BS EN 61753-088-2:2013

BSI Standards Publication

Fibre optic interconnecting devices and passive components — Performance standard

Part 088-2: Non-connectorized single-mode fibre optic LAN WDM devices with channel spacing of 800 GHz for category C — Controlled environments

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National foreword

This British Standard is the UK implementation of EN 61753-088-2:2013. It is identical to IEC 61753-088-2:2013. It supersedes DD IEC/PAS 61753-088-2: 2010 which is withdrawn.

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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Fibre optic interconnecting devices and passive components - Performance standard - Part 088-2: Non-connectorized single-mode fibre optic LAN WDM devices with channel spacing of 800 GHz for category C - Controlled environments

(IEC 61753-088-2:2013)

Dispositifs d'interconnexion et composants passifs à fibres optiques - Norme de performance - Partie 088-2: Dispositifs LAN WDM à fibres optiques unimodales, non connectorisés, avec un espacement entre canaux de 800 GHz, pour catégorie C - Environnements contrôlés
(CEI 61753-088-2:2013)

Lichtwellenleiter - Verbindungselemente und passive Bauteile - Betriebsverhalten - Teil 088-2: Nicht mit Steckverbindern versehene Einmoden LWL-LAN-WDM-Geräte mit Kanalweiten von 800 GHz für Kategorie C - Kontrollierte Umgebung
(IEC 61753-088-2:2013)

CENELEC

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Foreword

The text of document 86B/3549/FDIS, future edition 1 of IEC 61753-088-2, 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 approved by CENELEC as EN 61753-088-2:2013.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-01-22
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2016-04-22

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61753-088-2:2013 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 61300-3-2	NOTE	Harmonised as EN 61300-3-2.
IEC 61753-021-2	NOTE	Harmonised as EN 61753-021-2.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

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

Publication	Year	Title	EN/HD	Year
IEC 60793-2-50	-	Optical fibres - Part 2-50: Product specifications - Sectional specification for class B single-mode fibres	EN 60793-2-50	-
IEC 61300	Series	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures	EN 61300	Series
IEC 61300-2-1	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-1: Tests - Vibration (sinusoidal)	EN 61300-2-1	-
IEC 61300-2-4	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-4: Tests - Fibre/cable retention	EN 61300-2-4	-
IEC 61300-2-9	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-9: Tests - Shock	EN 61300-2-9	-
IEC 61300-2-17	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-17: Tests - Cold	EN 61300-2-17	-
IEC 61300-2-18	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-18: Tests - Dry heat - High temperature endurance	EN 61300-2-18	-
IEC 61300-2-19	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-19: Tests - Damp heat (steady state)	EN 61300-2-19	-
IEC 61300-2-22	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-22: Tests - Change of temperature	EN 61300-2-22	-
IEC 61300-2-42	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-42: Tests - Static side load for connectors	EN 61300-2-42	-

Publication	Year	Title	EN/HD	Year
IEC 61300-3-7	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-7: Examinations and measurements - Wavelength dependence of attenuation and return loss of single mode components	EN 61300-3-7	-
IEC 61300-3-20	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-20: Examinations and measurements - Directivity of fibre optic branching devices	EN 61300-3-20	-
IEC 61300-3-28	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-28: Examinations and measurements - Transient loss	EN 61300-3-28	-
IEC 61300-3-29	-	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-29: Examinations and measurements - Measurement techniques for characterising the amplitude of the spectral transfer function of DWDM components	EN 61300-3-29	-
IEC 61753-1	2007	Fibre optic interconnecting devices and passive components performance standard - Part 1: General and guidance for performance standards	EN 61753-1	2007
IEC 62074-1	-	Fibre optic interconnecting devices and passive components - Fibre optic WDM devices - Part 1: Generic specification	EN 62074-1	-
ITU-T Recommendation G.959.1	-	Optical transport network physical layer interfaces	-	-
IEEE P802.3ba	-	Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications	-	-

CONTENTS

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 088-2: Non-connectorized single-mode fibre optic LAN WDM devices with channel spacing of 800 GHz for category C – Controlled environments

1 Scope

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which a non-connectorized single-mode fibre optic Local Area Network Wavelength Division Multiplexing (LAN WDM) device with channel spacing of 800 GHz needs to satisfy in order to be categorized as meeting the requirements of Category C – Controlled environments, as defined in Annex A of IEC 61753-1:2007. The applications of LAN WDM devices are optical MUX and DEMUX for 100GBASE-LR4 (required operating range of 2 m to 10 km) and 100GBASE-ER4 (required operating range of 2 m to 30 km) defined in IEEE P802.3ba, as shown in Annex D. The requirements cover both an integrated 1×4 LAN WDM device and an individual 1×2 LAN WDM device for cascaded module construction.

