IEC 61202-1

Edition 3.0 2009-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Dispositfs d'interconnexion et composants passifs à fibres optiques – Isolateurs à fibres optiques –
Partie 1: Spécification générique

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC ISOLATORS –

Part 1: Generic specification

FOREWORD

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International Standard IEC 61202-1 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This third edition cancels and replaces the first edition published in 2000. It constitutes a technical revision. The specific technical changes with regard to the previous edition are as follows.

1) The definitions have been reconsidered.
2) Environmental category has been deleted from classification.
3) The clause relating to quality assessment procedures has been deleted.
4) Annexes A and B have been added.

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

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

FDIS	Report on voting
86B/2845/FDIS	86B/2883/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.

A list of all parts of the IEC 61202 series, under the general title: *Fibre optic interconnecting devices and passive components – Fibre optic isolators*, can be found on the IEC website.

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

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- withdrawn,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.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC ISOLATORS –

Part 1: Generic specification

1 Scope

This part of IEC 61202 applies to isolators used in the field of fibre optics, all exhibiting the following features:

– they are non-reciprocal optical devices, in which each port is either an optical fibre or fibre optic connector;

– they are passive devices containing no opto-electronic or other transducing elements;

– they have two optical ports for directionally transmitting optical power.

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

IEC 60050(731):1991, *International Electrotechnical Vocabulary – Chapter 731: Optical fibre communication*

IEC 60617 (all parts), *Graphical symbols for diagrams*

IEC 60695-11-5:2004, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60825-1:2007, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60869-1, *Fibre optic attenuators – Part 1: Generic specification*

IEC 60874 (all parts), *Connectors for optical fibres and cables*

IEC 61073-1, *Fibre optic interconnecting devices and passive components – Mechanical splices and fusion splice protectors for optical fibres and cables – Part 1: Generic specification*

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

IEC 61754-2, *Fibre optic connector interfaces – Part 2: Type BFOC/2,5 connector family*

IEC 61754-4, *Fibre optic connector interfaces – Part 4: Type SC connector family*

IEC 61754-13, *Fibre optic connector interfaces – Part 13: Type FC-PC connector*

IEC QC 01, *IEC Quality Assessment System for Electronic Components (IECQ System)* – Basic Rules

IEC QC 001002-3, *IEC Quality Assessment System for Electronic Components (IECQ) – Rules of Procedure – Part 3: Approval procedures*

IEC Guide 102, *Electronic components – Specification structures for quality assessment (Qualification approval and capability approval)*

ISO 129-1:2004, *Technical drawings – Indication of dimensions and tolerances – Part 1: General principles*

ISO 286-1:1988, *ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits*

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

ISO 8601:2004, *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) apply, together with the following.

3.1 Basic term definitions

3.1.1
port
optical fibre or fibre optic connector attached to a passive component for the entry and/or exit of the optical power

3.1.2
input port, output port
port designated for the ingress or regress respectively of an optical power

NOTE As a non-reciprocal device, the isolator is a directional one. The input and output port should be clearly marked.

3.1.3
forward direction of an optical isolator
operational direction in which the power of the optical source launches into the input port of an isolator

NOTE In this direction, the isolator has minimum insertion loss.

3.1.4
backward direction of an optical isolator
operational direction in which the power of the optical source launches into the output port of an isolator

NOTE The backward direction is opposite to the forward direction.

3.2 Component definitions

3.2.1
fibre optic isolator
non-reciprocal optical device intended to suppress backward reflections along an optical fibre transmission line while having minimum insertion loss in the forward direction

NOTE Fibre optic isolators are commonly used to avoid reflections back into laser diodes and optical amplifiers, which can make the laser and amplifiers oscillate unstably, and cause noise in the fibre optic transmission system.

3.2.2
bulk isolator based on magneto-optic effect
type of isolator with discrete components including a suitable magneto-optic crystal (ferro-magnetic crystal or paramagnetic glass, diamagnetic glass, etc.), of which the fundamental principle is based on magneto-optic effect

EXAMPLE It consists of the following discrete components: a polarizer, a 45° Faraday rotator and an analyser. The azimuthal angle between the polarizer and the analyser is set at 45°. It also has its own magnetic circuit, coupling devices, etc. The incident light, with linear polarization, will produce a 45° rotation with respect to its polarization plane in the rotator element and pass through the isolator with lower insertion loss while the backward light is blocked regardless of its polarization state.

3.2.3
in-line isolator
type of isolator with optical fibre for the entry input and output of the light

3.2.4
optical waveguide isolator
type of isolator with planer epitaxial magneto-optic crystal layers on a suitable substrate

NOTE The configuration of this type of isolator is compatible with the waveguide structures of the laser diode and other optical waveguide devices and transmission lines.

