

BS EN 62074-1:2009



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# Fibre optic interconnecting devices and passive components — Fibre optic WDM devices —

Part 1: Generic specification

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The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/2, Fibre optic interconnecting devices and passive components.

A list of organizations represented on this committee can be obtained on request to its secretary.

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# EN 62074-1

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English version

**Fibre optic interconnecting devices and passive components -  
Fibre optic WDM devices -  
Part 1: Generic specification  
(IEC 62074-1:2009)**

Dispositifs d'interconnexion  
et dispositifs passifs à fibres optiques -  
Dispositifs WDM à fibres optiques -  
Partie 1: Spécification générique  
(CEI 62074-1:2009)

Lichtwellenleiter -  
Verbindungselemente  
und passive Bauteile -  
Lichtwellenleiter-WDM-Bauteile -  
Teil 1: Fachgrundspezifikation  
(IEC 62074-1:2009)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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## CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

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## Foreword

The text of document 86B/2850/FDIS, future edition 1 of IEC 62074-1, prepared by SC 86B, Fibre optic interconnecting devices and passive components, of IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62074-1 on 2009-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented  
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- latest date by which the national standards conflicting  
with the EN have to be withdrawn (dow) 2012-10-01

Annex ZA has been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 62074-1:2009 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

|             |                                                      |
|-------------|------------------------------------------------------|
| IEC 61300-1 | NOTE Harmonized as EN 61300-1:2003 (not modified).   |
| IEC 61300-2 | NOTE Harmonized in EN 61300-2 series (not modified). |
| IEC 61300-3 | NOTE Harmonized in EN 61300-3 series (not modified). |

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## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

| <u>Publication</u>         | <u>Year</u>     | <u>Title</u>                                                                                                                    | <u>EN/HD</u>  | <u>Year</u>        |
|----------------------------|-----------------|---------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|
| IEC 60027                  | Series          | Letter symbols to be used in electrical technology                                                                              | EN 60027      | Series             |
| IEC 60050-731              | - <sup>1)</sup> | International Electrotechnical Vocabulary (IEV) - Chapter 731: Optical fibre communication                                      | -             | -                  |
| IEC 60617                  | Data-base       | Graphical symbols for diagrams                                                                                                  | -             | -                  |
| IEC 60695-11-5             | - <sup>1)</sup> | Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance | EN 60695-11-5 | 2005 <sup>2)</sup> |
| IEC 60825                  | Series          | Safety of laser products                                                                                                        | EN 60825      | Series             |
| ISO 129-1                  | - <sup>1)</sup> | Technical drawings - Indication of dimensions - and tolerances - Part 1: General principles                                     | -             | -                  |
| ISO 286-1                  | - <sup>1)</sup> | ISO system of limits and fits - Part 1: Bases of tolerances, deviations and fits                                                | EN 20286-1    | 1993 <sup>2)</sup> |
| ISO 370                    | - <sup>1)</sup> | Toleranced dimensions - Conversion from inches into millimetres and vice versa                                                  | -             | -                  |
| ISO 1101                   | - <sup>1)</sup> | Geometrical Product Specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out      | EN ISO 1101   | 2005 <sup>2)</sup> |
| ISO 8601                   | - <sup>1)</sup> | 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                                                             | -             | -                  |

<sup>1)</sup> Undated reference.

<sup>2)</sup> Valid edition at date of issue.

