IEC 60869-1

Edition 4.0 2012-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Fibre optic interconnecting devices and passive components – Fibre optic passive power control devices –
Part 1: Generic specification

Dispositifs d'interconnexion et composants passifs à fibres optiques – Dispositifs à fibres optiques passifs de contrôle de la puissance –
Partie 1: Spécification générique

IEC 60869-1:2012

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INTERNATIONAL
ELECTROTECHNICAL
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COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX V

ICS 33.180.20

ISBN 978-2-83220-544-0

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FIBRE OPTIC INTERCONECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC PASSIVE POWER CONTROL DEVICES –

Part 1: Generic specification

FOREWORD

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International Standard IEC 60869-1 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC TC 86: Fibre optics.

This fourth edition cancels and replaces the third edition, published in 1999, and constitutes a technical revision.

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

– the terms and definitions were reconsidered;
– the requirement concerning the IEC Quality Assessment System was reconsidered;
– the clause concerning quality assessment procedures was deleted.

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

FDIS	Report on voting
86B/3505/FDIS	86B/3551/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 the parts in the IEC 60869 series, under the general title *Fibre optic interconnecting devices and passive components – Fibre optic passive power control devices*, can be found on the IEC website.

Future standards will carry the new general title as cited above.

The committee has decided that the contents of this publication will remain unchanged until the stability 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

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FIBRE OPTIC INTERCONECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC PASSIVE POWER CONTROL DEVICES –

Part 1: Generic specification

1 Scope

This part of IEC 60869 applies to fibre optic power control devices. These have all of the following general features:

– they are passive in that they contain no opto-electronic or other transducing elements;
– they have two ports for the transmission of optical power and control the transmitted power in a fixed or variable fashion;
– the ports are unconnectorized optical fibre tails or optical fibre pigtails with connectors.

This standard establishes generic requirements for the following passive optical devices:

– optical attenuator;
– optical fuse;
– optical power limiter.

Test and measurement procedures for the above products are described in IEC 61300-1, the IEC 61300-2 series and the 61300-3 series [1,2,3] [1].

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60027, *Letter symbols to be used in electrical technology*

IEC 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 60617, *Graphical symbols for diagrams*. Available from <http://std.iec.ch/iec60617>

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60825 (all parts), *Safety of laser products*

ISO 129*, Technical drawings – Indication of dimensions and tolerances*

ISO 286-1, *Geometrical product specifications (GPS) – ISO coding system for tolerances of linear sizes – Part 1: Bases of tolerances and fits*

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1 References in square brackets refer to the Bibliography.

ISO 1101, *Geometrical product specifications (GPS) – Geometrical tolerancing – Tolerances of form, orientation, location and run-out*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the definitions given in IEC 60050-731 as well as the following apply.

NOTE Definitions are given in three sub-groups; basic terms, component terms and performance terms.

3.1 Basic terms

3.1.1
insertion loss
reduction in optical power between an input and output port of a passive device, intended to be transparent, expressed in decibel

Note 1 to entry: This is defined as follows:

$IL = -10 \log_{10} (P_1/P_0) = 10 \log_{10} (P_0/P_1)$

where P_0 is the optical power launched into the input port, and P_1 the optical power received from the output port.

3.1.2
operating wavelength
nominal wavelength λ at which a passive device is designed to operate with the specified performance

3.1.3
operating wavelength range – passband
specified range of wavelengths from $\lambda_{i\ min}$ to $\lambda_{i\ max}$ about a nominal operating wavelength λ_i, within which an optical passive device is designed to operate with the specified performance

3.1.4
return loss
fraction of optical input power that is returned from the port of a passive device

Note 1 to entry: This is defined as follows:

$RL = -10 \log_{10} (P_1/P_0) = 10 \log_{10} (P_0/ P_1)$

where P_0 is the optical power launched into the port, and P_1 the optical power received back from the same port.