3.2.5
polarization-dependent optical isolator
type of isolator not designed to have performance independent of the state of the polarization of the incident light

3.2.6
polarization-independent optical isolator
type of isolator in which the optical performance characteristics are independent of the polarization state of the incident light

3.2.7
polarization maintain optical isolator
type of isolator with the polarization-maintaining optical fibre for input and output, designed to have maintain polarization of the light which is adjusted to the optical axis of the polarization-maintaining optical fibre

3.2.8
single-stage/ dual(double)-stage isolator
- single-stage isolator: type of isolator composed of a basic isolator unit such as a set of polarizer, faraday rotator and analyser
- dual(double)-stage isolator: type of isolator composed of two basic isolator units connected in tandem for the purpose of obtaining more backward loss

3.2.9
PMD compensated optical isolator
type of isolator designed to compensate the polarization mode dispersion which is intrinsic to the birefringent crystal

3.3 Performance parameter definitions

3.3.1
insertion loss
measure of the decrease in optical power (decibels) resulting from the insertion of an optical isolator in its forward direction

It is defined as follows:

$$a_f = -10 \times \log (P_o/P_i) \quad \text{(dB)}$$

where

P_o is the optical power received from the output port of the isolator;

P_i is the power of any polarized light launched at the input port.

NOTE 1 In the case of polarization-independent isolators, a_f is defined as the maximum value for any state of polarization of P_i.

NOTE 2 In the case of polarization-dependent isolators, a_f is defined as the linearly polarized light which coincides with the polarizing direction of the polarizer in the isolator of P_i.

3.3.2
isolation
measure of the decrease in optical power (decibels) resulting from the insertion of an isolator in its backward direction

The launching port is the output port and the receiving port is the input port of the isolator. The measure of the decrease is given by the following formula:

$$a_b = -10 \times \log (P_{ob}/P_{ib}) \quad \text{(dB)}$$

where

P_{ob} is the optical power measured at the input port of the isolator when P_{ib} is launched into the output port and a_b is defined as the minimum absolute value for any state of polarization of P_{ib};

P_{ib} is the power of any polarized light launched at the output port.

3.3.3
polarization-dependent loss
PDL
for polarization-independent isolators, maximum fluctuation of a_f (insertion loss) for any state of polarization of P_i

3.3.4
polarization mode dispersion
PMD
for polarization-independent isolators, maximum differential delay for all polarization states when they pass through an optical isolator

3.3.5
return loss
fraction of input power that is returned from the input port of passive component and defined as

$$a = -10 \times \log (P_1/P_0) \quad \text{(dB)}$$

where

P_1 is the optical power launched into the port;

P_0 is the optical power received back from the same port.

3.3.6
operating wavelength
nominal wavelength λi, at which a passive component operates with the specified performance

3.3.7
operating wavelength range
bandpass
specified range of wavelengths from λi min. to λi max. close to a nominal operating wavelength λi, within which a passive component is designed to operate with the specified performance

4 Requirements

4.1 Classification

4.1.1 General

Fibre optic isolators shall be classified as follows:

– type;
– style;
– variant;
– environmental category;
– assessment level;
– normative reference extensions.

An example of a typical isolator classification is as follows:

Type:	– Name: Type OIFR bulk isolators based on the Faraday rotation – Operating wavelength: 1 300 nm – State of polarization: polarization-independent
Style:	– Configuration: C – Connector type: FC – Fibre type: IEC type B 1,2
Variant:	– Means of mounting
Assessment level:	– ……
Normative reference extensions:	– ……

4.1.2 Type

Isolators are divided into types.

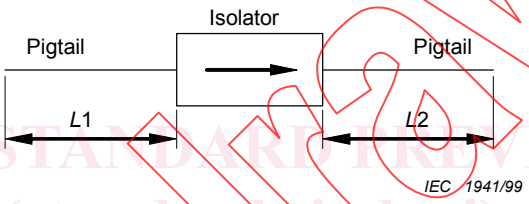
- By their fabrication technology:
  – bulk isolators based on the magneto-optic effect;
  – optical waveguide isolators;
  – other types.
- By their polarization selectivity:
  – polarization-dependent isolators;
  – polarization-independent isolators;
  – polarization maintain optical isolator.

- By their operational principles:
  - magneto-optic Faraday effect;
  - magneto-optic Cotton-Mouton effect and Kerr effect.
- By their operating wavelength:
  - short wavelength isolators (e.g. 630 nm);
  - long wavelength isolators (e.g. 1 300 nm, 1 550 nm);
  - other wavelength isolators.

