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Fibre optic interconnecting devices and passive components – Fibre optic circulators – Generic specification

IEC 62077:2022-08 RLV(en)

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC CIRCULATORS – GENERIC SPECIFICATION

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IEC 62077 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

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

a) harmonization of terms and definitions with IEC TS 62627-09;

b) change of Clause 4 regarding requirements.

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

Draft	Report on voting
86B/4624/FDIS	86B/4645/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC CIRCULATORS – GENERIC SPECIFICATION

1 Scope

This document applies to circulators used in the field of fibre optics bearing all of 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 in accordance with the categorization and definition provided in IEC TS 62538;

– they have three or more ports for directionally transmitting optical power.

An example of optical circulator technology and application is described in Annex A and Annex B, respectively.

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 http://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 tests and measurement procedures*

IEC TR 61930, *Fibre optic graphical symbology*

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

ISO 129-1, *Technical ~~drawings~~ product documentation (TPD) – ~~Indication~~ Presentation of dimensions and tolerances – Part 1: General principles*

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

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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*~~

ISO 8601-1, *Date and time – Representations for information interchange – Part 1: Basic rules*

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 Basic terms**~~

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

~~**3.1.2**~~
~~**transfer matrix**~~
~~$n \times n$ matrix of coefficients where n is the number of ports, and the coefficients represent the fractional optical power transferred between designated ports~~

~~Note 1 to entry: In general, the transfer matrix T is:~~

$$T = \begin{bmatrix} t_{11} & t_{12} & \cdots & t_{1n} \\ & t_{22} & & \\ & & t_{ij} & \\ t_{n1} & t_{n2} & & t_{nn} \end{bmatrix} \quad (1)$$

~~where~~

~~t_{ij} is the ratio of the optical power P_{ij} transferred out of port j with respect to input power P_i into port i, that is:~~

$$t_{ij} = \frac{P_{ij}}{P_i} \quad (2)$$

~~**3.1.3**~~
~~**transfer coefficient**~~
~~element t_{ij} of the transfer matrix~~

~~**3.1.4**~~
~~**logarithmic transfer matrix**~~
~~$n \times n$ matrix of logarithmic transfer coefficients of a_{ij} where n is the number of ports~~

~~Note 1 to entry: In general, the logarithmic transfer matrix A is:~~

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~~$$A = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ & a_{22} & & \\ & & a_{ij} & \\ a_{n1} & a_{n2} & & a_{nn} \end{bmatrix} \quad (3)$$~~

~~where a_{ij} is the optical power reduction, in decibels, out of port j with unit power into port i, that is:~~

~~$$a_{ij} = -10\log_{10} t_{ij} \quad (4)$$~~

~~where t_{ij} is the transfer matrix coefficient.~~

~~**3.1.5**~~
~~**conducting port pair**~~
~~two ports i and j between which t_{ij} is nominally greater than zero~~

~~**3.1.6**~~
~~**isolated port pair**~~
~~two ports i and j between which t_{ij} is nominally zero, and a_{ij} is nominally infinite~~

3.1 Component terms

3.1.1
fibre optic circulator
passive component possessing three or more ports which input and output are cyclic

Note 1 to entry: In the case of 3 ports circulator with port 1, port 2 and port 3, supposing optical power is transmitted from port 1 to port 2, optical power from port 2 is transmitted to port 3.

[SOURCE: IEC TS 62627-09:2016, 3.3.5, modified – The words "passive optical device (component)" have been replaced with "passive component".]

3.1.2
completely circulated type
type of circulator where all ports ~~can~~ function as both input and output

Note 1 to entry: In the case of a 3 port circulator with port 1, port 2 and port 3, where optical power is transmitted from port 1 to port 2, optical power from port 2 is also transmitted to port 3 and optical power from port 3 is also transmitted to port 1 (see Figure 1).

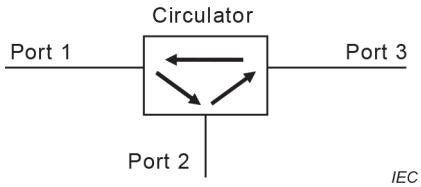

Figure 1 – Completely circulated type configuration

3.1.3
incompletely circulated type
type of circulator where a port is either an input or an output

Note 1 to entry: In the case of 3 ports circulator with port 1, port 2 and port 3, supposing optical power is transmitted from port 1 to port 2, optical power from port 2 is transmitted to port 3 and optical power from port 3 is not transmitted to port 1 (see Figure 2).

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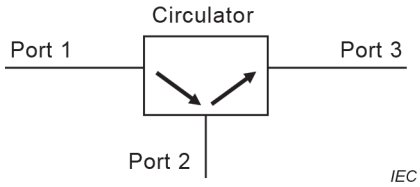


Figure 2 – Incompletely circulated type configuration

3.2 Performance ~~parameters~~ terms

3.2.1
insertion loss

~~element a_{ij} of the logarithmic transfer matrix of an input port i and output port j to which optical power is transmitted~~

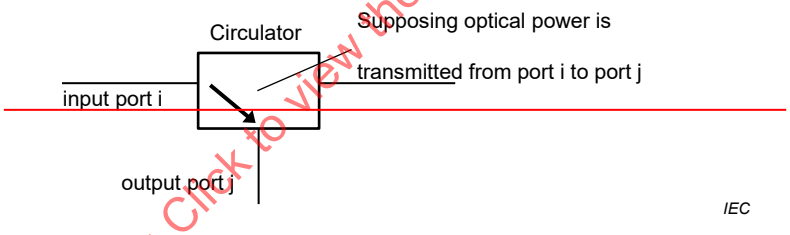
~~Note 1 to entry: The insertion loss is the reduction in optical power between an input and output port of a passive component (see Figure 3), expressed in decibels and defined as follows:~~

$$a_{ij} = 10\log_{10}\left(\frac{P_j}{P_{in}}\right) \quad (5)$$

~~where~~

~~P_{in} is the optical power launched into the input port;~~

~~P_j is the optical power received from the output port~~



~~Figure 3 – Insertion loss~~

attenuation
reduction of optical power in an operating wavelength range, when transmitted from an input port to an output port for a fibre optic circulator

Note 1 to entry: The insertion loss (attenuation) is expressed in decibels and defined as:

$$a_{ij} = -10\log_{10}\left(\frac{P_j}{P_i}\right)$$

where

P_i is the optical power launched into the input port;

P_j is the optical power received from the output port.

Note 2 to entry: Figure 3 shows the insertion loss (attenuation) for fibre optic circulators.

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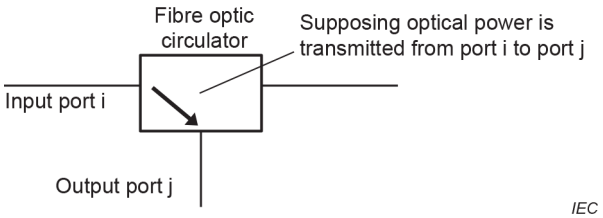


Figure 3 – Insertion loss

Note 3 to entry: The insertion loss (attenuation) is wavelength, polarization, temperature and port pair dependent. Generally, the insertion loss is the maximum value over operating wavelength range, all polarization state and all conducting port pairs.

3.2.2
isolation

~~element a_{ji} of the logarithmic transfer matrix of an output port j and input port i to which optical power is transmitted in the direction opposite to the insertion loss~~

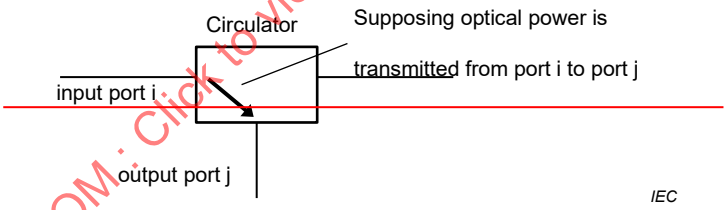
~~Note 1 to entry: The isolation is the reduction in optical power between an input and output port of a passive component, expressed in decibels and defined as follows:~~

$$~~a_{ji} = 10\log_{10}\left(\frac{P_i}{P_j}\right)~~ \quad (6)$$

~~where~~

~~P_i is the optical power received from the input port;~~

~~P_j is the optical power launched into the output port~~



~~Figure 4 – Isolation~~

reduction of optical power in an operating wavelength range, when transmitted from an output port to an input port for a fibre optic circulator

Note 1 to entry: The isolation is expressed in decibels and defined as follows:

$$a_{ji} = -10\log_{10}\left(\frac{P_i}{P_j}\right)$$

where

P_i is the optical power received from the input port;

P_j is the optical power launched into the output port.

