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INTERNATIONAL STANDARD

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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: Generic specification

FOREWORD

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International Standard IEC 62074-1 has been prepared by subcommittee SC86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This standard cancels and replaces IEC/PAS 62074-1 published in 2007. This first edition constitutes a technical revision.

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

FDIS	Report on voting
86B/2850/FDIS	86B/2889/RVD

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

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

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

A bilingual version of this publication may be issued at a later date.

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

Part 1: Generic specification

1 Scope

This part of IEC 62074 applies to fibre optic wavelength division multiplexing (WDM) devices. These have all of the following general features:

- They are passive, in that they contain no optoelectronic or other transducing elements; but they may use temperature control only the purpose to stabilize the characteristics of devices; they exclude any optical switching function.
- They have three or more ports for the entry and/or exit of optical power, and share optical power among these ports in a predetermined fashion depending on the wavelength.
- The ports are optical fibres or optical fibre connectors.

This standard establishes uniform requirements for the optical, mechanical and environmental properties.

2 Normative references

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

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

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

IEC 60617, *International Standard Database Snapshot – Graphical symbols for diagrams*

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

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

ISO 129-1, *Technical drawings – Indication of dimensions amd tolerances – General principles*

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

ISO 370, *Toleranced dimensions – Conversion from inches into millimeters and vice versa*

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*

ITU-T Recommendation G.671:2005, *Transmission characteristics of optical components and subsystems*

ITU-T Recommendation G.692:1998, *Optical interfaces for multichannel systems with optical amplifiers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050(731) and the following apply.

3.1 Basic term definitions

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 (input and/or output port)

3.1.2
transfer matrix
optical properties of a fibre optic wavelength-selective branching device can be defined in terms of an *n* x *n* matrix of coefficients, where *n* is the number of ports, and the coefficients represent the fractional optical power transferred between designated ports

NOTE The detail explanation of transfer matrix is shown in Annex A.

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

NOTE The detail explanation is shown in Annex A.

3.1.4
logarithmic transfer matrix
transfer matrix whose matrix element a_{ij} is a logarithmic value of transfer matrix element t_{ij}

NOTE The detail explanation is shown in Annex A.

3.1.5
conducting ports
two ports *i* and *j* between which t_{ij} is nominally greater than zero at a specified wavelength

3.1.6
input/output port pair
conducting ports *i* and *j* (t_{ij} nominally greater than zero) that are isolated from any other ports *j* (a_{ij} nominally infinite). The ports are numbered sequentially, so that the transfer matrix is developed to show all ports and all possible combinations. The port numbering is arbitrary.

NOTE Figure 1 below shows an example of a six-port device, with two input ports and four output ports.

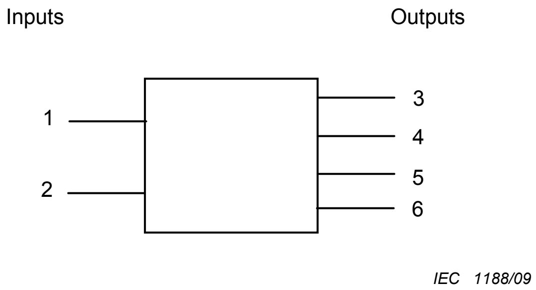

Figure 1 – Example of a six-port device, with two-input and four-output ports

If there are four operating wavelengths, then the resulting transfer matrix becomes a 6×6×4 matrix: loss at λ_1 from port 1 to port 6 would use a_{161}. Reflectance of port 2 at λ_4 would use a_{224}. Loss from port 5 to port 2 at λ_3 would use a_{523}

3.1.7
isolated ports
two ports *i* and *j* between which t_{ij} is nominally zero, and a_{ij} is nominally infinite at a specified wavelength

3.1.8
channel
another term for operating wavelength (or frequency)

3.1.9
channel spacing
centre-to-centre differences in frequency or wavelength between adjacent channels in a WDM device

3.2 Component definitions

3.2.1
wavelength-selective branching device
passive component possessing three or more ports which shares optical power among its ports in a predetermined fashion, without any amplification, switching, or other active modulation but only depending on the wavelength, in the sense that at least two different wavelength ranges are nominally transferred between two different couples of ports

3.2.2
wavelength division multiplexer
WDM
term which is frequently used as a synonym for a wavelength-selective branching device

