference between two adjacent data points) and uncertainty (spectral uncertainty around each data point) which in turn will define the bandwidth of the measurement system.

4.3 Definition

4.3.1 Attenuation

$A(\lambda)$ refers to the power decrease of light transmitted by the DUT as a function of wavelength. It is expressed as follows:

$$A(\lambda) = -10 \times \log\left[\frac{P_t(\lambda)}{P_i(\lambda)}\right] \text{ [dB]} \tag{1}$$

where

$P_t(\lambda)$ is the optical power, as a function of wavelength, transmitted through the input port of the DUT and measured at the output port of the DUT, expressed in watt;

$P_i(\lambda)$ is the optical power, as a function of wavelength, incident on and measured at the input port of the DUT, expressed in watt;

for bi-directional measurement,

$P_t(\lambda)$ is the optical power, as a function of wavelength, transmitted through the output port of the DUT and measured at the input port of the DUT, expressed in watt;

$P_i(\lambda)$ is the optical power, as a function of wavelength, incident on and measured at the output port of the DUT, expressed in watt.

Figure 1 illustrates the process.

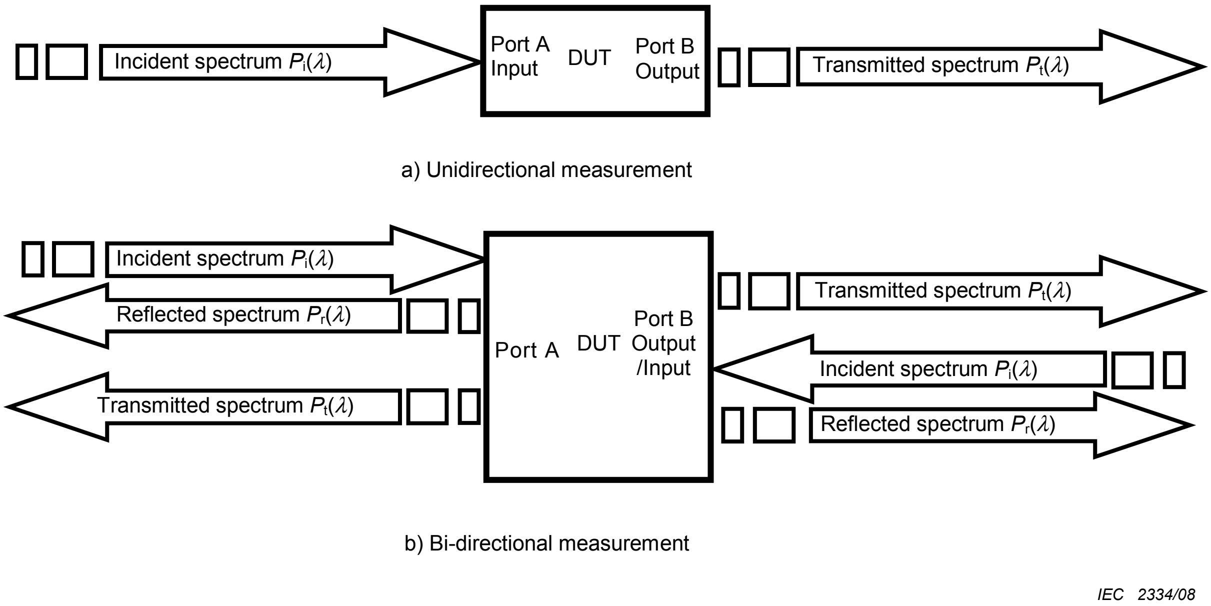

Figure 1 – Wavelength dependence of attenuation and return loss

4.3.2 Return loss

$RL(\lambda)$ refers to the power decrease of light reflected by the DUT as a function of wavelength. It is expressed as follows:

$$RL(\lambda) = -10 \times \log\left[\frac{P_r(\lambda)}{P_i(\lambda)}\right] \text{ [dB]} \qquad (2)$$

where

$P_r(\lambda)$ is the optical power, as a function of wavelength, reflected by and measured from the input port of the DUT, expressed in watt;

$P_i(\lambda)$ is the optical power, as a function of wavelength, incident on and measured at the input port of the DUT, expressed in watt;

for bi-directional measurement,

$P_r(\lambda)$ is the optical power, as a function of wavelength, reflected by and measured from the output port of the DUT, in units of W;

$P_i(\lambda)$ is the optical power, as a function of wavelength, incident on and measured at the output port of the DUT, in units of W.

Figure 1 illustrates the process.

4.4 Device under test

The DUT may have more than two ports. However, since measurement of $A(\lambda)$ is made across only two ports, be they unidirectional or bi-directional, the DUT in this standard shall be