3.2 Component terms

3.2.1
optical attenuator
passive device, which produces a controlled signal attenuation in an optical fibre transmission line. An attenuator is intended to be wavelength independent

3.2.2
variable optical attenuator
VOA
optically passive device, an attenuator that regulates the optical power in fibres, producing a controlled, optical output power, as a result of manual or electrical control input

3.2.3
optical fuse
passive device, which produces a controlled, permanent, signal blocking at a predetermined power threshold in an optical fibre transmission line

3.2.4
optical power limiter
passive device that regulates the optical power in fibres, producing a controlled, constant optical output power P_{limit}, as a result of varying optical input power higher than P_{limit}, and has no influence at optical powers below P_{limit}

3.2.5
plug style device
device having a combination of two interfacing features, a plug on one end and a socket on the other

3.2.6
adaptor style device
device having a combination of two sockets as interfacing features

3.3 Performance terms

3.3.1
optical fuse power threshold
optical input power, into an optical fuse, in which the optical output power is blocked

Note 1 to entry: The optical fuse power threshold P_{th} is expressed in Watt or dBm.

3.3.2
optical fuse response time
total time when the optical fuse output power level is higher than the optical fuse power threshold by 1 dB, staring when the rising power passes the power fuse power threshold plus 1 dB and ending when the declining power passes the fuse power threshold plus 1 dB on its way down

3.3.3
optical fuse blocking attenuation at threshold
drop of optical power through the optical fuse when exposed to more than the optical fuse power threshold P_{th}, and responds by blocking the power, expressed in dB

3.3.4
optical power limiter response time
total time where the optical power limiter output power level is higher than limit power + 1 dB, staring when the rising power passes the limit power plus 1 dB and ending when the declining power passes the limit power plus 1 dB on its way down

3.3.5
optical limit power
optical input power, into an optical power limiter, in which the optical output power is latched and cannot exceed this value. The optical limit power P_{limit} is expressed in Watt or dBm

3.3.6
minimum insertion loss
term applicable only to variable optical attenuators, (VOAs); it is the lowest insertion loss to which the device may be adjusted

3.3.7
variable attenuation range
range of insertion loss to which the device may be adjusted

Note 1 to entry: This term is applicable only to VOAs.

3.3.8
insertion loss setting resolution
minimal adjustable step size or difference of the insertion loss of the device

Note 1 to entry: This term is applicable only to VOAs.

3.3.9
accuracy of setting value of attenuation
difference between the insertion loss of the device at a given setting and the manually or electrically nominal adjusted value of the insertion loss

Note 1 to entry: This term is applicable only to VOAs.

3.3.10
repeatability of setting attenuation value
difference between the insertion loss of the device at a given setting and the value of the insertion loss in previous same settings

Note 1 to entry: This term is applicable only to VOAs.

3.3.11
maximum allowed power input
maximum input power that the device can handle without causing dysfunction or permanent damage, expressed in Watt or dBm

Note 1 to entry: This term is applicable to all passive power control devices.

4 Description of devices

4.1 Optical attenuator

The optical attenuator is a passive device used for optical power reduction into or out of an optical device. The optical attenuator is normally used for a broad range of wavelengths, attenuating the power at a predetermined level.

The performance curve of an optical attenuator is shown in Figure 1, where the attenuated power is always lower than the non-attenuated power and proportional to it.

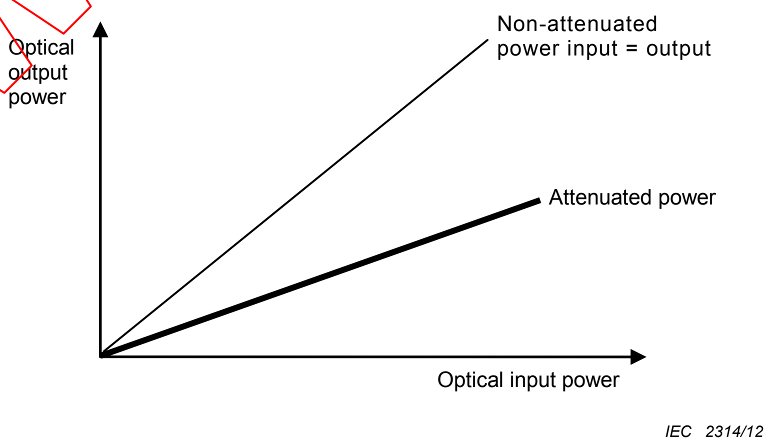

Figure 1 – Optical attenuator operation curve

4.2 Variable optical attenuator (VOA)

The performance curve of a VOA is similar to Figure 1 of an attenuator, where the attenuated power is always lower than the non-attenuated power and proportional to it. The VOA produces a controlled, optical output power, as a result of manual or electrical control input**.** The VOA is a passive device used for optical power reduction into or out of an optical device. The optical attenuator is normally used for a broad range of wavelengths, attenuating the power at a pre-adjusted level.