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 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*[1]

IEC 61300 (all parts), *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures*

IEC 61300-2-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal)*

IEC 61300-2-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre/cable retention*

IEC 61300-2-9, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-9: Tests – Shock*

IEC 61300-2-17, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

IEC 61300-2-18, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

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1 A fourth edition is due to be published shortly.

IEC 61300-2-22, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-2-42, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-42: Tests – Static side load for connectors*

IEC 61300-3-7, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-7: Examinations and measurements – Wavelength dependence of attenuation and return loss* of single mode components

IEC 61300-3-20, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-20: Examinations and measurements – Directivity of fibre optic branching devices*

IEC 61300-3-28, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*

IEC 61300-3-29, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-29: Examinations and measurements – Measurement techniques for characterizing the amplitude of the spectral transfer function of DWDM components*

IEC 61753-1:2007, *Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standard*

IEC 62074-1, *Fibre optic interconnecting devices and passive components – Fibre optic WDM devices – Part 1: Generic specification*

ITU-T Recommendation G.959.1, *Optical transport network physical layer interfaces*

IEEE P802.3ba, *Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62074-1, as well as the following, apply.

3.1
LAN WDM device
wavelength-selective branching device which performs the function both of wavelength multiplexing and demultiplexing with DWDM channel frequency of 231,4 THz, 230,6 THz, 229,8 THz, and 229,0 THz, where the channel frequency spacing is 800 GHz

3.2
integrated 1 × 4 LAN WDM device
single-mode fibre-pigtailed wavelength-selective branching device as shown in Figure 1. There is 1 common port (P0) and 4 input/output ports (P1-P4) corresponding to the 4 frequency channels

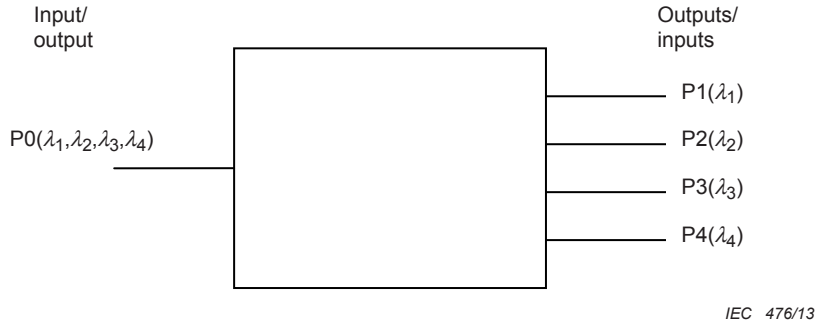

Figure 1 – Configuration of integrated 1 × 4 LAN WDM device

3.3
individual 1 × 2 LAN WDM device
single-mode fibre-pigtailed wavelength-selective branching device as shown in Figure 2. There are 4 types of individual 1 × 2 LAN WDM device, corresponding to the 4 frequency channels. There is 1 common port (P0) and 2 input/output ports (P1, P2). The signal of the corresponding channel frequency passes through between P0 and P1. The signals of non corresponding channel frequencies pass through between P0 and P2.

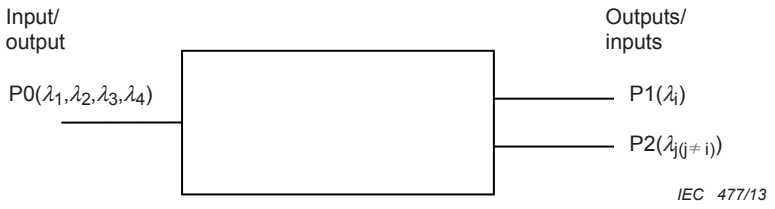

Figure 2 – Configuration of individual 1 × 2 LAN WDM device

4 Test conditions

Unless otherwise specified, all test methods are in accordance with the IEC 61300 series. LAN WDM devices used for each test are intended to be previously unstressed new samples but may also be selected from previously used samples if desired. The samples shall have pigtails of single-mode fibres as per IEC 60793-2-50, category B1.1, B1.3 or B6 in either coated fibres (primary and secondary) or reinforced cable format. All measurements shall be carried out under standard atmospheric conditions, unless otherwise specified. If the device is provided with an active temperature control, this shall be set at the set-point specified by the manufacturer.

The requirements apply to every combination of input and output ports.