Note 2 to entry: Figure 4 shows the isolation for fibre optic circulators.

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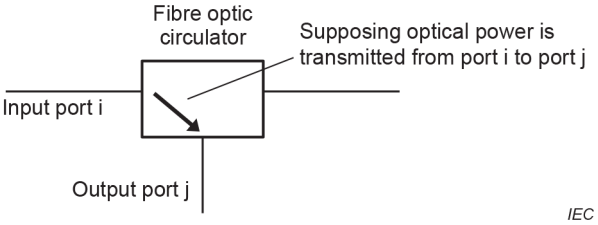

Figure 4 – Isolation

Note 3 to entry: The isolation is wavelength, polarization, temperature and port pair dependent. Generally, the isolation is the minimum value over operating wavelength range, all polarization state and all isolated port pairs.

~~**3.3.3**~~
~~**directivity**~~
~~element a_{ik} of the logarithmic transfer matrix port i and port k, which are not port pair for insertion loss (IL), return loss (RL) or isolation (Iso)~~

~~Note 1 to entry: For example, the transmission matrix for a 4-port incompletely circulated type optical circulator, the symbol *Dir* indicates directivity as in Equation (7).~~

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} = \begin{bmatrix} RL & IL & Dir & Dir \\ Iso & RL & IL & Dir \\ Dir & Iso & RL & IL \\ Dir & Dir & Iso & RL \end{bmatrix} \quad (7)$$

~~where~~

~~*Dir* is the directivity;~~

~~*IL* is the insertion loss;~~

~~*Iso* is the isolation;~~

~~*RL* is the return loss.~~

~~**3.3.4**~~
~~**operating wavelength**~~
~~nominal wavelength, λ_i, at which a passive component is designed to operate with the specified performance~~

~~**3.3.5**~~
~~**operating wavelength range**~~
~~specified range of wavelengths from $\lambda_{i\,min}$ to $\lambda_{i\,max}$ close to a nominal operating wavelength λ_i, within which a passive component is designed to operate with the specified performance~~

~~**3.3.6**~~
~~**return loss**~~
~~element a_{ii} in Equation (8) of the logarithmic transfer matrix~~

~~Note 1 to entry: It is the fraction of the input power that is returned from the input port of a passive component and defined as:~~

$$a_{ii} = 10\log_{10}\left(\frac{P_{refl}}{P_i}\right) \quad (8)$$

~~where~~

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~~P_i is the optical power launched into the i port;~~

~~P_{refl} is the optical power received back from i port~~

4 Requirements

4.1 Classification

4.1.1 General

Fibre optic circulators ~~shall be~~ are classified ~~as follows~~ either totally or in part in the following categories:

~~– type;~~

~~– style;~~

~~– variant;~~

~~– normative reference extensions.~~

– technology;

– port numbers;

– circulated type;

– wavelength band;

– interface style.

An example of a typical fibre optic circulator classification is given in Table 1.

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Table 1 – Example of a typical fibre optic circulator ~~set~~ classification

~~Type:~~	~~– Three port circulator~~ ~~– Completely circulated type~~ ~~– Operating wavelength range: O-band~~
~~Style:~~	~~– Configuration: B~~ ~~– Connector type: SC~~ ~~– Fibre type: IEC Category B 1.2~~
~~Variants:~~	~~– Means of mounting~~

Items	Classifications
Technology	Magneto-optic Faraday effect;
Port numbers	3
Circulated type	Completely circulated type
Wavelength band	C band
Interface style	Configuration B Fibre type: IEC 60793-2-50, B-657.B IEC 61754-4 (SC connector)

4.1.2 ~~Type~~ Technology, port numbers and functions

Circulators are mainly divided into types according to their configuration.

– Operational ~~principles~~ technologies:
  • magneto-optic Faraday effect;
  • magneto-optic ~~Cotton-Mouton effect and~~ Kerr effect.
– Port numbers;
– Circulated type:
  • completely circulated type;
  • incompletely circulated type.

4.1.3 Wavelength bands

– O-band;
– C-band;
– L-band;
– other wavelength circulators.

4.1.4 Interface style

~~Optical circulators 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 circulator ports is classified as follows (See Figure 5):~~

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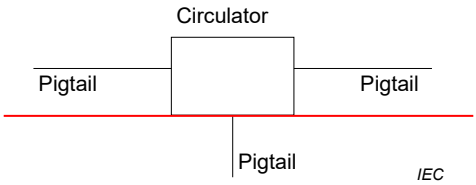
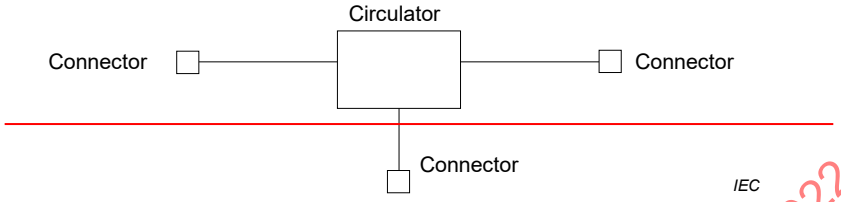
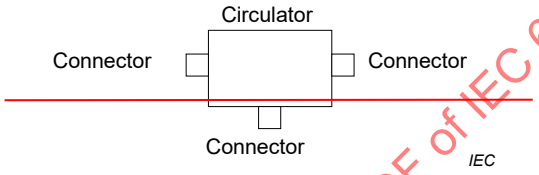


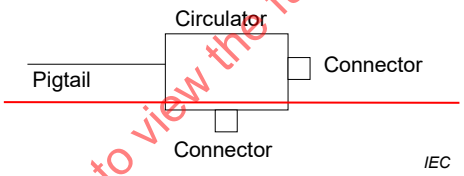
a) Configuration A – Device containing integral fibre optic pigtails without a connector



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



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



d) Configuration D Example – Device containing some combination of the interfacing features of the preceding configurations

Figure 5 – Optical circulator style configurations

The fibre optic circulator style shall be defined on the basis of the following elements:

– input and output port configuration;
– connector set type(s), if any.

NOTE Examples of interface style are provided in Annex C.

4.1.4 Variant

The circulator 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 Normative reference extensions

Normative reference extensions are used to identify integrated independent standards specifications or other reference documents as relevant specifications.

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~~Unless otherwise specified, additional requirements of extensions 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.~~

~~Some optical fibre circulator 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, the requirements are necessary to assure repeatable performance or adequate safety, and provide additional guidance for complete product specification. These extensions are mandatory whenever used to prepare, assemble or install an optical fibre circulator, 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 shall be given, in descending order, as follows: generic over mandatory extension, over relevant, over detail, over application specific extension.~~

~~Examples of requirements to normative extensions:~~

- ~~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;~~
- ~~specialized field tooling may require an extension to implement specific ocular safety, electrical shock, 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 the IEC 60027 series, IEC 60617 and IEC TR 61930.