4.3 Optical fuse

The optical fuse (see Figure 2) is a passive device, designed to protect equipment and fibre cables from damage due to optical overpower, spikes and surges. When the input power is lower than a predetermined threshold power, the optical fuse remains transparent. However, the optical fuse becomes permanently opaque when the optical power exceeds the specified predetermined threshold level. The optical fuse is wavelength independent in the region of its transparency. The optical fuse is bi-directional.

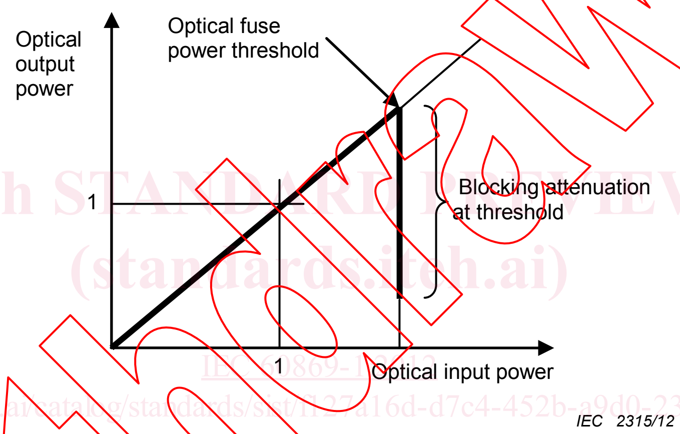

Figure 2 – Optical fuse operation curve

The optical fuse protects against power spikes and surges. The optical fuse is placed either at the input port of an optical device, such as a detector, or at the output port of a high power device, such as a laser or optical amplifier. An activated (burnt) fuse permanently blocks the forward optical power without enlarging the reflected power, thus preventing damage. The optical fuse can be used as an eye safety device.

4.4 Optical power limiter

The optical power limiter (see Figure 3) is a passive device that regulates the optical power in fibres, producing a controlled, constant output power P_{limit}, as a result of varying input power higher than P_{limit}, and has no influence at powers below P_{limit}. Under normal operation, when the input power is low, the optical power limiter has no effect on the system. However, when the input power is high, the optical output power is limited to a predetermined level (P_{limit}). The optical power limiter can typically operate under CW input up to 5 dB above P_{limit}, and can sustain short duration pulses and spikes (a second in every minute) up to 8 dB above P_{limit}.

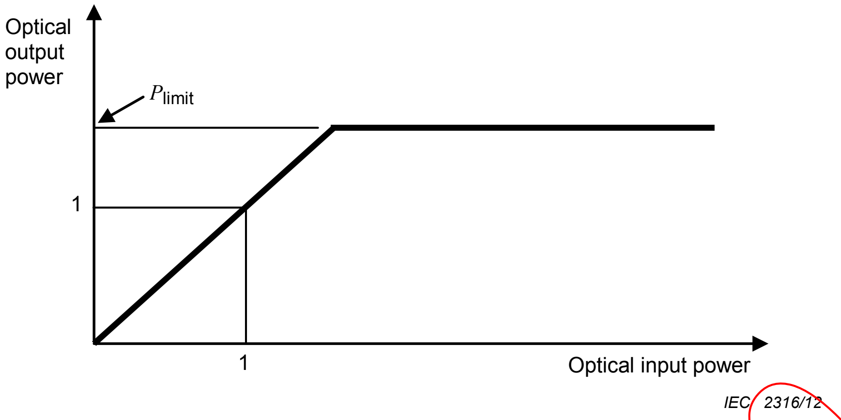

Figure 3 – Optical power limiter operation curve

The optical power limiter is used at the input of power-sensitive equipment and at the output of high power devices, such as amplifiers, or wherever power regulation is required. The optical power limiter can serve as an eye safety device. The optical power limiter is wavelength independent in the region of its transparency. The optical power limiter is bi-directional. The optical power limiter is, in some cases, combined in line with an optical fuse, ensuring that at high powers, when the optical power limiter fails, the following device is not exposed to damaging power.

5 Requirements

5.1 Classification

5.1.1 General

Power control devices are classified by the following categories:

- type;
- wavelength band;
- style;
- variant;
- environmental category;
- assessment level;
- normative reference extensions.

