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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Performance standard –
Part 081-06: Non-connectorized single-mode fibre optic middle-scale 1 × N DWDM devices for category OP+ – Extended outdoor protected environment

Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance –
Partie 081-06: Dispositifs DWDM 1 × N de milieu d'échelle fibroniques unimodaux, non connectorisés, pour catégorie OP+ – Environnement extérieur protégé étendu

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 081-06: Non-connectorized single-mode fibre optic middle-scale 1 × N DWDM devices for category OP+ – Extended outdoor protected environment

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IEC 61753-081-06 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics. It is an International Standard.

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The text of this International Standard is based on the following documents:

Draft	Report on voting
86B/4804/FDIS	86B/4822/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of IEC 61753 series, published under the general title *Fibre optic interconnecting devices and passive components – Performance standard*, can be found on the IEC website.

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FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 081-06: Non-connectorized single-mode fibre optic middle-scale 1 × N DWDM devices for category OP+ – Extended outdoor protected environment

1 Scope

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which a fibre optic middle-scale 1 × N (16 ≤ N ≤ 64) DWDM (dense wavelength division multiplexing) arrayed waveguide grating device with channel spacing of 50 GHz, 100 GHz or 200 GHz satisfies in order to be categorized as meeting the requirements of category OP+ (extended outdoor protected environment). The requirements are given for the DWDM devices with Gaussian passband profile and flat-top passband profile. The requirements exclude the devices with dynamic electrical temperature control.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60793-2-50, *Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres*

IEC 60794-2-50, *Optical fibre cables – Part 2-50: Indoor cables – Family specification for simplex and duplex cables for use in terminated cable assemblies*

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

IEC 61300-1, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 1: General and guidance*

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 or cable retention*

IEC 61300-2-5, *Fibre optic2 interconnecting devices and passive components – Basic test and measurement procedures – Part 2-5: Tests – Torsion*

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

IEC 61300-2-14, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-14: Tests – High optical power*

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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*

IEC 61300-2-21, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-21: Tests – Composite temperature/humidity cyclic test*

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

IEC 61300-2-26, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-26: Tests – Salt mist*

IEC 61300-2-27, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-27: Tests – Dust – Laminar flow*

IEC 61300-2-44, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-44: Tests – Flexing of the strain relief of fibre optic devices*

IEC 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examination and measurements – Polarization dependent loss in a single-mode fibre optic device*

IEC 61300-3-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

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 – Spectral transfer characteristics of DWDM devices*

IEC 61300-3-32, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-32: Examinations and measurements – Polarization mode dispersion measurement for passive optical components*

IEC 61300-3-38, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-38: Examinations and measurements – Group delay, chromatic dispersion and phase ripple*

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

IEC 61753-081-02, *Fibre optic interconnecting devices and passive components – Performance standard – Part 081-02: Non-connectorized single-mode fibre optic middle-scale 1 × N DWDM devices for category C – Controlled environments*

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

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IEC TS 62627-09, *Fibre optic interconnecting devices and passive components – Vocabulary for passive optical devices*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61753-081-02, IEC 62074-1 and IEC TS 62627-09, apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

4 Test

Unless otherwise specified, all test methods shall be in accordance with the IEC 61300 series. The samples shall be terminated onto single-mode fibres as per IEC 60793-2-50 category B-652.B, B-652.D or B-657 on either coated fibres (primary and secondary) or reinforced cable format as per IEC 60794-2-50. DWDM devices used for the test are intended to be previously unstressed new samples but may also be selected from previously used samples, if desired. All measurements shall be carried out at the standard atmospheric condition defined in IEC 61300-1, unless otherwise stated. If the device is provided with temperature control, this shall be set at the set-point specified by the manufacturer.

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

All tests shall be carried out to validate performance over the required operating wavelength 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.

Table 1 is intended to provide guidance on the wavelength ranges of the various spectral bands. It is not intended for specification. Values of operating wavelength used in performance verification shall be defined in the manufacturer's specification.