~~**4.2.2 Specification system**~~

~~**4.2.2.1 General**~~

~~This generic specification is part of a three-level IEC specification system. Subsidiary specifications shall consist of relevant specifications. This system is shown in Table 2. There are no sectional specifications for circulators.~~

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Table 2 – The IEC specification structure

Specification level	Examples of information to be included	Applicable to
Basic	– Assessment system rules – Inspection rules – Optical measurement methods – Environmental test methods – Sampling plans – Identification rule – Marking standards – Dimensional standards – Terminology – Symbol standards – Preferred number series – SI units	Two or more component families or sub-families
Generic	– Specific terminology – Specific symbols – Specific units – Preferred values – Marking – Selection of tests – Capability approval procedures	Component family
Blank detail	– Quality conformation test schedule – Inspection requirements – Information common to a number of types	Groups of types and/or styles having a common test schedule
Detail	– Individual values – Specific information – Completed quality conformance test schedules	Individual component(s)

4.2.2.2 Blank detail specifications

The blank detail specification lists all of the parameters and features applicable to a fibre optic circulator, including the type, operating characteristics, housing configurations, test methods, and performance requirements. The blank detail specification is applicable to any fibre optic circulator design and quality assessment requirement. The blank detail specification contains the preferred format for stating the required information in the detail specification.

Blank detail specifications are not, by themselves, a specification level. They are associated with the generic specification.

Each blank detail specification shall be limited to one environmental category.

Each blank detail specification shall contain:

– the minimum mandatory test schedules and performance requirements,

– the preferred format for stating the required information in the detail specification,

– in case of hybrid components, including connectors, addition of appropriate entry fields to show the reference normative document, document title and issue date.

4.2.2.3 Detail specifications

A specific circulator is described by a corresponding detail specification, which is prepared by filling in the blanks of the blank detail specification. Within the constraints imposed by this

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~~generic specification, the blank detail specification may be filled in by any national committee of the IEC, thereby defining a particular circulator as an IEC standard.~~

~~Detail specifications shall specify the following, as applicable:~~

- ~~type (see 4.1.2);~~
- ~~style (see 4.1.3);~~
- ~~variant(s) (see 4.1.4);~~
- ~~part identification number for each variant (see 4.6.2);~~
- ~~drawings, dimensions required (see 4.2.3);~~
- ~~test schedules (see 4.2.5);~~
- ~~performance requirements (see 4.5).~~

4.2.2 Drawings

4.2.2.1 General

The drawings and dimensions given in the relevant specifications shall not restrict detail construction nor ~~shall they~~ be used as manufacturing drawings.

4.2.2.2 Projection system

Either first angle or third angle projection shall be used for the drawings in documents covered by this document. All drawings within a document shall use the same projection system and the drawings shall state which system is used.

4.2.2.3 Dimensional system

All dimensions shall be given in accordance with ISO 129-1, ISO 286-1 and ISO 1101. The metric system shall be used in all specifications. Dimensions shall not contain more than five significant digits. When units are converted, a note shall be added in each relevant specification.

~~The metric system shall be used in all specifications.~~

~~Dimensions shall not contain more than five significant digits.~~

~~Conversion between systems of units shall be done correctly. When units are converted, a note shall be added in each relevant specification. Conversion between metric and imperial units shall use a factor of 25,4 mm to 1 inch.~~

4.2.3 Tests and measurements

4.2.3.1 Tests and measurements procedures

The tests and measurements procedures for optical, mechanical, climatic and environmental characteristics of fibre optic circulators to be used shall be defined and selected preferentially from the IEC 61300 series. The size measurement method to be used shall be specified in the relevant specification for dimensions which are specified within a total tolerance zone of 0,01 mm or less.

4.2.3.2 Reference components

Reference components for measurement purposes, if required, shall be specified in the relevant specification.

~~**4.2.4.3 Gauges**~~

~~Gauges, if required, shall be specified in the relevant specification.~~

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4.2.4 Test report

The test reports shall be prepared for each test conducted as required by a relevant specification. The reports shall be included in the qualification test report and in the periodic inspection report.

Test reports shall contain the following information as a minimum:

– title and date of test;

– specimen description including the type of fibre, connector or other coupling device. The description shall also include the variant identification number (see 4.6.2);

– test equipment used and date of latest calibration;

– all applicable test details;

– all measurement values and observations.

– sufficiently detailed documentation to provide traceable information for failure analysis.

4.2.5 Instructions for use

Instructions for use, when required, shall be given by the manufacturer and shall include.

– assembly and connection instructions;

– cleaning method;

– safety aspects;

– additional information, as necessary.

4.3 Standardization system

4.3.1 Interface standards

Interface standards provide both manufacturer and user with all the information required to make or use the product in conformity with the physical features of that standard interface. Interface standards fully define the features essential for the mating and unmating of optical fibre connectors and other components. They also serve to position the optical datum target, where defined, relative to other reference datum.

Interface standards ensure that connectors and adapters that comply with the standard will fit together. The standards may also contain tolerance grades for ferrules and alignment devices. Tolerance grades are used to provide different levels of alignment precision.

The interface dimensions may also be used to design other components that will mate with the connectors. For example, an active device mount can be designed using the adapter interface dimensions. The use of these dimensions combined with those of a standard plug provides the designer with assurance that the standard plugs will fit into the optical device mount. They also provide the location of the plug's optical datum target.

Standard interface dimensions do not, by themselves, guarantee optical performance. They guarantee connector mating at a specified fit. Optical performance is currently guaranteed via the manufacturing specification. Products from the same or different manufacturing specifications using the same standard interface will always fit together. Guaranteed performance can be given by any single manufacturer only for product delivered to the same manufacturing specification. However, it can be reasonably expected that some level of performance will be obtained by mating a product from different manufacturing specifications, although the level of performance cannot be expected to be any better than that of the lowest specified performance.

Refer proper references when (in case) the connector is used, such as the IEC 61754 series.

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4.3.2 Performance standards

Performance standards (IEC 61753 series) contain a series of tests and measurements (which may or may not be grouped into a specified schedule depending on the requirements of that standards) with clearly defined conditions, severities and pass/fail criteria. The tests are intended to be run on a "one-off" basis to prove the ability of ~~a given~~ any product to satisfy the "performance standards" requirement. Each performance standard has a different set of tests, and/or severities (and/or groupings) representing the requirements of a market sector, user group or system location.

A product that has been shown to meet all the requirements of a performance standard can be declared as complying with a performance standard but should then be controlled by a quality assurance/quality conformance programme.

~~It is possible to define a key point of the test and measurements standards when these are applied (particularly with regard to insertion loss and return loss) in conjunction with the interface standards of inter-product compatibility. This ensures conformance of each individual product to this standard.~~

4.3.3 Reliability standards

Reliability standards are intended to ensure that a component can meet performance specifications under stated conditions for a stated time period.

~~For each type of component, the following shall be identified (and appear in the standard):~~

- ~~failure modes (observable general mechanical or optical effects of failure);~~
- ~~failure mechanisms (general causes of failure, which may be common to several components);~~
- ~~failure effects (detailed causes of failure, specific to component).~~

~~These are all related to environmental and material aspects.~~

~~Initially, just after component manufacture, there is an "infant mortality phase" during which many components would fail if they were deployed in the field. To avoid early field failure, all components may be subjected to screen process in the factory, involving environmental stresses that may be mechanical, thermal and humidity related. This is to induce known failure mechanisms in a controlled environmental situation to occur earlier than would normally be seen in the unscreened population. For those components that survive (and are then sold), there is a reduced failure rate since these mechanisms have been eliminated.~~

~~Screening is an optional part of the manufacturing process, rather than a test method. It will not affect the "useful life" of a component, defined as the period during which it performs according to specifications. Eventually other failure mechanisms appear, and the failure rate increases beyond some defined threshold. At this point, the useful life ends and the "wear-out region" begins, and the component must be replaced.~~

~~At the beginning of useful life, performance testing on a sampled population of components may be applied by the supplier, by the manufacturer, or by a third party. This is to ensure that the component meets performance specifications over the range of intended environments at this initial time. Reliability testing, on the other hand, is applied to ensure that the component meets performance specifications for at least a specified minimum useful lifetime or specified maximum failure rate. These tests are usually carried out by utilising the performance testing, but increasing duration and severity to accelerate the failure mechanisms.~~

~~A reliability theory relates component reliability testing to component parameters and to lifetime or failure rate under testing. The theory then extrapolates these to lifetime or failure rate under less stressful service conditions. The reliability specifications include values of the component parameters needed to ensure the specified minimum lifetime or maximum failure rate in service.~~

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4.3.4 Interlinking

Standards currently under preparation are given in Figure 6. A large number of the test and measurement standards exist already and quality assurance qualification approval standards have existed for many years. With regard to interface, performance and reliability standards, once these three standards are all in place, the matrix given in Table 6 demonstrates some of the other options available for product standardization.

