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Edition 2.0 2014-02

INTERNATIONAL STANDARD

colour inside

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

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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 SC 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

This second edition cancels and replaces the first edition, published in 2009, and constitutes a technical revision.

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

a) substantial updating to the definitions;
b) the addition of informative Annexes C to G, giving examples of technical information concerning WDM devices.

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

FDIS	Report on voting
86B/3700/FDIS	86B/3722/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.

A list of all parts in the IEC 62074 series, published under the general title *Fibre optic interconnecting devices and passive components – Fibre optic wdm devices*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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; however they may use temperature control only to stabilize the device characteristics; they exclude any optical switching functions;
- 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 following:

- optical, mechanical and environmental properties.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

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

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

IEC 61931, *Fibre optics – Terminology*

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

ISO 286-1, *Geometrical product specifications (GPS) – ISO coding system for tolerances of linear sizes – Part 1: Bases of tolerances and fits*

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

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-731, as well as the following, apply.

3.1 Basic term definitions

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

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 1 to entry: A detailed explanation of the transfer matrix is shown in Annex A. 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 2 to entry: Figure 1 below shows an example of a six-port device, with two input ports and four output ports. This WDM device can operate as four input ports and two output ports for their reciprocity characteristics. Also, it shall be noted that a combination of input and output port number can be selected, for example, 1 input port and 5 output ports, 3 input ports and 3 output ports and so on, especially for bi-directional transmission system application. Refer to Annex B.

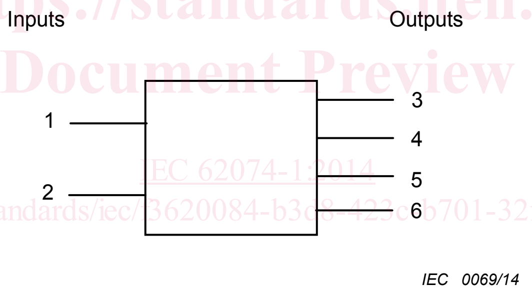

Figure 1 – Example of a six-port device, with two input and four output ports

Note 3 to entry: If there are four operating wavelengths, then the resulting transfer matrix becomes a 6 × 6 × 4 matrix: Optical attenuation at λ_1 from port 1 to port 6 would use a_{161}. Return loss of port 2 at λ_4 would use a_{224}. Optical attenuation from port 5 to port 2 at λ_3 would use a_{523}.

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

Note 1 to entry: t_{ij} is the number of more than or equal to zero, and less than or equal to one.

Note 2 to entry: A detailed 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}. a_{ij} is a number of positive and expressed in dB

Note 1 to entry: A detailed explanation is shown in Annex A.

3.1.5
conducting port pair
port pair consisting of i and j where t_{ij} is nominally greater than zero (ideally t_{ij} is 1 and a_{ij} is 0) at a specified wavelength

3.1.6
isolated port pair
pair i and j consisting where t_{ij} is nominally zero, and a_{ij} is nominally infinite at a specified wavelength

3.1.7
channel
wavelength (frequency) band in which an optical signal is transmitted for a WDM device

Note 1 to entry: WDM devices have two or more channels.

3.1.8
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 with three or more ports that shares optical power among its ports in a predetermined fashion, without any amplification 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 pairs of ports

3.2.2
wavelength division multiplexing device
wavelength division multiplexer
WDM device
synonym for a wavelength-selective branching device

Note 1 to entry: The term of wavelength-selective device is the contrast with the term of non-wavelength-selective branching device. The term of WDM device is frequently used.

3.2.3
dense wavelength division multiplexing device
DWDM device
WDM device which is intended to operate for a channel spacing equal or less than 1 000 GHz (approximately 8 nm at 1 550 nm and 5,7 nm at 1 310 nm)

3.2.4
coarse wavelength division multiplexing device
CWDM device
WDM device which is intended to operate for channel spacing less than 50 nm and greater than 1 000 GHz

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

3.2.6
wavelength multiplexer
MUX
WDM (DWDM, CWDM or WWDM) device which has *n* input ports and one output port, and whose 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) device which has one input port and *n* output ports, and whose 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
DWDM device which has three ports, and which function is to separate *n* different optical signals differentiated by wavelength from a common port and transmit an odd channel signal to one branching port and an even channel signal to the other branching port alternately

Note 1 to entry: An interleaver can operate as a wavelength multiplexer (OMUX) by reversing the demultiplexer.