3.2.3
dense WDM device
DWDM
WDM device which is intended to operate for channel spacing equal or less than 1 000 GHz

3.2.4
coarse WDM device
CWDM
WDM device which is intended to operate for channel spacing less than 50 nm and greater than 1 000 GHz (about 8 nm at 1 550 nm and 5,7 nm at 1 310 nm)

3.2.5
wide WDM device
WWDM
WDM device which is intended to operate for channel spacing equal or greater than 50 nm

3.2.6
wavelength multiplexer
MUX
WDM (DWDM, CWDM or WWDM) which has *n* input ports and one output port, and which function is to combine *n* different optical signals differentiated by wavelength from *n* corresponding input ports on to a single output port

3.2.7
wavelength demultiplexer
DEMUX
WDM (DWDM, CWDM or WWDM) which has one input port and *n* output ports, and which function is to separate *n* different optical signals differentiated by wavelength from a single input port to *n* corresponding output ports

3.2.8
interleaver
bidirectional DWDM which has three ports, and which function is to separate *n* different optical signals differentiated by wavelength from a single input port to odd channel signal to one output port and even channel signal to the other output port alternately

3.3 Performance parameter definitions

3.3.1
crosstalk
for WDM devices, the value of the ratio between the optical power of the specified signal and all noises

3.3.2
isolation
for WDM devices, the value of the ratio between the optical power of the specified signal and the specified noise

3.3.3
add-drop isolation
value of the optical power reduction in decibels a_{ij} between an input i, and an output port j, that are isolated at every wavelength (or frequency for a dense WDM (DWDM) device). a_{ij} is a logarithmic transfer element

3.3.4
adjacent channel isolation (adjacent channel crosstalk)
unidirectional (far-end) isolation with the restriction that *x*, the isolation wavelength number, is restricted to the channels immediately adjacent to the (channel) wavelength number associated with port *o*

NOTE This is illustrated in Figure 2 below. The adjacent channel crosstalk has the same meaning as adjacent channel isolation.

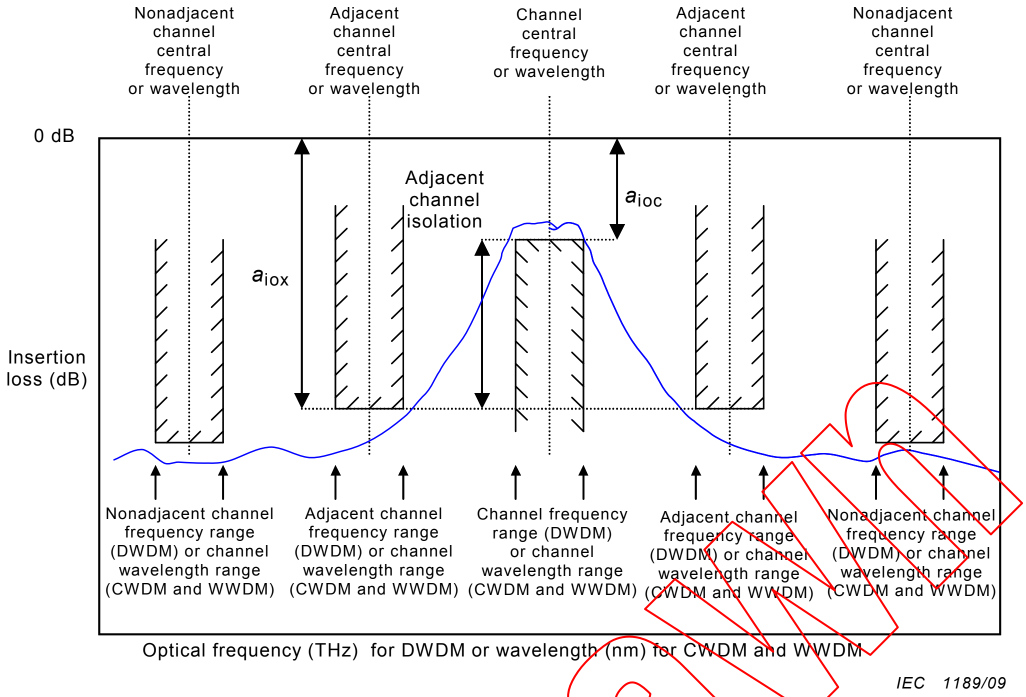

Figure 2 – Illustration of adjacent channel isolation

3.3.5
bidirectional (near-end) crosstalk attenuation
the (near-end) crosstalk attenuation for a bidirectional WDM multiplexer (MUX)/demultiplexer (DMUX) device

$BCA = a_{mox}$

where

a_{mox} is an element of the logarithmic transfer matrix;

m is the MUX input port number;

o is the DMUX output port number;

x is the wavelength number associated with port m.

