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

**Dispositifs d'interconnexion et composants passifs à fibres optiques –
Dispositifs WDM à fibres optiques –
Partie 1: Spécification générique**



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INTERNATIONAL STANDARD

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Partie 1: Spécification générique**

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**FIBRE OPTIC INTERCONNECTING DEVICES AND
PASSIVE COMPONENTS – FIBRE OPTIC WDM DEVICES –****Part 1: Generic specification**

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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.

This bilingual version (2016-01) corresponds to the monolingual English version, published in 2014-02.

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.

The French version of this standard has not been voted upon.

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

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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 (standards.iteh.ai)

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 $n \times n$ 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: 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.

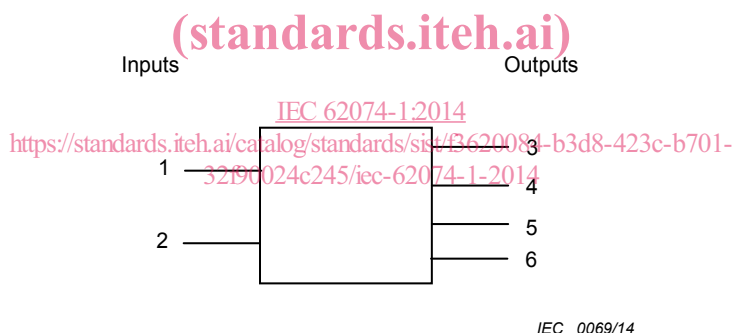


Figure 1 – Example of a six-port device, with two input and four output ports

Note 3 to entry: If there are four operating wavelengths, then the resulting transfer matrix becomes a $6 \times 6 \times 4$ 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

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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_n 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.

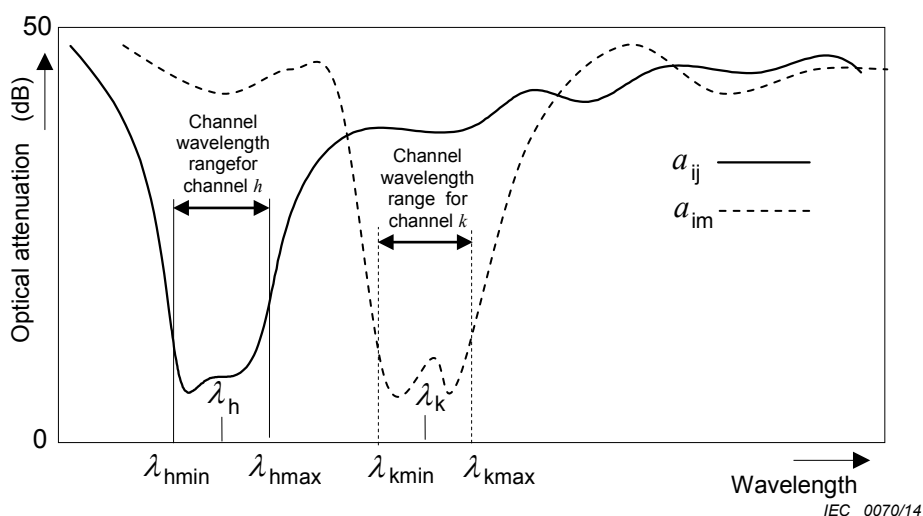


Figure 2 – Illustration of channel wavelength range

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_{nom} , this frequency range is from $f_{\text{imin}} = (f_{\text{nomi}} - \Delta f_{\text{max}})$ to $f_{\text{imax}} = (f_{\text{nomi}} + \Delta f_{\text{max}})$, 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:

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

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.

