IEC 60869-1

Edition 5.0 2018-11

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 fibroniques – Dispositifs fibroniques passifs de contrôle de la puissance – Partie 1: Spécification générique

IEC 60869-1:2018-11(en-fr)

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FIBRE OPTIC INTERCONNECTING 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 fifth edition cancels and replaces the fourth edition published in 2012 and constitutes a technical revision.

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

a) the terms and definitions have been reviewed;
b) the requirement concerning the IEC Quality Assessment System has been reviewed;
c) the clause concerning quality assessment procedures has been deleted;
d) Annex G, relating to technical information on variable optical attenuators, has been added.

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

FDIS	Report on voting
86B/4139/FDIS	86B/4144/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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- withdrawn,
- replaced by a revised edition, or
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FIBRE OPTIC INTERCONNECTING 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 passive power control devices. These have all of the following general features:

– they are passive in that they contain no optoelectronic or other transducing elements;

– they have two ports for the transmission of optical power and control of the transmitted power in a fixed or variable fashion;

– the ports are non-connectorized optical fibre pigtails, connectorized optical fibres or receptacles.

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

– optical attenuator;

– optical fuse;

– optical power limiter.

This document also provides generic information including terminology for the IEC 61753-05x series. Published IEC 61753-05x series documents are listed in Bibliography.

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050-731, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication* (available at www.electropedia.org)

IEC 60617, *Graphical symbols for diagrams* (available at 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*

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

ISO 129-1, *Technical product documentation (TPD) – Presentation of dimensions and tolerances*

ISO 286-1, *Geometrical product specifications (GPS) – ISO code system for tolerances on linear sizes – Part 1: Basis of tolerances, deviations and fits*

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 terms and definitions given in IEC 60050-731, IEC TS 62627-09 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1 Component terms

3.1.1
fibre optic passive power control device
passive optical device (component) which controls a transmittance with a designed wavelength-independent transfer coefficient

Note 1 to entry: The transfer coefficient may be controlled for all intensity of input power or for input power over a threshold power.

3.1.2
optical attenuator
passive optical device (component), which produces a wavelength-independent controlled signal attenuation in an optical fibre transmission line

Note 1 to entry: An attenuator is intended to be wavelength independent.

3.1.3
fixed optical attenuator
optical attenuator in which attenuation is constant

3.1.4
variable optical attenuator
VOA
optical attenuator in which attenuation is controllable

Note 1 to entry: Attenuation values of variable optical attenuators are generally controlled by manual or electric means.

Note 2 to entry: This note applies to the French language only.

3.1.5
optical fuse
fibre optic passive power control device, which produces controlled, permanent, signal blocking for higher optical power than a predetermined power threshold in an optical fibre transmission line

3.1.6
optical power limiter
fibre optic passive power control device that regulates the optical power in fibres, producing a controlled, constant optical output power of optical limit power, as a result of varying optical input power higher than the input optical limit power

3.1.7
plug-receptacle style device
fibre optic device having a combination of two interfacing features, a plug at one end and a receptacle at the other

3.2 Performance terms

3.2.1
optical fuse power threshold
P_{th}
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.

3.2.2
optical fuse response time
time between the start of the input power and the end time when the output optical power has decreased to be less than the predetermined optical power

Note 1 to entry: The predetermined power shall be either of the power threshold, P_{th} minus insertion loss, IL, ($P_{th} - IL$) in dB, or the input power, P_{in} minus the required blocking attenuation at threshold, A_{block}.

Note 2 to entry: The optical fuse response time depends on the optical input power level and the input pulse time.

Note 3 to entry: An example of the input power, P_{in}, is recommended to be 3 dB over of the power threshold, P_{th}, and the rectangle shape pulse of 1 ms ($P_{in} = P_{th}$ + 3 dB). An example of the required blocking attenuation at threshold, A_{block} of 30 dB is recommended.

3.2.3
optical fuse blocking attenuation at threshold
A_{block}
drop in optical power through the optical fuse when exposed to more than the optical fuse power threshold P_{th}, with response by blocking the power, expressed in dB

3.2.4
optical power limiter response time
length of time between the start of the input power and the end time in decreasing the output power to be less than or equal to the predetermined power

Note 1 to entry: The optical power limiter response time depends on the optical input power level and the input pulse time.

Note 2 to entry: An example of the input power, P_{in} is recommended to be 3 dB over of the optical limit power and the rectangular pulse of 1 ms ($P_{in} = P_{limit}$ + 3 dB). An example of the pre-determined optical power of P_{limit} + 1 dB is recommended.