An example of a typical power control device classification is as follows:

Type:	– continuously variable
Wavelength band:	– L band
Style:	– Configuration C
	– LC-LC connectors
Variant:	– Means of mounting
Assessment level:	– A

5.1.2 Type

Power control devices types are defined by their intended function.

There are three types of optical attenuators:

– fixed;
– continuously variable;
– discrete step variable.

There is one type of optical fuse, having discrete predetermined threshold power.

There is one type of optical power limiter, having discrete predetermined limit power.

There are various combinations of the above-mentioned devices, e.g. a fixed optical attenuator and an optical power limiter in one device, or an optical power limiter and an optical fuse in one device.

5.1.3 Wavelength band

Power control devices types are defined by their wavelength band, O, C or L, and sometimes two or more bands.

5.1.4 Style

Power control devices may be classified into styles based upon fibre type, connector type, and cable type, housing shape and dimensions and configuration.

The configuration of the power control device ports is classified as follows:

– Configuration A – A device as shown in Figure 4 containing integral optical pigtails without connectors.

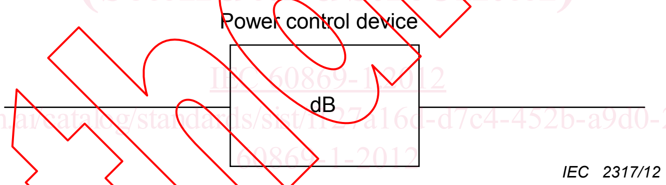

Figure 4 – Configuration A

– Configuration B – A device as shown in Figure 5 containing integral optical pigtails, with a connector on each pigtail.

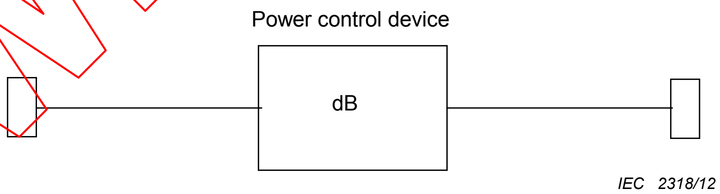

Figure 5 – Configuration B

– Configuration C – A device as shown in Figure 6 containing fibre optic connectors as an integral part of the device housing.

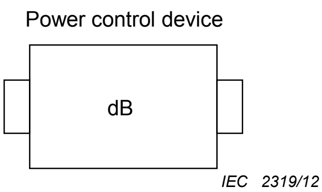

Figure 6 – Configuration C

– Configuration D – A device containing some combination of the interfacing features of the preceding configurations.

5.1.5 Variant

The power control device variant identifies those features which encompass structurally similar components.

Examples of features which define a variant include, but are not limited to, the following:

– orientation of ports on housing;
– means for mounting.

5.1.6 Assessment level

The detail specification shall include all required tests for quality assessment.

Each test shall be assigned to one of four groups labelled A, B, C and D.

The detail specification shall specify one or more assessment levels, each of which shall be designated by a capital letter. The assessment level defines the relationship between the inspection levels/AQLs of groups A and B and the inspection periods of groups C and D.

The following are preferred levels:

– Assessment level A
  - group A inspection: inspection level II, AQL = 4 %
  - group B inspection: inspection level II, AQL = 4 %
  - group C inspection: 24-month periods
  - group D inspection: 48-month periods
– Assessment level B
  - group A inspection: inspection level II, AQL = 1 %
  - group B inspection: inspection level II, AQL = 1 %
  - group C inspection: 18-month periods
  - group D inspection: 36-month periods
– Assessment level C
  - group A inspection: inspection level II, AQL = 0,4 %
  - group B inspection: inspection level II, AQL = 0,4 %
  - group C inspection: 12-month periods
  - group D inspection: 24-month periods

Groups A and B are subject to lot-by-lot inspection and groups C and D are subject to periodic inspection. One additional assessment level (other than those specified above) may be added in the detail specification. In this case, it shall be designated by the capital letter X.

NOTE AQL = Acceptable Quality Level.

5.1.7 Normative reference extensions

Normative reference extensions are used to identify integrated independent standard specifications or other reference documents into blank detail specifications.

Unless specified exceptions are noted, additional requirements imposed by an extension are mandatory. Usage is primarily intended to merge associated components to form hybrid