

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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

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

<https://standards.iteh.ai/catalog/standards/sist/e45fee55-a032-4da1-9994-48a7ff8bb320/iec-62077-2022>





## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

#### IEC publications search - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Recherche de publications IEC -

[webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [sales@iec.ch](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

---

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

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

<https://standards.iteh.ai/catalog/standards/sist/e45fee55-a032-4da1-9994-48a7ff8bb320/iec-62077-2022>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 33.180.20

ISBN 978-2-8322-5244-4

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD .....	4
1 Scope .....	6
2 Normative references .....	6
3 Terms and definitions .....	7
3.1 Component terms.....	7
3.2 Performance terms .....	8
4 Requirements .....	9
4.1 Classification .....	9
4.1.1 General .....	9
4.1.2 Technology, port numbers and functions.....	9
4.1.3 Wavelength bands .....	9
4.1.4 Interface style.....	10
4.2 Documentation.....	10
4.2.1 Symbols .....	10
4.2.2 Drawings .....	10
4.2.3 Tests and measurements.....	10
4.2.4 Test report.....	10
4.2.5 Instructions for use.....	11
4.3 Standardization system.....	11
4.3.1 Interface standards.....	11
4.3.2 Performance standards.....	11
4.3.3 Reliability standards .....	11
4.4 Design and construction.....	11
4.4.1 Materials .....	11
4.4.2 Workmanship.....	11
4.5 Quality .....	12
4.6 Performance requirements.....	12
4.7 Identification and marking .....	12
4.7.1 General .....	12
4.7.2 Component marking.....	12
4.7.3 Package marking .....	12
4.8 Packaging .....	12
4.9 Storage conditions .....	12
4.10 Safety .....	13
Annex A (informative) Example of technology of bulk circulator based on magneto-optic effect.....	14
Annex B (informative) Example of application of a circulator .....	15
Annex C (informative) Examples of interface style .....	16
Bibliography.....	17
Figure 1 – Completely circulated type configuration .....	7
Figure 2 – Incompletely circulated type configuration .....	7
Figure 3 – Insertion loss .....	8
Figure 4 – Isolation .....	8
Figure A.1 – Example of a circulator .....	14

Figure B.1 – Example of application of a circulator..... 15  
Figure C.1 – Examples of interface style for fibre optic circulators ..... 16  
  
Table 1 – Example of a typical fibre optic circulator classification .....9

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[IEC 62077:2022](https://standards.iteh.ai/catalog/standards/sist/e45fee55-a032-4da1-9994-48a7ff8bb320/iec-62077-2022)  
<https://standards.iteh.ai/catalog/standards/sist/e45fee55-a032-4da1-9994-48a7ff8bb320/iec-62077-2022>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://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](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ITEH STANDARD PREVIEW  
(standards.iteh.ai)

IEC 62077:2022

<https://standards.iteh.ai/catalog/standards/sist/e45fee55-a032-4da1-9994-48a7ff8bb320/iec-62077-2022>

# 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 62077:2022 4-48a7ff8bb320/iec-62077-2022
- 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*



### 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.

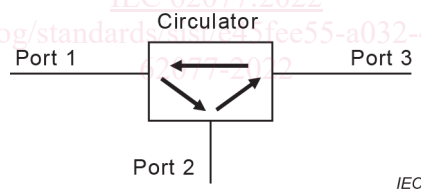
[SOURCE: IEC TS 62627-09:2016, 3.3.5, modified – The words "passive optical device (component)" have been replaced with "passive component".]

##### 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).



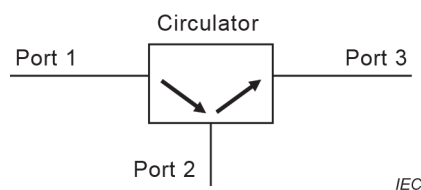
**Figure 1 – Completely circulated type configuration**

##### 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**

### 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:

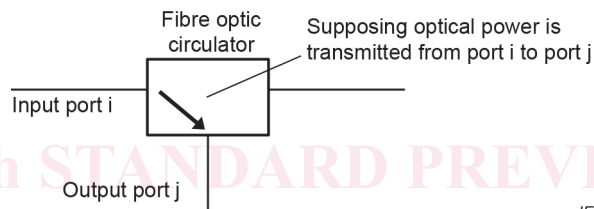
$$a_{ij} = -10 \log_{10} \left( \frac{P_j}{P_i} \right)$$

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:

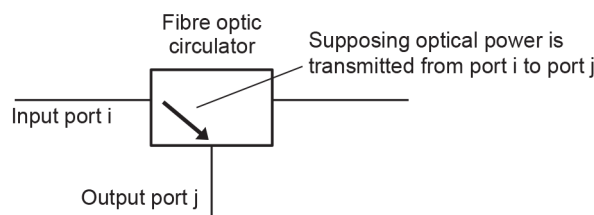
$$a_{ji} = -10 \log_{10} \left( \frac{P_i}{P_j} \right)$$

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**

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)

#### 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.