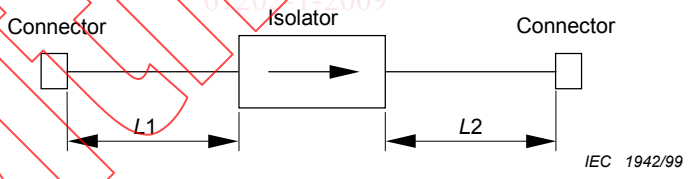
4.1.3 Style

Optical isolators may be classified into styles based upon fibre type(s), connector type(s), cable type(s), housing shape and dimensions, and configuration. The configuration of the isolator ports is classified as follows.

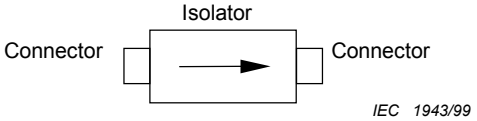
Configuration A – Device containing integral fibre optic pigtails without connector



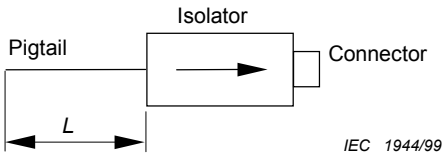
Configuration B – Device containing integral fibre optic pigtails, with a connector on each pigtail



Configuration C – Device containing connectors as an integral part of the device housing



Configuration D – Device containing some combination of the interfacing features of the preceding configurations, for example:



4.1.4 Variant

The isolator variant identifies those common features which encompass structurally similar components. Examples of features which define a variant include, but are not limited to, the following:

– position and orientation of ports on housing;

– means of mounting.

4.1.5 Assessment level

Assessment level defines the inspection levels and the acceptable quality level (AQL) of groups A and B and the periodicity of inspection of groups C and D. Detail specifications shall specify one or more assessment levels, each of which shall be designated by a capital letter.

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

One additional assessment level may be added in the detail specification. When this is done, the capital letter X shall be used.

4.1.6 Normative reference extensions

Normative reference extensions are used to identify independent standards, specifications or other reference documents integrated into blank detail specifications. Unless specified exception is noted, additional requirements imposed by an extension are mandatory. Usage is primarily intended to merge associated components to form hybrid devices, or integrated functional application requirements that are dependent on technical expertise other than fibre optics.

Published reference documents produced by ITU, consistent with the scope statements of the relevant IEC specification series may be used as extensions. Published documents produced by other regional standardization bodies may be referenced in a bibliography, attached to the generic specification.

Some optical fibre isolator configurations require special qualification provisions which shall not be imposed universally. This accommodates individual component design configurations, specialized field tooling or specific application processes. In this case, requirements are necessary to assure repeatable performance or adequate safety and to provide additional

guidance for complete product specification. These extensions are mandatory whenever used to prepare, assemble or install an optical fibre isolator either for field application usage or preparation of qualification test specimens. The relevant specification shall clarify all stipulations. However, design and style-dependent extensions shall not be imposed universally.

In the event of conflicting requirements, precedence, in descending order, shall be as follows: "generic" over "mandatory extension", over "blank detail", over "detail", over "application specific extension".

Examples of optical connector extensions are given as follows:

- using IEC 61754-4 and IEC 61754-2 to partially define a future specification in the IEC 60874 series for a duplex type "SC/BFOC/2,5" hybrid connector adapter;
- using IEC 61754-13 and IEC 60869-1 to partially define a future specification in the IEC 60874 series for an integrated type "FC" preset attenuated optical connector;
- using IEC 61754-2 and IEC 61073-1 to partially define a future specification in the IEC 60874 series for a duplex "BFOC/2,5" receptacle incorporating integral mechanical splices.

Other examples of requirements for normative extensions include the following:

a) some commercial or residential building applications may require direct reference to specific safety codes and regulations or incorporate other specific material flammability or toxicity requirements for specialized locations;

b) specialized field tooling may require an extension to implement specific ocular safety, electrical shock or burn hazard avoidance requirements, or require isolation procedures to prevent potential ignition of combustible gases.

4.2 Documentation

4.2.1 Symbols

Graphical and letter symbols shall, whenever possible, be taken from IEC 60027 series and IEC 60617.

4.2.2 Specification system

4.2.2.1 General

This specification is part of a three-level IEC specification system. Subsidiary specifications shall consist of blank detail specifications and detail specifications. This system is shown in Table 1. There are no sectional specifications for isolators.

Table 1 – Three-level IEC specification structure

Specification level	Examples of information to be included	Applicable to
Basic	– Assessment system rules – Inspection rules – Optical measuring methods – Environmental test methods – Sampling plans – Identification rule – Marking standards – Dimensional standards – Terminology	Two or more component families or sub-families