Table 1 – Single-mode spectral bands[1]

Band	Descriptor	Range nm
O-band	Original	1 260 to 1 360
E-band	Extended	1 360 to 1 460
S-band	Short wavelength	1 460 to 1 530
C-band	Conventional	1 530 to 1 565
L-band	Long wavelength	1 565 to 1 625
U-band	Ultralong wavelength	1 625 to 1 675

[1] Reproduced from ITU-T G-series Recommendations – Supplement 39, with the permission of ITU-T.

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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 Performance requirements

6.1 Reference components

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

6.2 Dimensions

Dimensions shall comply with either an appropriate IEC interface standard or with those given in appropriate manufacturers drawings, where the IEC interface standard does not exist or cannot be used.

6.3 Sample size

Sample sizes are defined in Table A.1 of Annex A.

6.4 Test details and requirements

The requirements are given only for pigtailed DWDM devices. For connectorized components, the connector performances shall be in compliance with IEC 61753-1.

The minimum length of fibre or cable of 1,0 m per port on each pigtailed side shall be used for all tests.

Test details and minimum requirements for category OP+ is shown in Table 2, Table 3 and Table 4.

Table 2 – Test details and requirements for type A (Gaussian passband profile)

No	Tests	Requirements	Details	
1A	Number of channels: N	$16 \leq N \leq 64$	Operating wavelength: NOTE	ITU-T grid (ITU-T Recommendation G.694.1) or custom design Design information (not test item)
2A	Channel frequency range	Channel central frequency $\pm$ 0,125 × Δf where Δf is the channel spacing	Channel central frequency: NOTE	ITU-T grid (ITU-T Recommendation G.694.1) or custom design Design information (not test item)
3A	Attenuation (insertion loss) IEC 61300-3-29	≤ 6,0 dB (channel spacing with 50 GHz) ≤ 4,5 dB (channel spacing with 100 GHz, 200 GHz) Maximum allowable attenuation (insertion loss) over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The attenuation (insertion loss) is determined as the maximum value over all states of polarization.
4A	Channel non-uniformity IEC 61300-3-29	≤ 1,5 dB Maximum allowable channel non-uniformity of attenuation.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The channel non-uniformity is determined as the maximum value over all states of polarization.

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No	Tests	Requirements	Details	
5A	1 dB passband width IEC 61300-3-29	≥ 0,25 × Δf where Δf is the channel spacing. Minimum allowable 1 dB passband width (centred at the channel frequency).	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,01 × Δf The 1 dB passband width is determined as the minimum value over all states of polarization.
6A	3 dB passband width IEC 61300-3-29	≥ 0,4 × Δf where Δf is the channel spacing (channel spacing with 200 GHz). ≥ 0,5 × Δf where Δf is the channel spacing (channel spacing with 50 GHz, 100 GHz). Minimum allowable 3 dB passband width (centred at the channel frequency).	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,01 × Δf The 3 dB passband width is determined as the minimum value over all states of polarization.
7A	Passband ripple IEC 61300-3-29	≤ 1,5 dB Maximum attenuation variation within the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The passband ripple is determined as the maximum value over all states of polarization.
8A	Adjacent channel crosstalk IEC 61300-3-29	≤ –25 dB Maximum allowable adjacent channel crosstalk over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB The adjacent channel crosstalk is specified only for demultiplexer. The adjacent channel crosstalk is determined as the maximum value over all states of polarization.
9A	Non-adjacent channel crosstalk IEC 61300-3-29	≤ –30 dB Maximum allowable non-adjacent channel crosstalk over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB The non-adjacent channel crosstalk is specified only for demultiplexer. The non-adjacent channel crosstalk is determined as the maximum value over all states of polarization.
10A	Total channel crosstalk IEC 61300-3-29	≤ –20 dB Maximum allowable total channel crosstalk value.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB The total channel crosstalk is specified only for demultiplexer. The total channel crosstalk is determined as the maximum value over all states of polarization.
11A	Polarization dependent loss (PDL) IEC 61300-3-2	≤ 0,75 dB Maximum allowable PDL over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,10 dB The allowable PDL combination applies to all combination of input and output ports.