Product A is fully IEC standardized, having a standard interface and meeting defined performance standards and reliability standards.

Product B is a product with a proprietary interface but which meets a defined IEC performance standard and reliability standard.

Product C is a product which complies with an IEC standard interface but does not meet the requirements of either an IEC performance standard or reliability standard.

Product D is a product which complies with both an IEC standard interface and performance standard but does not meet any reliability requirements.

Obviously the matrix is more complex than shown since there will be a number of interface, performance and reliability standards which may cross-refer. In addition, the products may all be subject to a recognized quality assurance programme including qualification approval, capability approval, technology approval or even a national or company quality assurance system.

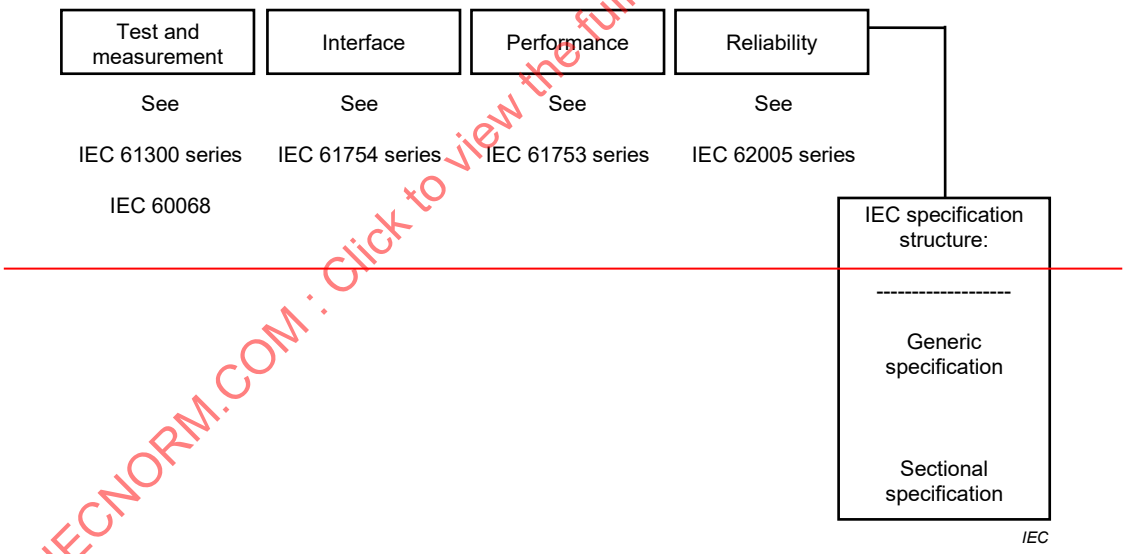

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Figure 6 – Standards currently under preparation

Table 3 – Standards interlink matrix

Product type	Interface standard	Performance standard	Reliability standard
Product A	YES	YES	YES
Product B	NO	YES	YES
Product C	YES	NO	NO
Product D	YES	YES	NO

4.4 Design and construction

4.4.1 Materials

4.4.1.1 ~~Corrosion resistance~~ General

All housing materials used in the construction ~~of circulator sets~~ shall be ~~corrosion resistant or suitably finished to~~ manufactured with materials which meet the requirements of the relevant specification.

4.4.1.2 Non-flammable materials

When non-flammable materials are required, the requirements shall be specified ~~in the relevant specification~~, and reference should be made to IEC 60695-11-5. If an alternate standard is used for non-flammable materials, it shall be ~~referenced~~ declared.

4.4.2 Workmanship

Components and associated hardware shall be manufactured to a uniform quality and shall be free of sharp edges, burrs or other defects that ~~will~~ would affect life, serviceability or appearance. Particular attention shall be given to neatness and thoroughness of marking, plating, soldering, bonding, etc.

4.5 Quality

Fibre optic circulators shall be controlled by the quality assessment procedures and declared.

4.6 Performance requirements

Fibre optic circulators shall meet the performance requirements specified in the relevant specification.

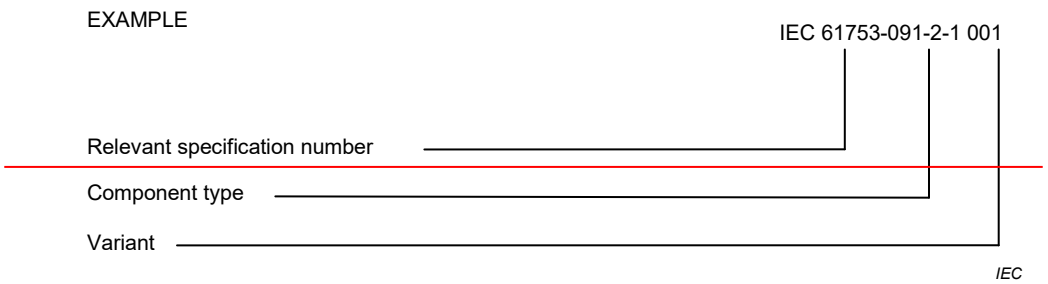
4.7 Identification and marking

4.7.1 General

Components, associated hardware and shipping packages shall be permanently and legibly identified and marked when required by the relevant specification.

~~**4.6.2 Variant identification number**~~

~~Each variant in a relevant specification shall be assigned a variant identification number. The number shall consist of the number assigned to the relevant specification followed by a dash and a four-digit number. The first digit of the four-digit number shall be sequentially assigned to each component type covered by the relevant specification. The last three digits shall be sequentially assigned to each variant of the component (see Figure 7).~~



~~**Figure 7 – Example of a variant identification number**~~

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4.7.2 Component marking

Component marking, if required, ~~shall~~ should be specified in the relevant specification. The preferred order of marking is:

a) port identification;

b) direction of optical path (by arrow);

c) manufacturer's part number (including serial number, if applicable);

d) manufacturer's identification mark or logo.

~~d) manufacturing date;~~

~~e) variant identification number;~~

~~f) any additional marking required by the relevant specification.~~

If space does not allow for all the required marking on the component, each unit shall be individually packaged with a data sheet containing all of the required information which is not marked.

4.7.3 Package marking

Several devices may be packaged together for shipment.

Package marking, if required, shall be specified in the relevant specification. The preferred order of marking is:

a) manufacturer's identification mark or logo;

b) manufacturer's part number~~;~~

~~c) manufacturing date code (year/week; see ISO 8601);~~

~~d) variant identification number(s) (see 4.6.2);~~

~~e) type designations (see 4.1.2);~~

~~f) any additional marking required by the relevant specification~~.

When applicable, individual unit packages (within the sealed package) ~~shall~~ should be marked with the reference number of the certified record of released lots, the manufacturer's factory identity code and the component identification.

4.8 Packaging

Packaging shall be securely without any damage to passive optical components during transportation and storage.

Packages shall include instructions for use when required by the specification (see 4.2.5).

4.9 Storage conditions

Where short-term degradable materials, such as adhesives, are supplied with the package ~~of circulator parts~~, the manufacturer shall mark these with the expiry date ~~(year and week numbers, see~~ according to ISO 8601-1~~)~~ together with any requirements or precautions concerning safety hazards or environmental conditions for storage.

4.10 Safety

~~Optical~~ Fibre optic circulators, when used on ~~an optical~~ a fibre optic circulator transmission system and/or equipment, may emit potentially hazardous radiation from an uncapped or unterminated output port or fibre end.

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The optical ~~circulator~~ filter manufacturers shall ~~make available~~ provide sufficient information to alert system designers and users about the potential hazard and shall indicate the required precautions and working practices.

In addition, each relevant specification shall include the following:

WARNING ~~NOTE~~ –

Care should be taken when handling small diameter fibre to prevent puncturing the skin, especially in the eye area. Direct viewing of the end of an optical fibre or an optical fibre connector when it is propagating energy is not recommended, unless prior assurance has been obtained as to the safety energy output level.