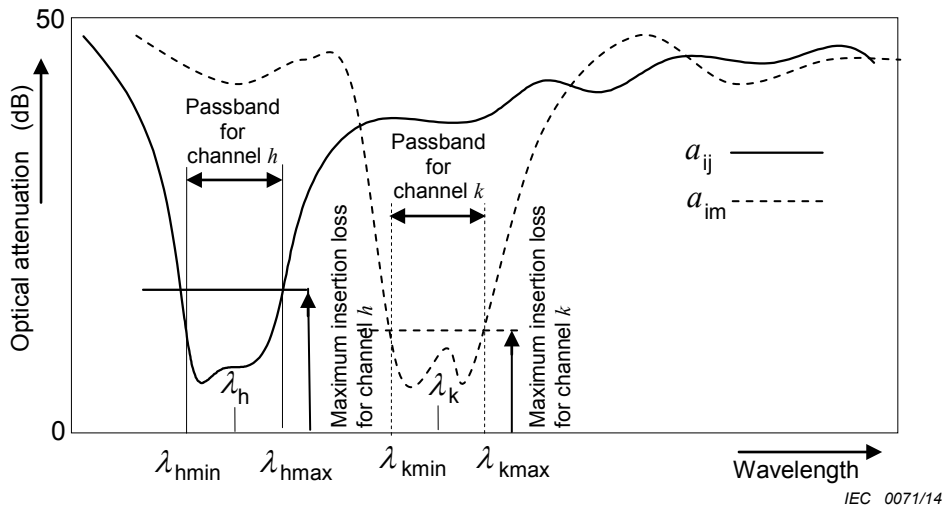


Figure 3 – Illustration of insertion loss

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

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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)

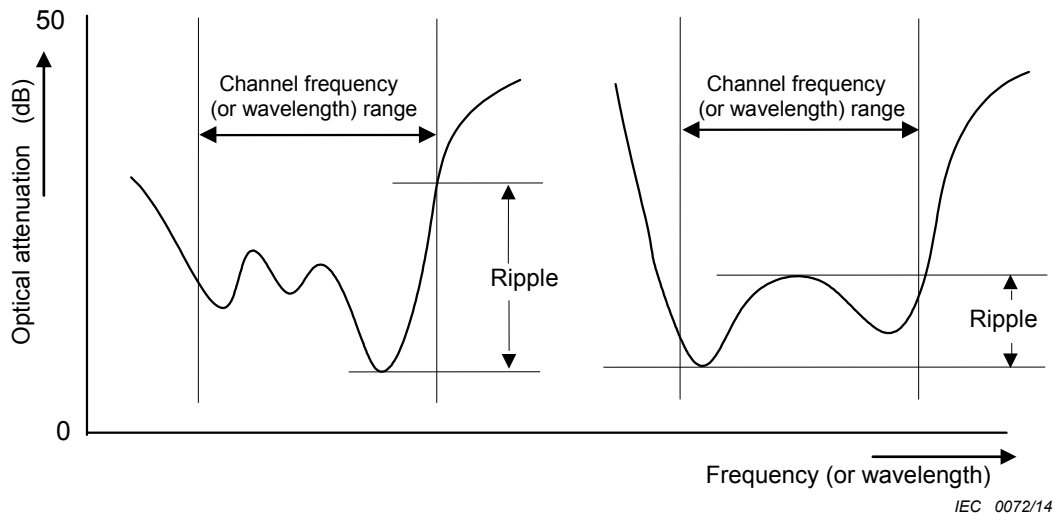


Figure 4a – Ripple at band edges

Figure 4b – Ripple in band

Figure 4 – Illustration of ripple

3.3.9**maximum channel insertion loss deviation**

maximum variation of the insertion loss (absolute value) within the passband (channel frequency range for a DWDM device or channel wavelength range for a coarse WDM (CWDM) and a wide WDM (WWDM) device) (See Figure 5)

Note 1 to entry: Channel insertion loss deviation should not to be confused with ripple defined in Figure 5 below.