3.2.5
input optical limit power
$P_{in\text{-}limit}$
optical input power, into an optical power limiter, at which the optical output power is latched and cannot exceed that value, $P_{in\text{-}limit}$, which is expressed in watt or dBm

3.2.6
output optical limit power
$P_{out\text{-}limit}$
optical output power from an optical power limiter, at which the optical output power is latched and cannot exceed that value, $P_{out\text{-}limit}$, which is expressed in watt or dBm

3.2.7
minimum insertion loss
lowest insertion loss to which a VOA is adjusted

3.2.8
variable attenuation range
range of attenuation to which the device may be adjusted

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

3.2.9
nominal attenuation
supplier specified attenuation value for fixed attenuators and user-set attenuation value for variable attenuators

3.2.10
maximum attenuation
<for variable optical attenuator> attenuation of the maximum value which is set

3.2.11
minimum attenuation
<for variable optical attenuator> attenuation of the minimum value which is set

3.2.12
attenuation setting resolution
minimal adjustable step size or difference of the attenuation of a VOA

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

3.2.13
error of setting value of attenuation
difference between the insertion loss of the device at a given setting and nominal attenuation

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

3.2.14
repeatability of setting attenuation value
maximum deviation of the insertion loss of the device at a given setting in multiple times of repeated settings

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

3.2.15
maximum allowed power input
maximum input power that the device can handle without causing malfunction or permanent damage, expressed in watt or dBm

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

Note 2 to entry: This term is equal to optical fuse power threshold to optical fuse.

Note 3 to entry: The maximum input power defined in IEC TS 62627-09 has a different meaning of the maximum input optical power for which a passive optical device keeps the required optical performances.

4 Description of devices

4.1 Optical attenuator

The optical attenuator is a passive optical 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 by a predetermined attenuation rate.

There are two types of optical attenuator: a fixed optical attenuator and a variable optical attenuator.

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

Annex E describes the fixed optical attenuator application note as a users' guide.

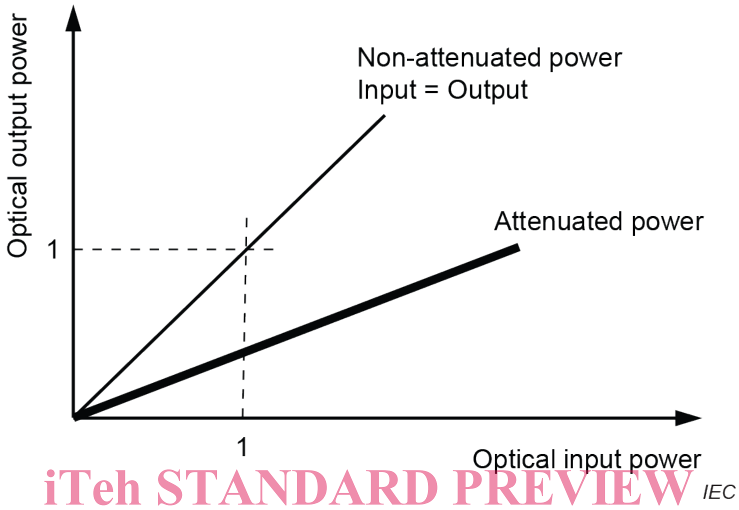


Figure 1 – Fixed optical attenuator operation curve

The performance curve of a variable optical attenuator (VOA) is shown in Figure 2. In a manner similar to that of the fixed optical attenuator, 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.

Annex F describes the variable optical attenuator application note as a users' guide.

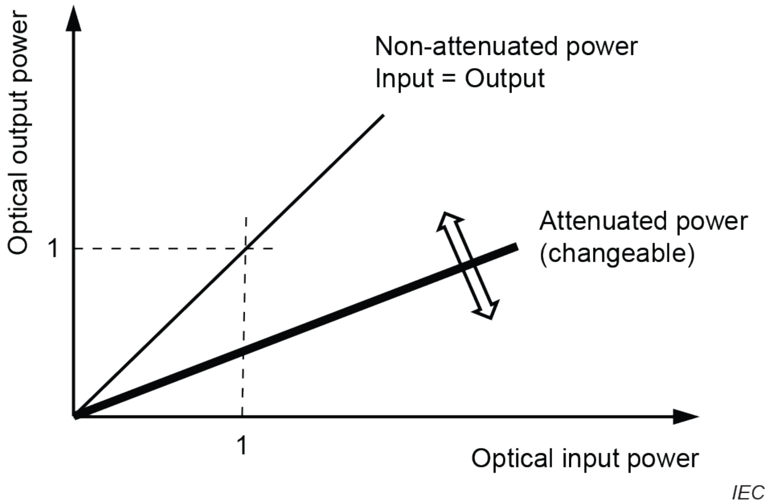
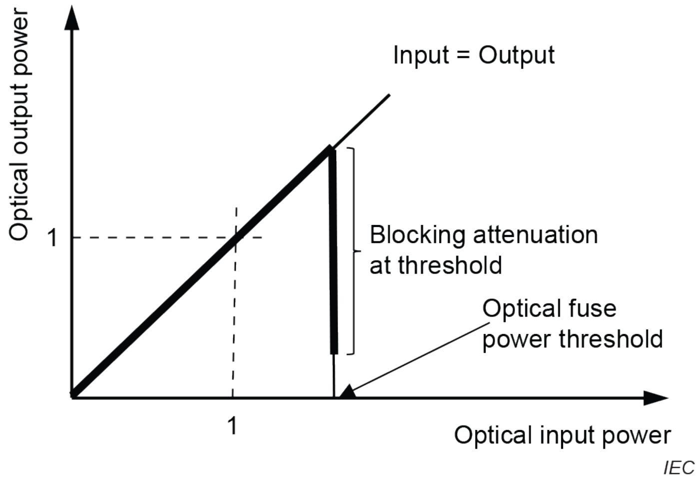