Reference shall be made to the IEC 60825 series, the relevant ~~standard~~ reference on safety.

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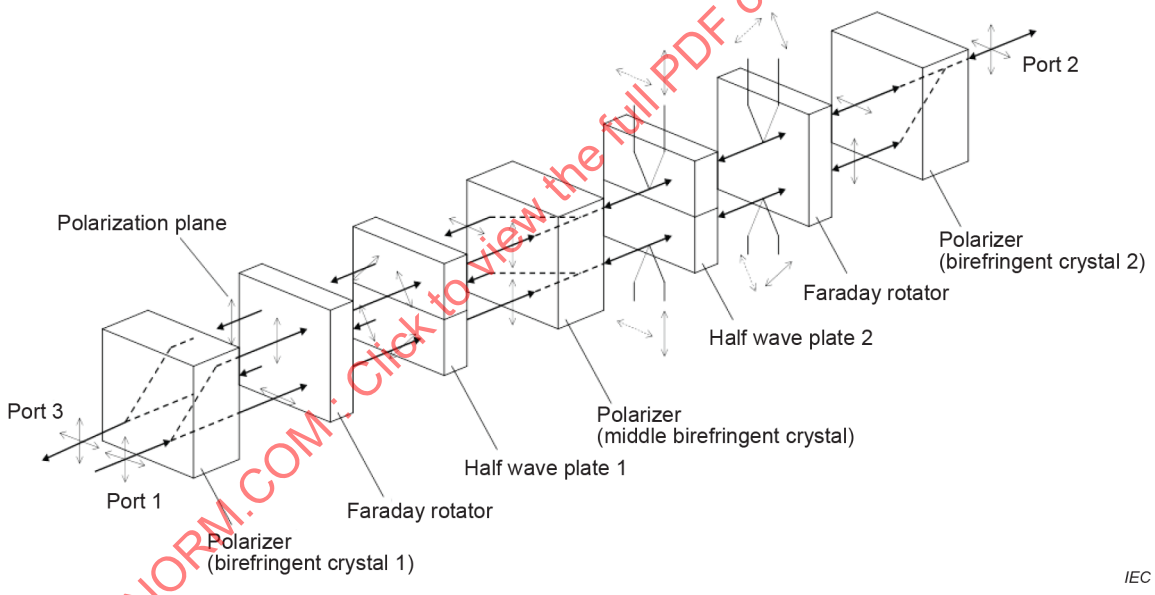
Annex A
(informative)

Example of technology of bulk circulator based on magneto-optic effect

The bulk circulator based on magneto-optic effect consists of the following typical discrete components.

Figure A.1 shows an example of a circulator based on magneto-optic effect. The circulator consists of a Faraday rotator, a polarizer (birefringent crystal) and a half-wave plate. The incident light from port 1 is separated to two cross-polarizations by the birefringent crystal 1. Two cross-polarizations are paralleled by the half-wave plate and Faraday rotator. Two polarizations are combined by the birefringent crystal 2, exit from port 2. In the reverse direction, the incident light from port 2 is separated into two cross-polarizations by the birefringent crystal 2. Two cross-polarizations are paralleled by the half-wave plate and Faraday rotator where the polarization direction crosses between the forward direction and reverse direction. Two polarizations are shifted by the middle birefringent crystal, due to the direction of polarization. As a result, two polarizations are combined by the birefringent crystal 1, exit from port 3.

NOTE The function of the polarizer (birefringent crystal) is to separate the input light into different directions due to a different refractive index of the birefringent crystal for ordinary and extraordinary rays.



NOTE Polarization plane depends on the direction of propagating light

Solid line: from port 1 to port 2

Broken line: from port 2 to port 3

Figure A.1 – Example of a circulator

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Annex B
(informative)

Example of application of a circulator

Figure B.1 shows the filter in which a circulator is used. The filter consists of a circulator and a fibre Bragg grating (FBG). The fibre Bragg grating (FBG) reflects particular wavelengths of light and transmits other wavelengths. A circulator is used in order to pick up particular reflected wavelengths.

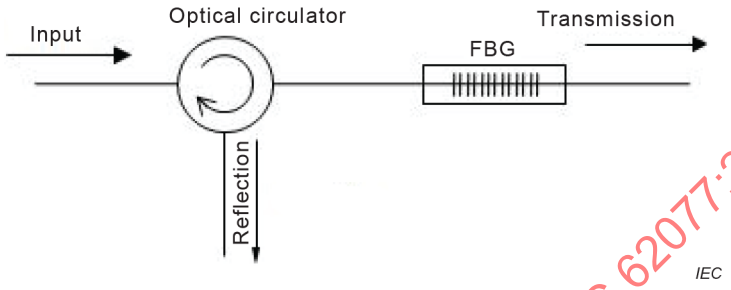

Figure B.1 – Example of application of a circulator

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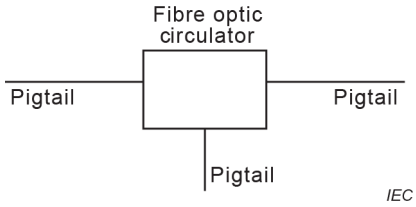
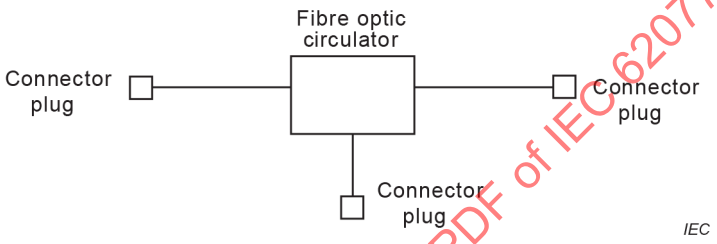
Annex C
(informative)

Examples of interface style

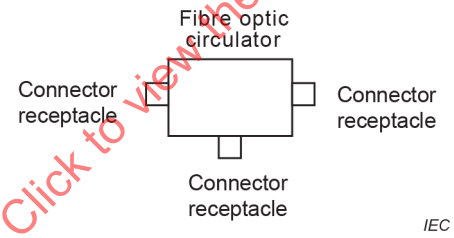
The four examples of interface style for fibre optic circulators are shown in Figure C.1 a) to Figure C.1 d).



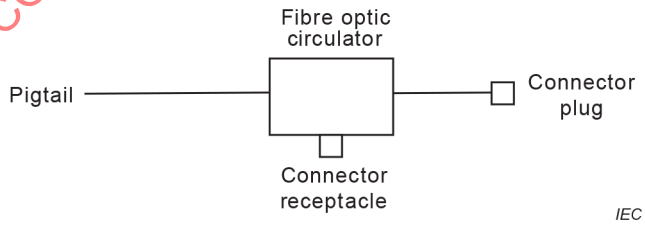
a) Configuration A – Device containing integral fibre optic pigtails without a connector



b) Configuration B – Device containing integral fibre optical pigtails terminated with a connector plug on each port



c) Configuration C – Device containing connector receptacles as an integral part of the device housing



d) Configuration D – Device containing some combination of the interfacing features of the preceding configurations

Figure C.1 – Examples of interface style for fibre optic circulators

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Bibliography

IEC 60068 (all parts), *Environmental testing*

~~IEC 60410, *Sampling plans and procedures for inspection by attributes*~~

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

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

~~IEC 61300-2 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2: Tests*~~

~~IEC 61300-3 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3: Examinations and measurements*~~

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

IEC 61753-091-02, *Fibre optic interconnecting devices and passive components – Performance standard – Part 091-2: Non-connectorized 3-port incompletely circulated single-mode fibre optic circulators for category C – Controlled environments*

IEC 61754 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces*

IEC 61754-4, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 4: Type SC connector family*

~~IEC 61978-1, *Fibre optic interconnecting devices and passive components – Fibre optic passive chromatic compensators – Part 1: Generic specification*~~

IEC 62005 (all parts), ~~*Reliability of*~~ *Fibre optic interconnecting devices and passive components – Reliability*

IEC TS 62538, *Categorization of optical devices*

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IEC 62077

Edition 4.0 2022-08

INTERNATIONAL STANDARD

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Fibre optic interconnecting devices and passive components – Fibre optic circulators – Generic specification

Dispositifs d'interconnexion et composants passifs fibroniques – Circulateurs fibroniques – Spécification générique

IEC 62077:2022-08(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC CIRCULATORS – GENERIC SPECIFICATION

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC 62077 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015. This edition constitutes a technical revision.