All tests are to be carried out to validate performance over the required operating channel frequency range. As a result, single or multiple spectral bands may be chosen for the qualification and differing target specifications may be assigned to each spectral band.

5 Test report

Fully documented test reports and supporting evidence shall be prepared and be available for inspection as evidence that the tests have been carried out and complied with.

6 Reference components

The test for these components does not require the use of reference components.

7 Performance requirements

7.1 Channel requirements

Table 1 shows channel requirements (design information) as specified by IEEE P802.3ab and ITU-T Recommendation G.959.1.

Table 1 – Channel requirements

No	Items	Requirements
1	Centre frequency	Channel 1: 231,4 THz (≒ 1 295,56 nm) Channel 2: 230,6 THz (≒ 1 300,05 nm) Channel 3: 229,8 THz (≒ 1 304,58 nm) Channel 4: 229,0 THz (≒ 1 309,14 nm)
2	Channel spacing	800 GHz
3	Channel frequency range	Centre frequency ± 184 GHz Channel 1: 231,584 – 231,216 THz (≒ 1 294,53 – 1 296,59 nm) Channel 2: 230,784 – 230,416 THz (≒ 1 299,02 – 1 301,09 nm) Channel 3: 229,984 – 229,616 THz (≒ 1 303,54 – 1 305,63 nm) Channel 4: 229,184 – 228,816 THz (≒ 1 308,09 – 1 310,19 nm)

7.2 Dimensions

Dimensions shall comply with those given in appropriate manufacturers drawings.

7.3 Test details and requirements

A minimum length of fibre or cable of 2,0 m per port shall be included in all climatic and environmental test chambers. Even though a wavelength range is used instead of the precise required frequency range, the wavelength range required includes the required frequency range.

Table 2 – Test details and requirements *(1 of 5)*

No	Tests	Requirements	Details	
1	Attenuation (insertion loss) IEC 61300-3-29	Maximum allowable attenuation (insertion loss) over the channel frequency range according to Table 1: 2,0 dB (Integrated 1 × 4 LAN WDM device) See Annex B. 0,85 dB for P0-P1 (Individual 1 × 2 LAN WDM device) See Annex C. 0,45 dB for P0-P2 (Individual 1 × 2 LAN WDM device) See Annex C	Method: Launch fibre length: Wavelength scanning range Wavelength resolution Wavelength accuracy Step size	A and B can be applicable ≥ 2,0 m 1 290 – 1 315 nm ≤ 0,05 nm ≤ ± 0,025 nm ≤ 0,025 nm The insertion loss shall be determined as the worst case over all states of polarization. Test results should be obtained under measurement uncertainty of ± 0,05 dB
2	Adjacent: channel isolation IEC 61300-3-29	Minimum allowable adjacent channel isolation over the channel frequency range according to Table 1: 25 dB (Integrated 1 × 4 LAN WDM device) See Annex B. 25 dB for P0-P1 (Individual 1 × 2 LAN WDM device) See Annex C. 14 dB for P0-P2 (Individual 1 × 2 LAN WDM device) See Annex C	Method: Launch fibre length: Wavelength scanning range Wavelength resolution Wavelength accuracy Step size	A and B can be applicable ≥ 2,0 m 1 290 – 1 315 nm ≤ 0,05 nm ≤ ± 0,025 nm ≤ 0,025 nm The adjacent channel isolation is specified only for DEMUX. The adjacent channel isolation shall be determined as the worst case over all states of polarization. Test results should be obtained under measure-ment uncertainty of ± 0,5 dB

Table 2 *(2 of 5)*

No	Tests	Requirements	Details	
3	Non-adjacent channel Isolation IEC 61300-3-29	Minimum allowable non-adjacent channel isolation over the channel frequency range according to Table 1: 35 dB (Integrated 1 × 4 LAN WDM device) See Annex B. 35 dB for P0-P1 (Individual 1 × 2 LAN WDM device) See Annex C. 14 dB for P0-P2 (Individual 1 × 2 LAN WDM device) See Annex C	Method: Launch fibre length: Wavelength scanning range Wavelength resolution Wavelength accuracy Step size	A and B can be applicable ≥ 2,0 m 1 290 – 1 315 nm ≤ 0,05 nm ≤ ± 0,025 nm ≤ 0,025 nm The non-adjacent channel isolation is specified only for DEMUX. The non-adjacent channel isolation shall be determined as the worst case over all states of polarization. Test results should be obtained under measurement uncertainty of ± 0,5 dB
4	Return loss IEC 61300-3-7	Minimum allowable return loss over the channel frequency range according to Table 1: 40 dB Grade R	Method: Launch fibre length	A, B, C and D can be applicable. ≥ 2,0 m Test results should be obtained under measurement uncertainty of ± 1 dB. All ports not under test shall be terminated to avoid unwanted reflections contributing to the measurement
5	Directivity IEC 61300-3-20	Maximum allowable directivity over the channel frequency range according to Table 1: 50 dB Grade U	Launch fibre length: Source:	≥ 2,0 m Laser diode Test results should be obtained under measurement uncertainty of ± 1 dB. All ports not under test shall be terminated to avoid unwanted reflections contributing to the measurement. The directivity shall be measured between any pair of input or output ports