3.3.6
bidirectional (near-end) isolation
(near-end) isolation for a bidirectional WDM-MUX/DEMUX device. Because bidirectional WDM-MUX/DMUX devices have both input channels and output channels at the same side of the device, input light for one direction can appear on the output port for the other direction. The bidirectional (near-end) isolation is defined to be:

$I_B = a_{mox} - a_{doc}$

where

a_{mox} is an element of the logarithmic transfer matrix;

a_{doc} is an element of the logarithmic transfer matrix;

d is the DMUX input port number;

o is the DMUX output port number;

c is the (channel) wavelength number associated with port o;

m is the MUX input port number;

x is the wavelength number associated with port *m*.

NOTE 1 In the example given below of a four-wavelength bidirectional system, wavelengths 1 and 2 travel from left to right and wavelengths 3 and 4 from right to left (see Figure 3).

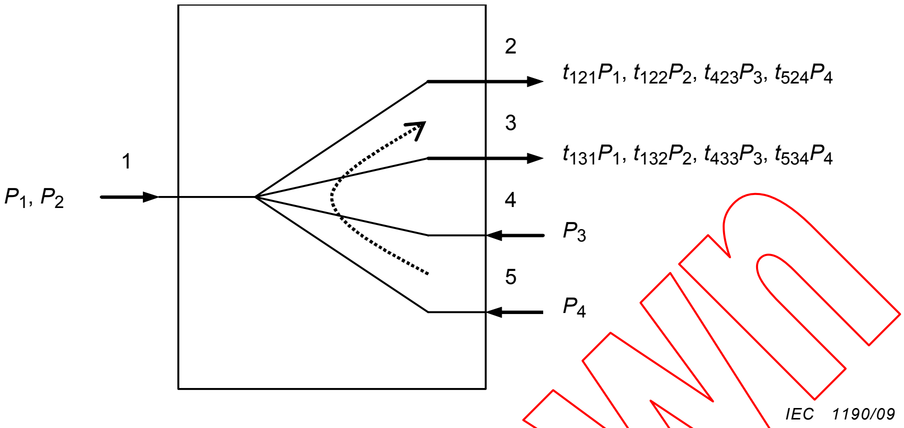

Figure 3 – Illustration of a four-wavelength bidirectional system

NOTE 2 For the example given above, the bidirectional isolation of port 2 to wavelength 3 is $a_{423} - a_{121}$.

3.3.7
centre wavelength deviation
differences between the centre wavelength and nominal wavelength (frequency) of the specified channel for DWDM devices. Where centre wavelength is defined as the centre of the wavelength range which is x dB less than the peak of insertion loss for the specified channel

NOTE 0,5, 1 or 3 are generally used for x.

3.3.8
channel extinction
within the operating wavelength range, the difference (in dB) between the minimum powers of the conducting channels (in dBm) and the maximum power of the isolated channels (in dBm)

3.3.9
channel frequency range
frequency range within which a DWDM device is required to operate with a specified performance. For a particular nominal channel frequency, f_{nomi}, this frequency range is from $f_{imin} = (f_{nomi} - \Delta f_{max})$ to $f_{imax} = (f_{nomi} + \Delta f_{max})$, where Δf_{max} is the maximum channel centre frequency deviation. Nominal; channel centre frequency and maximum channel centre frequency deviation are defined in ITU-T Rec. G.692

3.3.10
channel insertion loss
term used for WDM devices which has the same meaning as insertion loss

3.3.11
channel insertion loss deviation
maximum variation of the insertion loss over the operating wavelength range (channel frequency range for a DWDM device or channel wavelength range for a coarse WDM (CWDM) and a wide WDM (WWDM) device)

NOTE Channel insertion loss deviation should not to be confused with ripple defined below.