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

a) harmonization of terms and definitions with IEC TS 62627-09;
b) change of Clause 4 regarding requirements.

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

Draft	Report on voting
86B/4624/FDIS	86B/4645/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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
- amended.

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – FIBRE OPTIC CIRCULATORS – GENERIC SPECIFICATION

1 Scope

This document applies to circulators used in the field of fibre optics bearing all of 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 in accordance with the categorization and definition provided in IEC TS 62538;

– they have three or more ports for directionally transmitting optical power.

An example of optical circulator technology and application is described in Annex A and Annex B, respectively.

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 http://www.electropedia.org

IEC 60617, *Graphical symbols for diagrams*, available at http://std.iec.ch/iec60617

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

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

IEC TR 61930, *Fibre optic graphical symbology*

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 – Part 1: General principles*

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 8601-1, *Date and time – Representations for information interchange – Part 1: Basic rules*

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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 circulator
passive component possessing three or more ports which input and output are cyclic

Note 1 to entry: In the case of 3 ports circulator with port 1, port 2 and port 3, supposing optical power is transmitted from port 1 to port 2, optical power from port 2 is transmitted to port 3.

[SOURCE: IEC TS 62627-09:2016, 3.3.5, modified – The words "passive optical device (component)" have been replaced with "passive component".]

3.1.2
completely circulated type
type of circulator where all ports function as both input and output

Note 1 to entry: In the case of a 3 port circulator with port 1, port 2 and port 3, where optical power is transmitted from port 1 to port 2, optical power from port 2 is also transmitted to port 3 and optical power from port 3 is also transmitted to port 1 (see Figure 1).

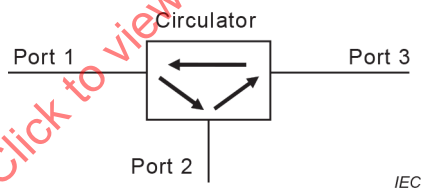

Figure 1 – Completely circulated type configuration

3.1.3
incompletely circulated type
type of circulator where a port is either an input or an output

Note 1 to entry: In the case of 3 ports circulator with port 1, port 2 and port 3, supposing optical power is transmitted from port 1 to port 2, optical power from port 2 is transmitted to port 3 and optical power from port 3 is not transmitted to port 1 (see Figure 2).

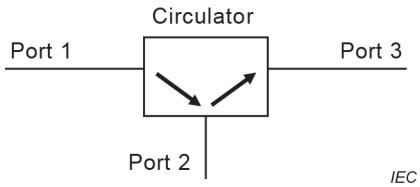

Figure 2 – Incompletely circulated type configuration

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3.2 Performance terms

3.2.1
insertion loss
attenuation
reduction of optical power in an operating wavelength range, when transmitted from an input port to an output port for a fibre optic circulator

Note 1 to entry: The insertion loss (attenuation) is expressed in decibels and defined as:

$$a_{ij} = -10\log_{10}\left(\frac{P_j}{P_i}\right)$$

where

P_i is the optical power launched into the input port;

P_j is the optical power received from the output port.

Note 2 to entry: Figure 3 shows the insertion loss (attenuation) for fibre optic circulators.

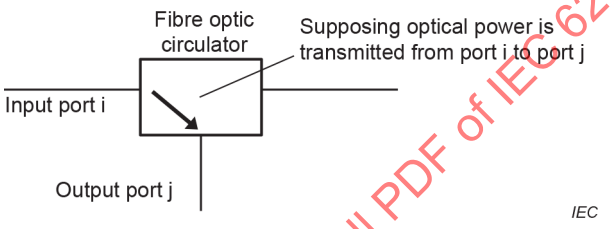

Figure 3 – Insertion loss

Note 3 to entry: The insertion loss (attenuation) is wavelength, polarization, temperature and port pair dependent. Generally, the insertion loss is the maximum value over operating wavelength range, all polarization state and all conducting port pairs.

3.2.2
isolation
reduction of optical power in an operating wavelength range, when transmitted from an output port to an input port for a fibre optic circulator

Note 1 to entry: The isolation is expressed in decibels and defined as follows:

$$a_{ji} = -10\log_{10}\left(\frac{P_i}{P_j}\right)$$

where

P_i is the optical power received from the input port;

P_j is the optical power launched into the output port.

Note 2 to entry: Figure 4 shows the isolation for fibre optic circulators.

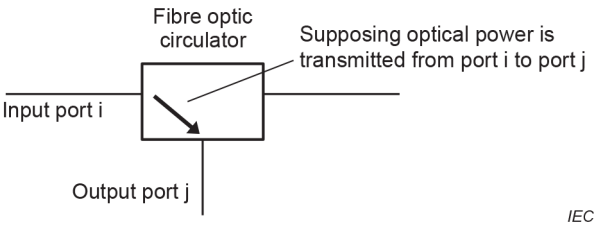

Figure 4 – Isolation

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Note 3 to entry: The isolation is wavelength, polarization, temperature and port pair dependent. Generally, the isolation is the minimum value over operating wavelength range, all polarization state and all isolated port pairs.

4 Requirements

4.1 Classification

4.1.1 General

Fibre optic circulators are classified either totally or in part in the following categories:

– technology;
– port numbers;
– circulated type;
– wavelength band;
– interface style.

An example of a typical fibre optic circulator classification is given in Table 1.

Table 1 – Example of a typical fibre optic circulator classification

Items	Classifications
Technology	Magneto-optic Faraday effect;
Port numbers	3
Circulated type	Completely circulated type
Wavelength band	C band
Interface style	Configuration B Fibre type: IEC 60793-2-50, B-657.B IEC 61754-4 (SC connector)

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4.1.2 Technology, port numbers and functions

Circulators are mainly divided into types according to their configuration.

– Operational technologies:
  • magneto-optic Faraday effect;
  • magneto-optic Kerr effect.
– Port numbers;
– Circulated type:
  • completely circulated type;
  • incompletely circulated type.

4.1.3 Wavelength bands

– O-band;
– C-band;
– L-band;
– other wavelength circulators.

4.1.4 Interface style

The fibre optic circulator style shall be defined on the basis of the following elements:

– input and output port configuration;
– connector set type(s), if any.

NOTE Examples of interface style are provided in Annex C.

4.2 Documentation

4.2.1 Symbols

Graphical and letter symbols shall, whenever possible, be taken from the IEC 60027 series, IEC 60617 and IEC TR 61930.

4.2.2 Drawings

4.2.2.1 General

The drawings and dimensions given in the relevant specifications shall not restrict detail construction nor be used as manufacturing drawings.

4.2.2.2 Projection system

Either first angle or third angle projection shall be used for the drawings in documents covered by this document. All drawings within a document shall use the same projection system and the drawings shall state which system is used.

4.2.2.3 Dimensional system

All dimensions shall be given in accordance with ISO 129-1, ISO 286-1 and ISO 1101. The metric system shall be used in all specifications. Dimensions shall not contain more than five significant digits. When units are converted, a note shall be added in each relevant specification.

4.2.3 Tests and measurements

4.2.3.1 Tests and measurements procedures

The tests and measurements procedures for optical, mechanical, climatic and environmental characteristics of fibre optic circulators to be used shall be defined and selected preferentially from the IEC 61300 series. The size measurement method to be used shall be specified in the relevant specification for dimensions which are specified within a total tolerance zone of 0,01 mm or less.

4.2.3.2 Reference components

Reference components for measurement purposes, if required, shall be specified in the relevant specification.