Table 2 *(3 of 5)*

N°	Tests	Requirements	Details	
6	Polarization dependent loss (PDL) IEC 61300-3-29	Maximum allowable PDL over the channel frequency range according to Table 1: 0,5 dB for 1 x 4 0,2 dB for 1 x 2	Method: Launch fibre length: Wavelength scanning range: Wavelength resolution: Wavelength accuracy: Step size	A and B can be applicable ≥ 2,0 m 1 290 – 1 315 nm ≤ 0,05 nm ≤ ± 0,025 nm ≤ 0,025 nm Test results should be obtained under measurement uncertainty of ± 0,05 dB
7	Optical power handling IEC 61300-2-14	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within ± 0,3 dB of the initial value.	Method: Input power for short-term test: Duration of the optical power exposure: Temperature: Note:	2 200 mW, 400 mW, 600 mW, 800 mW, (continuing in increments of 200 mW) 500 h (long-term test) 60 °C ± 2 °C Input power for the long-term test is determined by he short-term test. Test results should be obtained under attenuation measurement uncertainty of less than ± 0,05 dB. Test results should be obtained under return loss measurement uncertainty of less than ± 1 dB
8	Cold: IEC 613002-17	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	Temperature: Duration of exposure:	–10 °C ± 2 °C 96 h

Table 2 *(4 of 5)*

No	Tests	Requirements	Details	
9	High temperature endurance IEC 61300-2-18	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	Temperature: Duration of exposure	+60 °C ± 2 °C 96 h
10	Damp heat (steady state) IEC 61300-2-19	Before and after the test, the limits of insertion loss, isolation and return loss of test no. 1, 2 and 3 shall be met. During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within ± 0,3 dB of the initial value. During the test, the adjacent and non-adjacent isolation changes are monitored. The sum of the initial values and the changes of the isolations shall be within the value defined at test no. 2 and 3	Temperature: Relative humidity: Duration of exposure	+40°C ± 2 °C 93 $^{+2}_{-3}$ % RH 96 h
11	Change of temperature IEC 61300-2-22	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within ± 0,3 dB of the initial value. During the test, the adjacent and non-adjacent isolation changes are monitored. The sum of the initial values and the changes of the isolations shall be within the value defined at test no. 2 and 3	High temperature: Low temperature: Number of cycles: Duration at extreme temperature: Rate of change: Maximum interval between measurements	+60 °C ± 2 °C –10 °C ± 2 °C 5 60 min 1 °C/min 30 min
12	Vibration IEC 61300-2-1 IEC 61300-3-28	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within ± 0,3 dB of the initial value. During the test, the adjacent and non-adjacent isolation changes are monitored. The sum of the initial values and the changes of the isolations shall be within the value defined at test no. 2 and 3	Frequency range: Number of axes: Number of sweeps: Sweep rate: Amplitude	5 Hz – 55 Hz. 3 orthogonal axes 15/axis 1 octave/min 0,75 mm

Table 2 *(5 of 5)*

No	Tests	Requirements	Details	
13	Shock IEC 61300-2-9	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value.	Acceleration: Duration: Number of axis: Number of shocks:	Components: 5 000 m/s^2 Modules: 0,125 kg < module mass ≤ 0,225 kg: 2 000 m/s^2 0,225 kg < module mass ≤ 1 kg: 500 m/s^2 1 ms, half sine pulse 3 axes in 2 directions 2 shocks per axis, 12 shock in total
14	Optical fibre cable flexing IEC 61300-2-44	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	Tensile force: Number of cycles:	2 N for reinforced cable 30 cycles ± 90°
15	Fibre/cable retention IEC 61300-2-4	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	Magnitude and rate of application: Duration of the test: Point of application of tensile load: Method of mounting:	(10 ± 1) N at 5 N/s for reinforced cables (5,0 ± 0,5) N at 0,5 N/s for secondary coated fibres (2,0 ± 0,2) N at 0,5 N/s for primary coated fibres 120 s duration at 10 N 60 s duration at 2 N or 5 N 0,3 m from the exit point of the fibre / cable from the specimen. The sample shall be rigidly mounted such that the load is only applied to the fibre/cable retention mechanism
16	Static side load IEC 61300-2-42	Before and after the test, the limits of insertion loss, adjacent channel isolation, non-adjacent channel isolation and return loss of test no. 1, 2, 3 and 4 shall be met. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	Magnitude and duration of the tensile load: Direction of application:	1 N for 1 h for reinforced cable 0,2 N for 5 min for secondary coated fibres Two mutually perpendicular directions