3.3 Performance parameter definitions

3.3.1
operating wavelength
nominal wavelength λ_h at which a WDM device operates with the specified performance

Note 1 to entry: The term "operating wavelength" includes the wavelength to be nominally transmitting, designated attenuating and isolated.

Note 2 to entry: Operating frequency is also used for DWDM devices.

3.3.2
operating wavelength range
specified range of wavelengths including all operating wavelengths

Note 1 to entry: It includes all passbands and isolation wavelength ranges corresponding to all channels.

Note 2 to entry: The term "operating wavelength range" is defined for a WDM device, not for each channel or port.

3.3.3
channel wavelength range
range within which a CWDM or WWDM device operates with less than or equal to a specified optical attenuation for the conducting port pair

Note 1 to entry: For a particular nominal channel centre wavelength, λ_{nom}, this wavelength range from $\lambda_{imin} = (\lambda_{nom} - \Delta\lambda_{max})$ to $\lambda_{imax} = (\lambda_{nom} + \Delta\lambda_{max})$, where $\Delta\lambda_{max}$ is the maximum channel centre wavelength deviation.

Note 2 to entry: For CWDM devices, channel centre wavelengths and maximum channel centre wavelength deviations are defined as nominal central wavelengths and wavelength deviations in ITU-T. G 694.2.

Note 3 to entry: An illustration of channel wavelength range is shown in Figure 2.

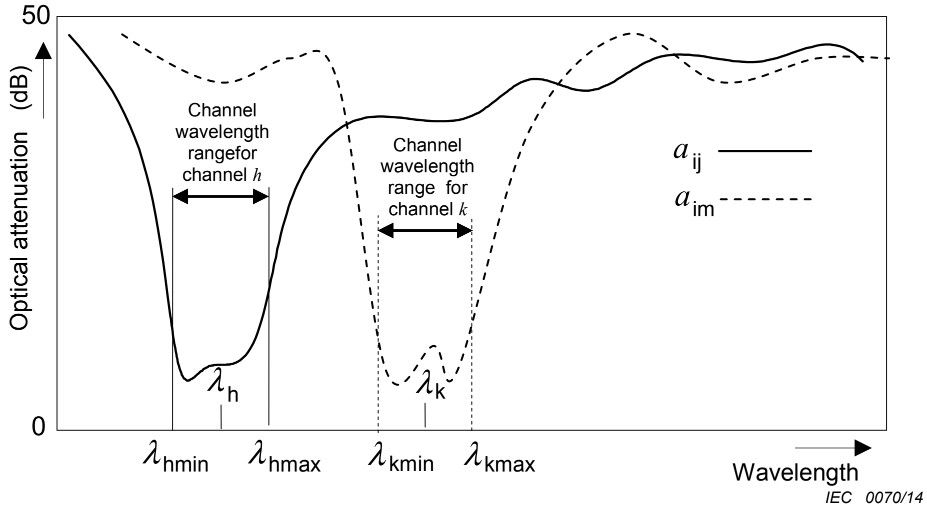

Figure 2 – Illustration of channel wavelength range

3.3.4
channel frequency range
frequency range within which a DWDM device is required to operate with less than or equal to a specified optical attenuation for the conducting port pair

Note 1 to entry: For a particular nominal channel frequency, f_{nomi}, this frequency range is from f_{imin} = (f_{nomi} - Δf_{max}) to $_{fimax}$ = (f_{nomi} + Δf_{max}), where Δf_{max} is the maximum channel centre frequency deviation.

Note 2 to entry: Nominal channel centre frequency and maximum channel centre frequency deviation are defined in ITU-T. G.694.1.

3.3.5
passband
channel passband
synonym for channel wavelength range (channel frequency range)

Note 1 to entry: Passband is frequently used.

Note 2 to entry: There are two or more passbands for WDM devices. Each passband is defined corresponding to each channel.

3.3.6
insertion loss
maximum value of a_{ij} (where $i \neq j$) within the passband for conducting port pair

Note 1 to entry: It is the optical attenuation from a given port to a port which is another port of conducting port pair of the given port of a WDM device. Insertion loss is a positive value in decibels. It is calculated as:

$$IL = -10\log\left(\frac{P_{out}}{P_{in}}\right)$$

where

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

P_{out} is the optical power received from the other port of the conducting port pair.