4.2.4 Test report

The test reports shall be prepared for each test conducted as required by a relevant specification. The reports shall be included in the qualification test report and in the periodic inspection report.

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Test reports shall contain the following information as a minimum:

– title and date of test;
– test equipment used;
– all applicable test details;
– all measurement values and observations.

4.2.5 Instructions for use

Instructions for use, when required, shall be given by the manufacturer.

4.3 Standardization system

4.3.1 Interface standards

Refer proper references when (in case) the connector is used, such as the IEC 61754 series.

4.3.2 Performance standards

Performance standards (IEC 61753 series) contain a series of tests and measurements (which may or may not be grouped into a specified schedule depending on the requirements of that standards) with clearly defined conditions, severities and pass/fail criteria. The tests are intended to be run on a "one-off" basis to prove the ability of any product to satisfy the "performance standards" requirement. Each performance standard has a different set of tests, and/or severities (and/or groupings) representing the requirements of a market sector, user group or system location.

A product that has been shown to meet all the requirements of a performance standard can be declared as complying with a performance standard but should then be controlled by a quality assurance/quality conformance programme.

4.3.3 Reliability standards

Reliability standards are intended to ensure that a component can meet performance specifications under stated conditions for a stated time period.

4.4 Design and construction

4.4.1 Materials

4.4.1.1 General

All housing materials used in the construction shall be manufactured with materials which meet the requirements of the relevant specification.

4.4.1.2 Non-flammable materials

When non-flammable materials are required, the requirements shall be specified, and reference should be made to IEC 60695-11-5. If an alternate standard is used for non-flammable materials, it shall be declared.

4.4.2 Workmanship

Components and associated hardware shall be manufactured to a uniform quality and shall be free of sharp edges, burrs or other defects that would affect life, serviceability or appearance. Particular attention shall be given to neatness and thoroughness of marking, plating, soldering, bonding, etc.

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4.5 Quality

Fibre optic circulators shall be controlled by the quality assessment procedures and declared.

4.6 Performance requirements

Fibre optic circulators shall meet the performance requirements specified in the relevant specification.

4.7 Identification and marking

4.7.1 General

Components, associated hardware and shipping packages shall be permanently and legibly identified and marked when required by the relevant specification.

4.7.2 Component marking

Component marking, if required, should be specified in the relevant specification. The preferred order of marking is:

a) port identification;

b) direction of optical path (by arrow);

c) manufacturer's part number (including serial number, if applicable);

d) manufacturer's identification mark or logo.

If space does not allow for all the required marking on the component, each unit shall be individually packaged with a data sheet containing all of the required information which is not marked.

4.7.3 Package marking

Several devices may be packaged together for shipment.

Package marking, if required, shall be specified in the relevant specification. The preferred order of marking is:

a) manufacturer's identification mark or logo;

b) manufacturer's part number.

When applicable, individual unit packages (within the sealed package) should be marked with the reference number of the certified record of released lots, the manufacturer's factory identity code and the component identification.

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4.8 Packaging

Packaging shall be securely without any damage to passive optical components during transportation and storage.

Packages shall include instructions for use when required by the specification (see 4.2.5).

4.9 Storage conditions

Where short-term degradable materials, such as adhesives, are supplied with the package, the manufacturer shall mark these with the expiry date according to ISO 8601-1 together with any requirements or precautions concerning safety hazards or environmental conditions for storage.

4.10 Safety

Fibre optic circulators, when used on a fibre optic circulator transmission system and/or equipment, may emit potentially hazardous radiation from an uncapped or unterminated output port or fibre end.

The optical filter manufacturers shall provide sufficient information to alert system designers and users about the potential hazard and shall indicate the required precautions and working practices.

In addition, each relevant specification shall include the following:

WARNING – Care should be taken when handling small diameter fibre to prevent puncturing the skin, especially in the eye area. Direct viewing of the end of an optical fibre or an optical fibre connector when it is propagating energy is not recommended, unless prior assurance has been obtained as to the safety energy output level.

Reference shall be made to the IEC 60825 series, the relevant reference on safety.

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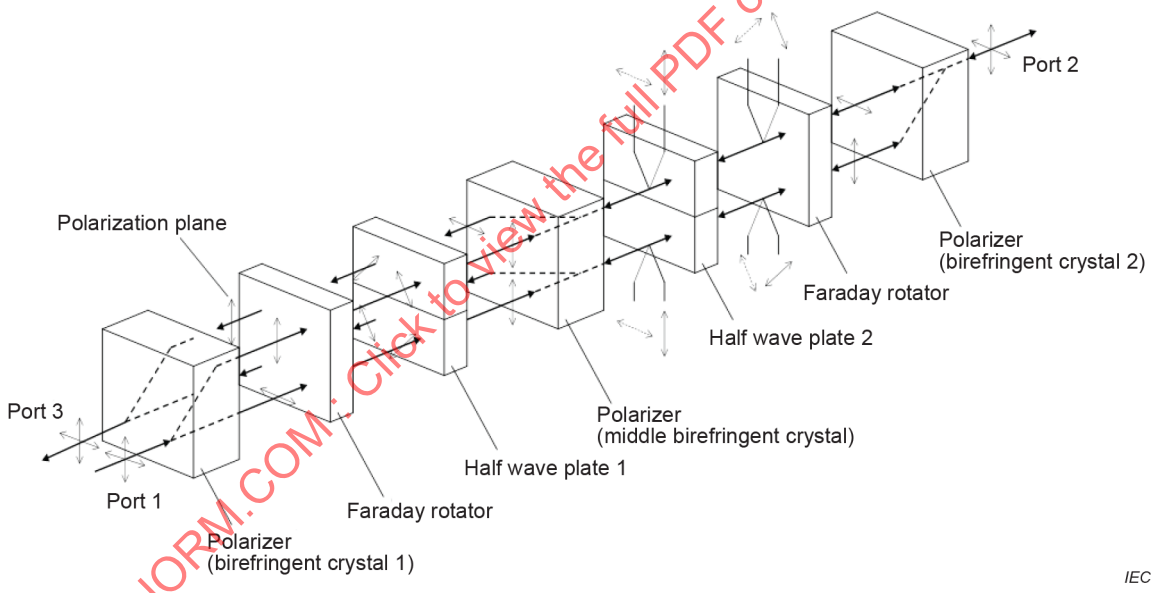
Annex A
(informative)

Example of technology of bulk circulator based on magneto-optic effect

The bulk circulator based on magneto-optic effect consists of the following typical discrete components.

Figure A.1 shows an example of a circulator based on magneto-optic effect. The circulator consists of a Faraday rotator, a polarizer (birefringent crystal) and a half-wave plate. The incident light from port 1 is separated to two cross-polarizations by the birefringent crystal 1. Two cross-polarizations are paralleled by the half-wave plate and Faraday rotator. Two polarizations are combined by the birefringent crystal 2, exit from port 2. In the reverse direction, the incident light from port 2 is separated into two cross-polarizations by the birefringent crystal 2. Two cross-polarizations are paralleled by the half-wave plate and Faraday rotator where the polarization direction crosses between the forward direction and reverse direction. Two polarizations are shifted by the middle birefringent crystal, due to the direction of polarization. As a result, two polarizations are combined by the birefringent crystal 1, exit from port 3.

NOTE The function of the polarizer (birefringent crystal) is to separate the input light into different directions due to a different refractive index of the birefringent crystal for ordinary and extraordinary rays.



NOTE Polarization plane depends on the direction of propagating light

Solid line: from port 1 to port 2

Broken line: from port 2 to port 3

Figure A.1 – Example of a circulator

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Annex B
(informative)

Example of application of a circulator

Figure B.1 shows the filter in which a circulator is used. The filter consists of a circulator and a fibre Bragg grating (FBG). The fibre Bragg grating (FBG) reflects particular wavelengths of light and transmits other wavelengths. A circulator is used in order to pick up particular reflected wavelengths.