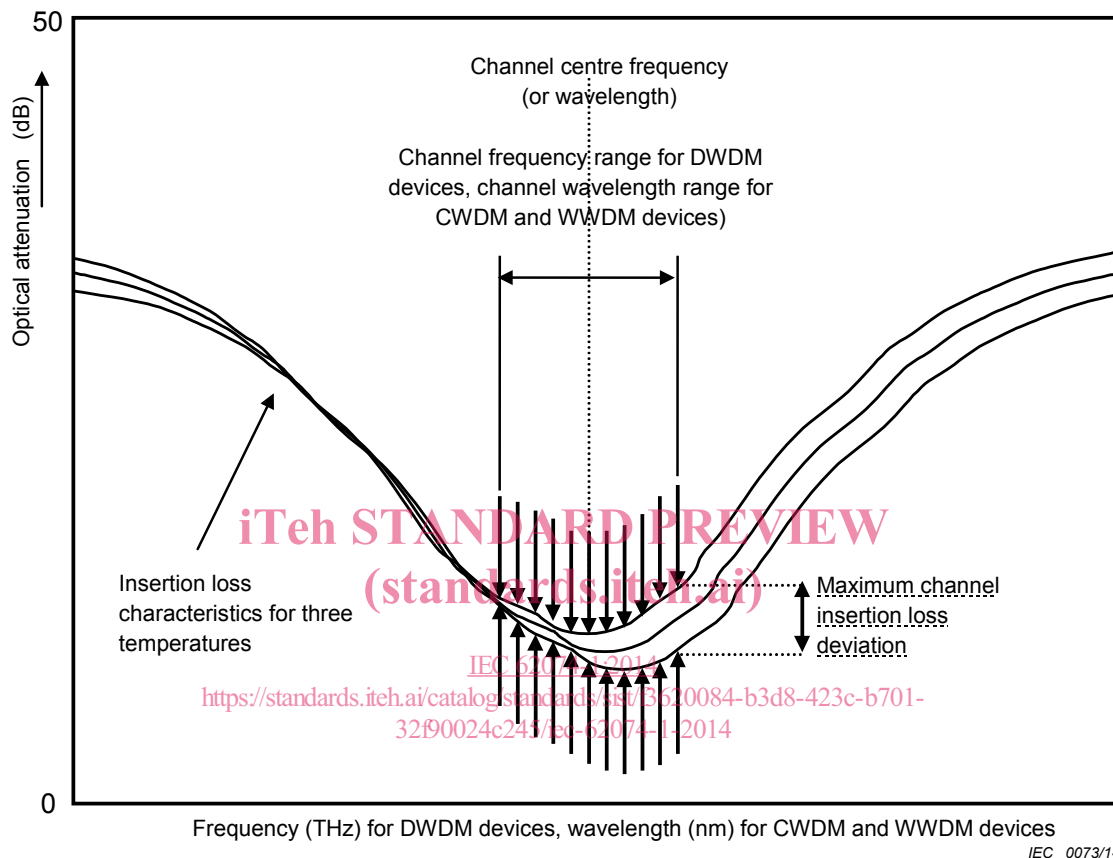


Figure 5 – Illustration of channel insertion loss variation

3.3.10**channel non-uniformity**

insertion loss channel non-uniformity

for a specified set of branching ports the difference between the maximum and the minimum insertion loss at the common port

Note 1 to entry: Channel non-uniformity is defined for a MUX ($N \times 1$ WDM device) and a DEMUX ($1 \times N$ WDM device). Channel non-uniformity is a positive value, and expressed in dB.

Note 2 to entry: For CWDM and DWDM devices, channel non-uniformity should be defined as the differences between the maximum and the minimum insertion loss at nominal wavelengths (frequencies) of all channels.

3.3.11**centre wavelength deviation**

difference between the centre wavelength and nominal wavelength (frequency) of the specified channel for DWDM devices, where the centre wavelength is defined as the centre of the wavelength range which is x dB less than the minimum optical attenuation for the specified passband (channel)

Note 1 to entry: 0,5, 1 or 3 are generally used for x .