Annex A
(normative)

Sample size

The number of samples to be evaluated for each test is defined in the sample size column in the following Table A.1.

Table A.1 – Number of samples for each test

No	Tests	Sample size
1	Attenuation (insertion loss)	12
2	Adjacent channel isolation	12
3	Non-adjacent channel Isolation	12
4	Return loss	12
5	Directivity	12
6	Polarisation dependent loss (PDL)	12
7	Optical power handling	6
8	Cold	6
9	High temperature endurance	6
10	Damp heat (steady state)	6
11	Change of temperature	6
12	Vibration (sinusoidal)	6
13	Shock	6
14	Optical fibre cable flexing	6
15	Fibre/cable retention	6
16	Static side load	6

Annex B
(informative)

Logarithmic transfer matrix for an integrated 1 × 4 LAN WDM device

Tables B.1 to B.4 show logarithmic transfer matrix for the integrated 1 × 4 WDM device.

IL_{P1} is a maximum insertion loss between P0 and P1.

IL_{P2} is a maximum insertion loss between P0 and P2.

IL_{P3} is a maximum insertion loss between P0 and P3.

IL_{P4} is a maximum insertion loss between P0 and P4.

Unit is dB.

Table B.1 – Logarithmic transfer matrix for channel 1: Frequency range of 231,584 – 231,216 THz (≈1 294,53 – 1 296,59 nm)

	P0	P1	P2	P3	P4
P0	≥ 40	≤ 2,0	≥ 25+IL_{P2}	≥ 35+IL_{P3}	≥ 35+IL_{P4}
P1	≤ 2,0	≥ 40	≥ 50	≥ 50	≥ 50
P2	≥ 25+IL_{P2}	≥ 50	≥ 40	≥ 50	≥ 50
P3	≥ 35+IL_{P3}	≥ 50	≥ 50	≥ 40	≥ 50
P4	≥ 35+IL_{P4}	≥ 50	≥ 50	≥ 50	≥ 40

Table B.2 – Logarithmic transfer matrix for channel 2: Frequency range of 230,784 – 230,416 THz (≈1 299,02 – 1 301,09 nm)

	P0	P1	P2	P3	P4
P0	≥ 40	≥ 25+IL_{P1}	≤ 2,0	≥ 25+IL_{P3}	≥ 35+IL_{P4}
P1	≥ 25+IL_{P1}	≥ 40	≥ 50	≥ 50	≥ 50
P2	≤ 2,0	≥ 50	≥ 40	≥ 50	≥ 50
P3	≥ 25+IL_{P3}	≥ 50	≥ 50	≥ 40	≥ 50
P4	≥ 35+IL_{P4}	≥ 50	≥ 50	≥ 50	≥ 40

Table B.3 – Logarithmic transfer matrix for channel 3: Frequency range of 229,984 – 229,616 THz (≈1 303,54 – 1 305,63 nm)

	P0	P1	P2	P3	P4
P0	≥ 40	≥ 35+IL_{P1}	≥ 25+IL_{P2}	≤ 2,0	≥ 25+IL_{P4}
P1	≥ 35+IL_{P1}	≥ 40	≥ 50	≥ 50	≥ 50
P2	≥ 25+IL_{P2}	≥ 50	≥ 40	≥ 50	≥ 50
P3	≤ 2,0	≥ 50	≥ 50	≥ 40	≥ 50
P4	≥ 25+IL_{P4}	≥ 50	≥ 50	≥ 50	≥ 40

Table B.4 – Logarithmic transfer matrix for channel 4: Frequency range of 229,184 – 228,816 THz (≈1 308,09 – 1 310,19 nm)

	P0	P1	P2	P3	P4
P0	≥ 40	≥ 35+IL_{P1}	≥ 35+IL_{P2}	≥ 25+IL_{P3}	≤ 2,0
P1	≥ 35+IL_{P1}	≥ 40	≥ 50	≥ 50	≥ 50
P2	≥ 35+IL_{P2}	≥ 50	≥ 40	≥ 50	≥ 50
P3	≥ 25+IL_{P3}	≥ 50	≥ 50	≥ 40	≥ 50
P4	≤ 2,0	≥ 50	≥ 50	≥ 50	≥ 40

Annex C
(informative)

Logarithmic transfer matrix for an individual 1 × 2 LAN WDM device

Tables C.1 to C.4 show logarithmic transfer matrix for the individual 1 × 2 WDM device.