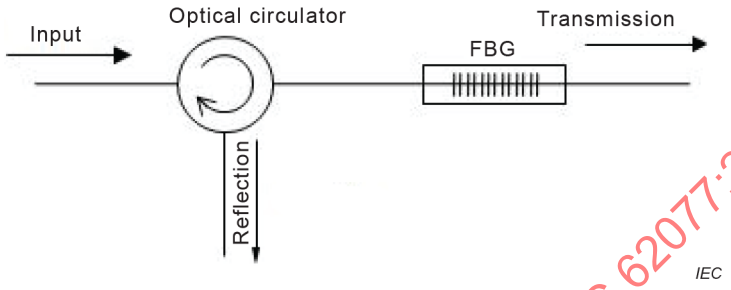

Figure B.1 – Example of application of a circulator

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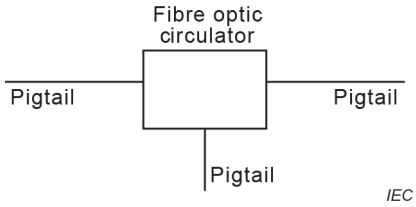
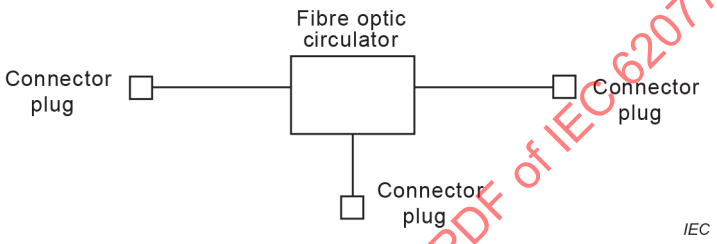
Annex C
(informative)

Examples of interface style

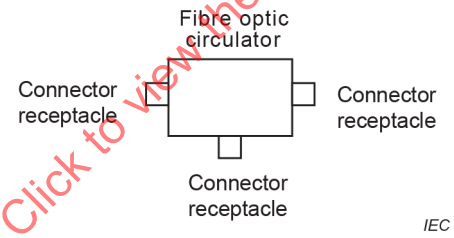
The four examples of interface style for fibre optic circulators are shown in Figure C.1 a) to Figure C.1 d).



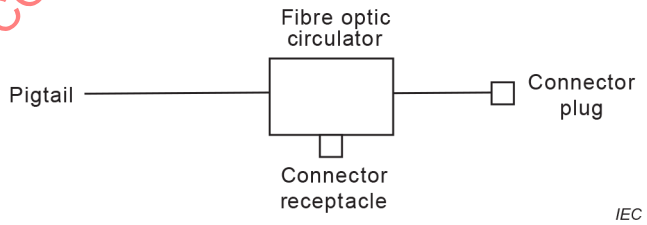
a) Configuration A – Device containing integral fibre optic pigtails without a connector



b) Configuration B – Device containing integral fibre optical pigtails terminated with a connector plug on each port



c) Configuration C – Device containing connector receptacles as an integral part of the device housing



d) Configuration D – Device containing some combination of the interfacing features of the preceding configurations

Figure C.1 – Examples of interface style for fibre optic circulators

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Bibliography

IEC 60068 (all parts), *Environmental testing*

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

IEC 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 61753 (all parts), *Fibre optic interconnecting devices and passive components – Performance standard*

IEC 61753-091-02, *Fibre optic interconnecting devices and passive components – Performance standard – Part 091-2: Non-connectorized 3-port incompletely circulated single-mode fibre optic circulators for category C – Controlled environments*

IEC 61754 (all parts), *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces*

IEC 61754-4, *Fibre optic interconnecting devices and passive components – Fibre optic connector interfaces – Part 4: Type SC connector family*

IEC 62005 (all parts), *Fibre optic interconnecting devices and passive components – Reliability*

IEC TS 62538, *Categorization of optical devices*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS PASSIFS FIBRONIQUES – CIRCULATEURS FIBRONIQUES – SPÉCIFICATION GÉNÉRIQUE

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Cette quatrième édition annule et remplace la troisième édition parue en 2015. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) harmonisation des termes et définitions avec l'IEC TS 62627-09;
b) modification de l'Article 4, portant sur les exigences.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
86B/4624/FDIS	86B/4645/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

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DISPOSITIFS D'INTERCONNEXION ET COMPOSANTS PASSIFS FIBRONIQUES – CIRCULATEURS FIBRONIQUES – SPÉCIFICATION GÉNÉRIQUE

1 Domaine d'application

Le présent document s'applique aux circulateurs utilisés dans le domaine de la fibronique, qui présentent toutes les caractéristiques suivantes:

– ce sont des dispositifs optiques non réciproques, dont chaque port est soit une fibre optique, soit un connecteur fibronique;

– ce sont des dispositifs passifs, conformément à la classification et à la définition données dans l'IEC TS 62538;

– ils disposent d'au moins trois ports pour la transmission de la puissance optique de façon directionnelle.

Un exemple de technologie et d'application de circulateur optique est décrit à l'Annexe A et à l'Annexe B, respectivement.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60027 (toutes les parties), *Symboles littéraux à utiliser en électrotechnique*

IEC 60050-731, *Vocabulaire Electrotechnique International – Chapitre 731: Télécommunications par fibres optiques,* disponible à l'adresse http://www.electropedia.org

IEC 60617, *Symboles graphiques pour schémas,* disponible à l'adresse http://std.iec.ch/iec60617

IEC 60825 (toutes les parties), *Sécurité des appareils à laser*

IEC 61300 (toutes les parties), *Dispositifs d'interconnexion et composants passifs fibroniques – Méthodes fondamentales d'essais et de mesures*

IEC TR 61930, *Symbologie des graphiques de fibres optiques*

IEC TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices* (disponible en anglais seulement)

ISO 129-1, *Documentation technique de produits – Représentation des dimensions et tolérances – Partie 1: Principes généraux*

ISO 286-1, *Spécification géométrique des produits (GPS) – Système de codification ISO pour les tolérances sur les tailles linéaires – Partie 1: Base des tolérances, écarts et ajustements*

ISO 1101, *Spécification géométrique des produits (GPS) – Tolérancement géométrique – Tolérancement de forme, orientation, position et battement*

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ISO 8601-1, *Date et heure – Représentations pour l'échange d'information – Partie 1: Règles de base*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60050-731, de l'IEC TS 62627-09 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1 Termes relatifs aux composants

3.1.1
circulateur fibronique
composant passif qui a trois ports ou plus, dont l'entrée et la sortie sont cycliques

Note 1 à l'article: Dans le cas d'un circulateur à 3 ports, à savoir le port 1, le port 2 et le port 3, en prenant pour hypothèse que la puissance optique est transmise du port 1 au port 2, la puissance optique du port 2 est transmise au port 3.

[SOURCE: IEC TS 62627-09:2016, 3.3.5 modifié – l'expression "dispositif optique passif (composant)" a été remplacée par "composant passif".]

3.1.2
type à circulation intégrale
type de circulateur dans lequel tous les ports fonctionnent à la fois comme entrée et comme sortie

Note 1 à l'article: Dans le cas d'un circulateur à 3 ports, à savoir le port 1, le port 2 et le port 3, dans lequel la puissance optique est transmise du port 1 au port 2, la puissance optique du port 2 est également transmise au port 3, et la puissance optique du port 3 est également transmise au port 1 (voir Figure 1).

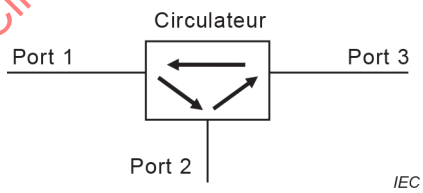

Figure 1 – Configuration de type à circulation intégrale

3.1.3
type à circulation partielle
type de circulateur dans lequel un port est soit une entrée, soit une sortie

Note 1 à l'article: Dans le cas d'un circulateur à 3 ports, à savoir le port 1, le port 2 et le port 3, en prenant pour hypothèse que la puissance optique est transmise du port 1 au port 2, la puissance optique du port 2 est transmise au port 3, et la puissance optique du port 3 n'est pas transmise au port 1 (voir Figure 2).

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