Figure 2 – VOA operation curve

4.2 Optical fuse

The optical fuse (see Figure 3) 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, ideally. 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 bidirectional.



NOTE Figure 3 schematically explains how the optical fuse operates, with the representation of the ideal optical fuse, which has no insertion loss (*IL*).

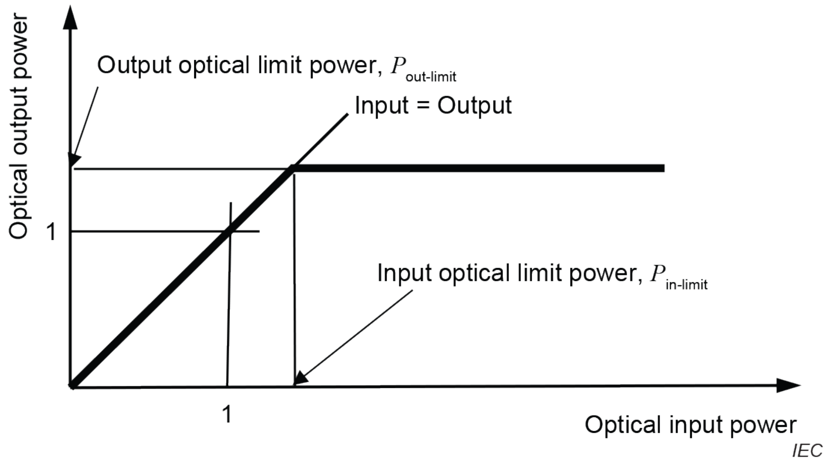
Figure 3 – Optical fuse operation curve

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 in the case of a detector, or at the output port of a high power device, such as in the case of a laser or optical amplifier. An activated (burnt) fuse permanently blocks the forward optical power without increasing the reflected power, thus preventing damage. The optical fuse can be used as an eye safety device.

Annexes A and B describe optical fuse configuration and performance examples, and optical fuse application notes.

4.3 Optical power limiter

The optical power limiter (see Figure 4) is a passive device that regulates the optical power in fibres, producing a controlled, constant output power $P_{\text{out-limit}}$, as a result of varying input power higher than $P_{\text{in-limit}}$, and has no influence at powers below $P_{\text{in-limit}}$. 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 ($P_{\text{out-limit}}$). The optical power limiter can typically operate under continuous wave (CW) input up to 5 dB above $P_{\text{in-limit}}$, and can sustain short duration pulses and spikes (1 s/min) up to 8 dB above $P_{\text{in-limit}}$.



NOTE Figure 4 schematically explains how the optical power limiter operates, with the representation of the ideal optical power limiter, which has no insertion loss (*IL*).

Figure 4 – 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 bidirectional. 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.

Annexes C and D describe optical power limiter configuration and performance examples, and optical power limiter application notes.

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 device 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, for example a fixed optical attenuator and an optical power limiter in one device, or an optical power limiter and an optical fuse in one device.

There are several technology types for VOAs, such as manual, micro-electromechanical system (MEMS), magnet optics effect, planar lightwave circuit and thermal optic effect, $LiNbO_3$ crystal based electro-optic effect. Annex G shows the example of technical information on variable optical attenuators.

5.1.3 Wavelength band

Power control device types are defined by their wavelength band, O, C or L, and sometimes by a combination of these bands (such as C and L).

5.1.4 Style

Power control devices may be classified into styles based upon fibre type, connector type, 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 5 containing integral optical pigtails without connectors.

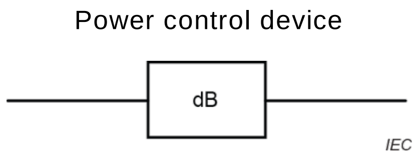


Figure 5 – Configuration A

– Configuration B – A device as shown in Figure 6 containing integral optical pigtails, with a connector on each pigtail.

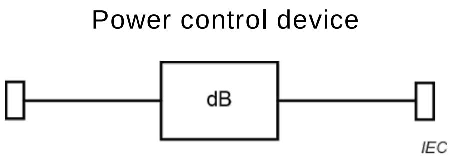


Figure 6 – Configuration B