IL_{P1} is a maximum insertion loss between P0 and P1.

IL_{P2} is a maximum insertion loss between P0 and P2.

Unit is dB.

Type 1

Table C.1 – Logarithmic transfer matrix for channel 1: Frequency range of 231,584 – 231,216 THz (≈1 294,53 – 1 296,59 nm)

	P0	P1	P2
P0	≥ 40	≤ 0,85	≥ 14 +IL_{P2}
P1	≤ 0,85	≥ 40	≥ 50
P2	≥ 14 +IL_{P2}	≥ 50	≥ 40

Table C.2 – Logarithmic transfer matrix for channel 2: Frequency range of 230,784 – 230,416 THz (≈1 299,02 – 1 301,09 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL_{P1}	≤ 0,45
P1	≥ 25+IL_{P1}	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.3 – Logarithmic transfer matrix for channel 3: Frequency range of 229,984 – 229,616 THz (≈1 303,54 – 1 305,63 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL_{P1}	≤ 0,45
P1	≥ 35+IL_{P1}	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.4 – Logarithmic transfer matrix for channel 4: Frequency range of 229,184 – 228,816 THz (≈1 308,09 – 1 310,19 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL_{P1}	≤ 0,45
P1	≥ 35+IL_{P1}	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Type 2

Table C.5 – Logarithmic transfer matrix for channel 1: Frequency range of 231,584 – 231,216 THz (≈1 294,53 – 1 296,59 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL $_{P1}$	≤ 0,45
P1	≥ 25+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.6 – Logarithmic transfer matrix for channel 2: Frequency range of 230,784 – 230,416 THz (≈1 299,02 – 1 301,09 nm)

	P0	P1	P2
P0	≥ 40	≤ 0,85	≥ 14 +IL $_{P2}$
P1	≤ 0,85	≥ 40	≥ 50
P2	≥ 14 +IL $_{P2}$	≥ 50	≥ 40

Table C.7 – Logarithmic transfer matrix for channel 3: Frequency range of 229,984 – 229,616 THz (≈1 303,54 – 1 305,63 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL $_{P1}$	≤ 0,45
P1	≥ 25+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.8 – Logarithmic transfer matrix for channel 4: Frequency range of 229,184 – 228,816 THz (≈1 308,09 – 1 310,19 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL $_{P1}$	≤ 0,45
P1	≥ 35+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Type 3

Table C.9 – Logarithmic transfer matrix for channel 1: Frequency range of 231,584 – 231,216 THz (≈1 294,53 – 1 296,59 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL $_{P1}$	≤ 0,45
P1	≥ 35+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.10 – Logarithmic transfer matrix for channel 2: Frequency range of 230,784 – 230,416 THz (≈1 299,02 – 1 301,09 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL $_{P1}$	≤ 0,45
P1	≥ 25+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.11 – Logarithmic transfer matrix for channel 3: Frequency range of 229,984 – 229,616 THz (≈1 303,54 – 1 305,63 nm)

	P0	P1	P2
P0	≥ 40	≤ 0,85	≥ 14 +IL $_{P2}$
P1	≤ 0,85	≥ 40	≥ 50
P2	≥ 14 +IL $_{P2}$	≥ 50	≥ 40

Table C.12 – Logarithmic transfer matrix for channel 4: Frequency range of 229,184 – 228,816 THz (≈1 308,09 – 1 310,19 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL $_{P1}$	≤ 0,45
P1	≥ 25+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Type 4

Table C.13 – Logarithmic transfer matrix for channel 1: Frequency range of 231,584 – 231,216 THz (≈1 294,53 – 1 296,59 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL $_{P1}$	≤ 0,45
P1	≥ 35+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.14 – Logarithmic transfer matrix for channel 2: Frequency range of 230,784 – 230,416 THz (≈1 299,02 – 1 301,09 nm)