Note 2 to entry: An illustration of insertion loss is shown in Figure 3.

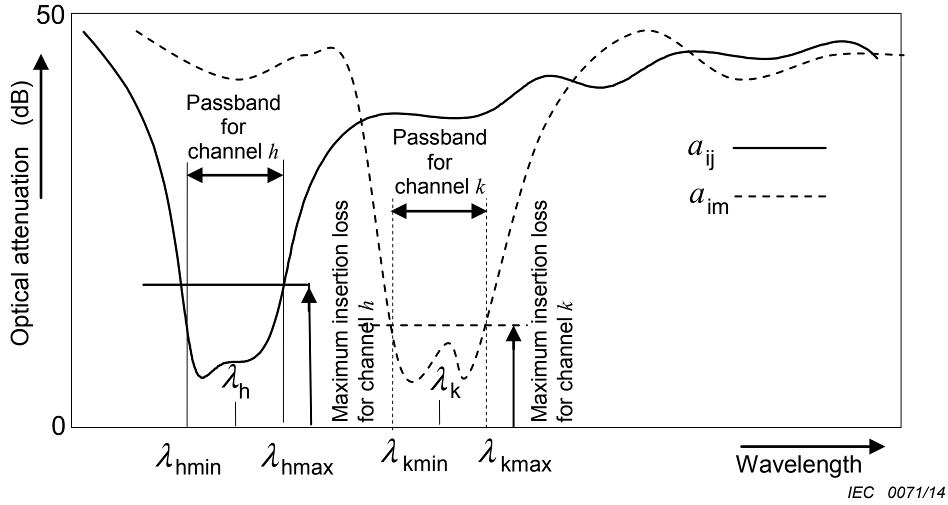

Figure 3 – Illustration of insertion loss

Note 3 to entry: For a WDM device, the insertion loss shall be specified as a maximum value of the insertion losses of all channels

3.3.7
channel insertion loss
term used for WDM devices which has a similar same meaning as insertion loss except that channel insertion loss is used for a channel whereas insertion loss is used in the specifications of both a WDM device and for a channel

3.3.8
passband ripple
maximum peak-to-peak variation of the insertion loss (absolute value) over the passband (within a channel frequency or wavelength range) (refer to Figure 4 below)

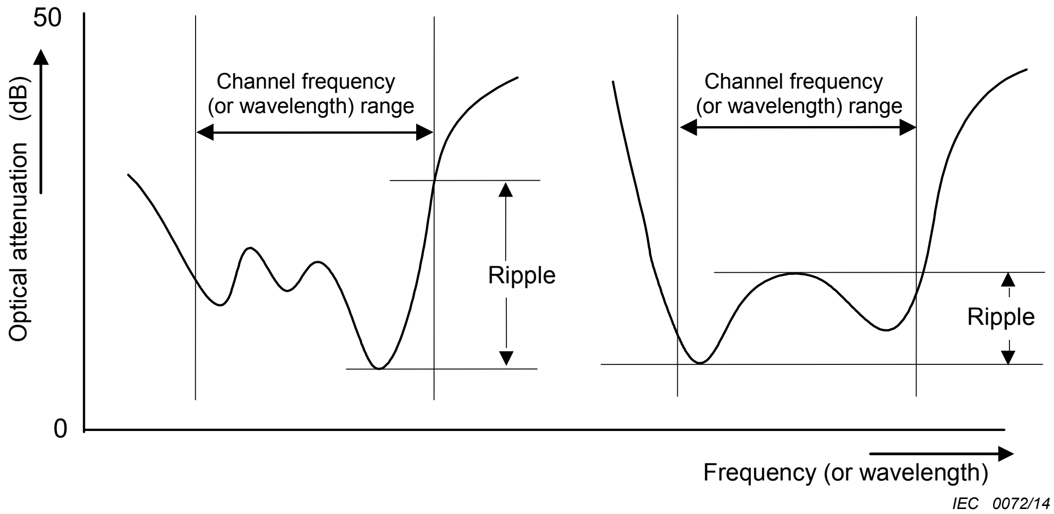

Figure 4a – Ripple at band edges **Figure 4b – Ripple in band**

Figure 4 – Illustration of ripple