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

NOTE 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**

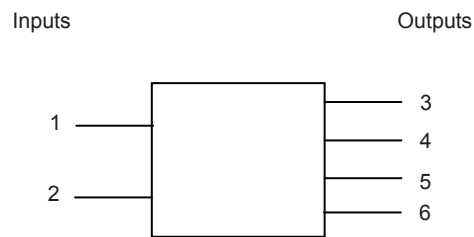
two ports  $i$  and  $j$  between which  $t_{ij}$  is nominally greater than zero at a specified wavelength

##### 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.



IEC 1188/09

**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  $6 \times 6 \times 4$  matrix: loss at  $\lambda_1$  from port 1 to port 6 would use  $a_{161}$ . Reflectance of port 2 at  $\lambda_4$  would use  $a_{224}$ . Loss from port 5 to port 2 at  $\lambda_3$  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

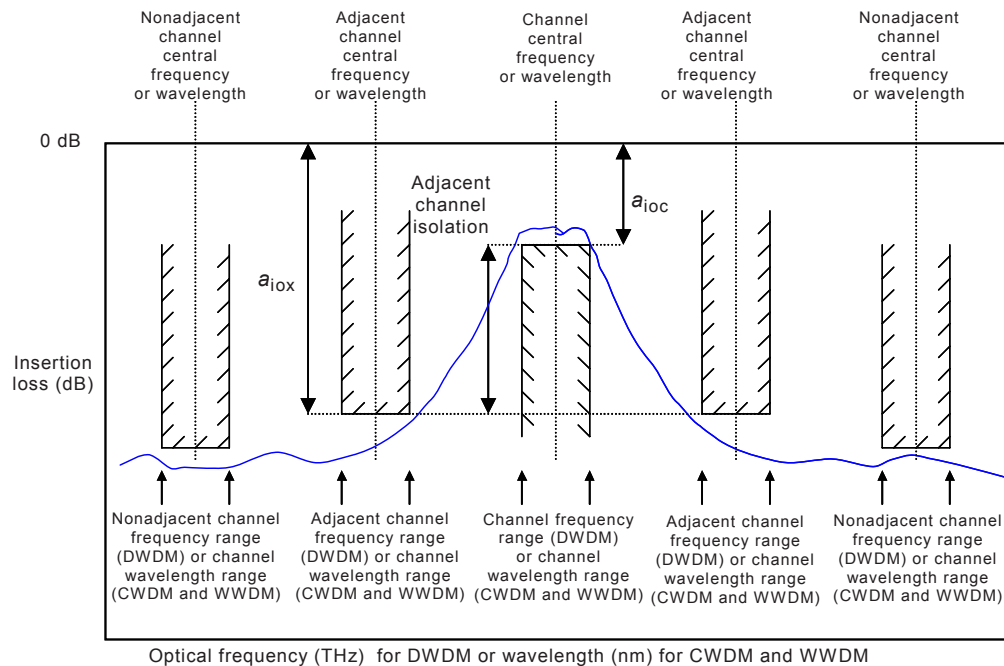
**3.3.3****add-drop isolation**

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.



IEC 1189/09

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;

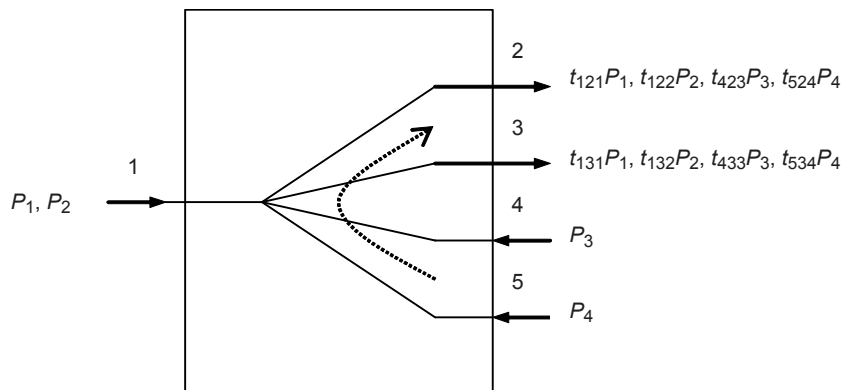
$o$  is the DMUX output port number;

$c$  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).



IEC 1190/09

**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,  $f_{\text{nomi}}$ , 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  $\Delta f_{\text{max}}$  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.