	P0	P1	P2
P0	≥ 40	≥ 35+IL $_{P1}$	≤ 0,45
P1	≥ 35+IL $_{P1}$	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.15 – Logarithmic transfer matrix for channel 3: Frequency range of 229,984 – 229,616 THz (≈1 303,54 – 1 305,63 nm)

	P0	P1	P2
P0	≥ 40	≥ 25+IL_{P1}	≤ 0,45
P1	≥ 25+IL_{P1}	≥ 40	≥ 50
P2	≤ 0,45	≥ 50	≥ 40

Table C.16 – Logarithmic transfer matrix for channel 4: Frequency range of 229,184 – 228,816 THz (≈1 308,09 – 1 310,19 nm)

	P0	P1	P2
P0	≥ 40	≤ 0,85	≥ 14 +IL_{P2}
P1	≤ 0,85	≥ 40	≥ 50
P2	≥ 14 +IL_{P2}	≥ 50	≥ 40

Annex D
(informative)

General information for applications of integrated 1 × 4 LAN WDM devices

The applications of integrated 1 × 4 LAN WDM devices are optical MUX and DEMUX for 100GBASE-LR4 and 100GBASE-ER4 defined in IEEE Draft P802.3ba, as shown in Figure D.1.

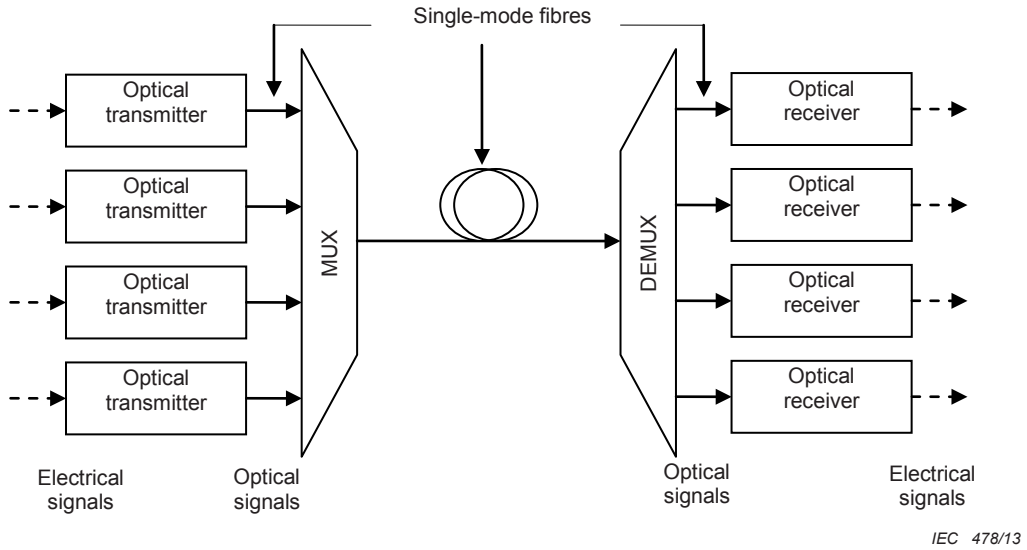

Figure D.1 – Block diagram for 100GBASE-LR4 and 100GBASE-ER4 transmit/receive paths

Annex E
(informative)

General information for internal configurations of integrated 1 × 4 LAN WDM devices

Internal configurations of integrated 1 × 4 LAN WDM devices are shown in Figure E.1 to E.3.