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No	Tests	Requirements	Details	
12A	Polarization mode dispersion (PMD) IEC 61300-3-32	≤ 0,5 ps Maximum allowable PMD over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,1 ps The allowable PMD combination applies to all combination of input and output ports.
13A	Chromatic dispersion (CD) IEC 61300-3-38	≤ 20 ps/nm Maximum allowable CD over the channel frequency range (absolute value).	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 ps/nm The allowable CD combination applies to all combination of input and output ports.
14A	Return loss IEC 61300-3-6	≥ 40 dB Minimum allowable return loss.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB All ports not under test are terminated to avoid unwanted reflections contributing to the measurement.
15A	Directivity IEC 61300-3-20	≥ 40 dB Minimum allowable directivity.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB All ports not under test are terminated to avoid unwanted reflections contributing to the measurement. The directivity is measured between any pair of input or output ports.
16A	High optical power IEC 61300-2-14	Before and after the test, the limits of attenuation and return loss of test 3A and 14A shall be met. During the test, the change in attenuation is monitored. During and after the test, the change in attenuation (insertion loss) shall be within ±1,0 dB of the attenuation (insertion loss) at the starting to input high optical power after the DUT temperature is stable in the environmental chamber. After the test, the change in attenuation (insertion loss) shall be. within ±1,0 dB of that before the test (test 3A/B). During the test, the return loss is monitored. The return loss shall be within the value defined at test 14A.	Optical power: Wavelength: Duration of the optical power exposure: Temperature: Relative humidity: Input port: Measurement uncertainty:	300 mW 1 550 nm 30 min 75 °C ± 2 °C 93 % $^{+2}_{-3}$ % Single input port ≤ 0,2 dB for insertion loss before and after the test (test 3A) ≤ 1 dB for return loss before and after the test (test 14A) ≤ 0,05 dB for insertion loss change measurement during the test ≤ 1 dB for return loss measurement during the test If the device under test (DUT) is hermetically seal-packaged, it is not necessary to control the test humidity.

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Table 3 – Test details and requirements for type B (Flat-top passband profile)

No	Tests	Requirements	Details	
1B	Number of channels: N	$16 \leq N \leq 64$	Operating wavelength: NOTE	ITU-T grid (ITU-T Recommendation G.694.1) or custom design. Design information (not test item).
2B	Channel frequency range	Channel central frequency ± 0,125 × Δf where Δf is the channel spacing.	Channel central frequency: NOTE	ITU-T grid (ITU-T Recommendation G.694.1) or custom design. Design information (not test item).
3B	Attenuation (insertion loss) IEC 61300-3-29	≤ 6,7 dB (channel spacing with 50 GHz) ≤ 6,0 dB (channel spacing with 100 GHz, 200 GHz) Maximum allowable attenuation (insertion loss) over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The attenuation (insertion loss) is determined as the maximum value over all states of polarization.
4B	Channel non-uniformity IEC 61300-3-29	≤ 1,5 dB Maximum allowable channel non-uniformity of attenuation.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The channel non-uniformity is determined as the maximum value over all states of polarization.
5B	1 dB passband width IEC 61300-3-29	≥ 0,4 × Δf where Δf is the channel spacing (channel spacing with 50 GHz, 100 GHz, 200 GHz). Minimum allowable 1 dB passband width (centred at the channel frequency).	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,01 × Δf The 1 dB passband width is determined as the minimum value over all states of polarization.
6B	3 dB passband width IEC 61300-3-29	≥ 0,5 × Δf where Δf is the channel spacing. Minimum allowable 3 dB passband width (centred at the channel frequency).	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,01 × Δf The 3 dB passband width is determined as the minimum value over all states of polarization.
7B	Passband ripple IEC 61300-3-29	≤ 0,5 dB Maximum attenuation variation within the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 0,2 dB The passband ripple is determined as the maximum value over all states of polarization.
8B	Adjacent channel crosstalk IEC 61300-3-29	≤ –25 dB Maximum allowable adjacent channel crosstalk over the channel frequency range.	Launch fibre length: Measurement uncertainty: NOTE	≥ 2,0 m ≤ 1 dB The adjacent channel crosstalk is specified only for demultiplexer. The adjacent channel crosstalk is determined as the maximum value over all states of polarization.

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