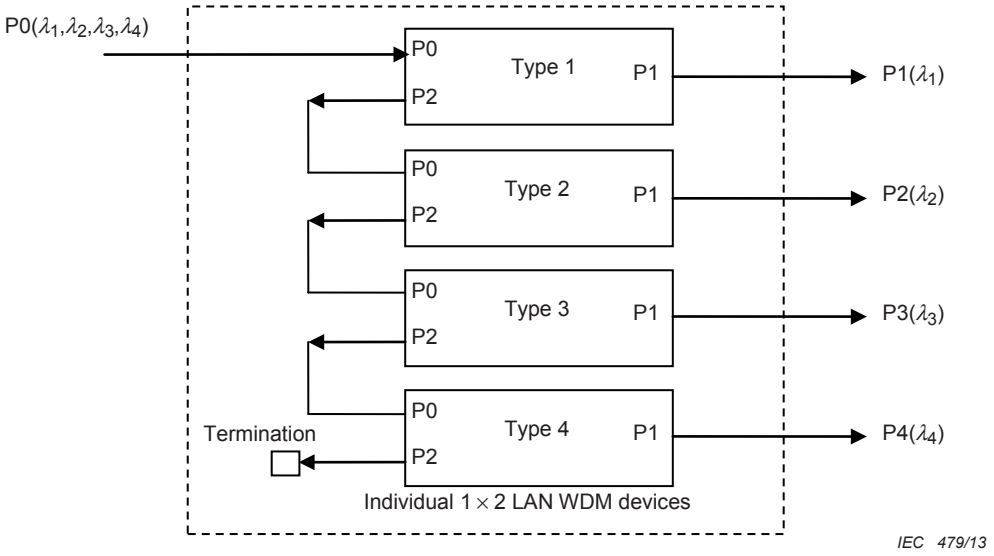

Figure E.1 – Configuration example of serial-type integrated 1 × 4 LAN WDM device (DEMUX)

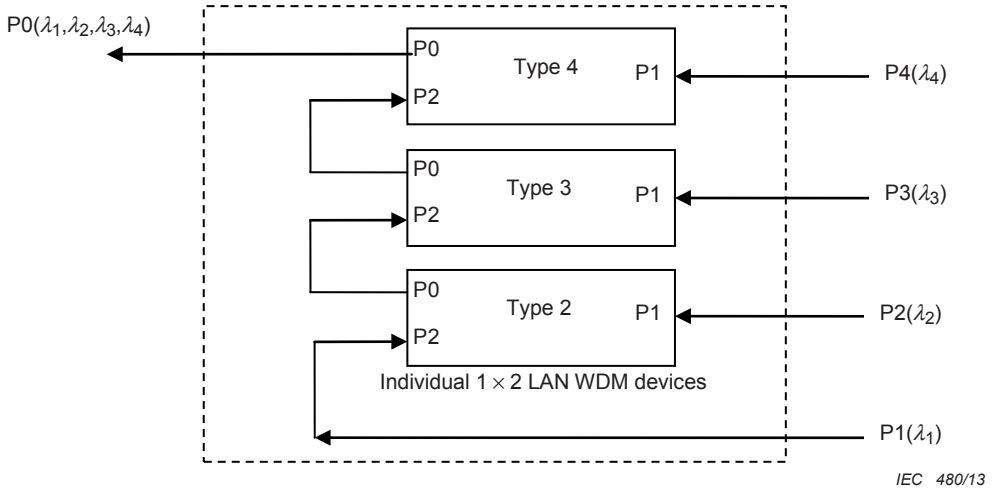

Figure E.2 – Configuration example of serial-type integrated 1 × 4 LAN WDM device (MUX)

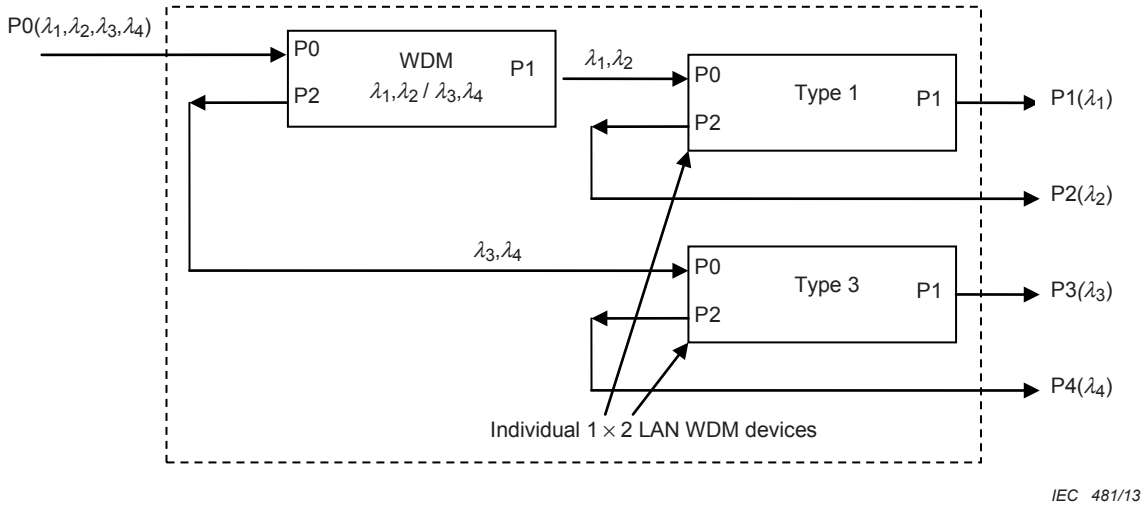

Figure E.3 – Configuration example of tree-type integrated 1 × 4 LAN WDM device (MUX/DEMUX)

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