IEC 61753-053-02

Edition 1.0 2022-07

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

**Fibre optic interconnecting devices and passive components – Performance standard –**
**Part 053-02: Non-connectorized, single-mode fibre, electrically controlled, variable optical attenuator for category C – Controlled environments**

**Dispositifs d'interconnexion et composants passifs fibroniques – Norme de performance –**
**Partie 053-02: Affaiblisseur optique variable commandé électriquement, à fibres unimodales, non connectorisé, pour la catégorie C – Environnements contrôlés**



IEC 61753-053-02:2022-07(en-fr)

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IEC 61753-053-02 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.

This first edition cancels and replaces IEC 61753-053-2 published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to IEC 61753-053-2:2014:

a) harmonization of terms and definitions with those in IEC 60869-1 and IEC TS 62627-09;
b) harmonization of test items and their conditions with IEC 61753-1:2018 and IEC 61753-1:2018/AMD1:2020.

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

| Draft | Report on voting |
|---|---|
| 86B/4622/FDIS | 86B/4644/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/standardsdev/publications.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

# FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

## Part 053-02: Non-connectorized, single-mode fibre, electrically controlled, variable optical attenuator for category C – Controlled environments

## 1 Scope

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which non-connectorized single-mode fibre electrically controlled variable optical attenuator needs to satisfy in order to be categorised as meeting the requirements of category C – Controlled environments, as defined in Annex A of IEC 61753-1:2018.

## 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 60869-1, *Fibre optic interconnecting devices and passive components – Fibre optic passive power control devices – Part 1: Generic specification*

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 or cable retention*

IEC 61300-2-5, *Fibre optic 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*

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

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 strain relief*

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 61300-3-3, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-3: Examinations and measurements – Active monitoring of changes in attenuation and return loss*

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 61300-3-14, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-14: Examinations and measurements – Error and repeatability of the attenuation settings of a variable optical attenuator*



IEC 61300-3-21, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-21: Examinations and measurements – Switching time*



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 61753-1:2018, *Fibre optic interconnecting devices and passive components – Performance standard – Part 1: General and guidance*

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 60869-1 and IEC TS 62627-09, as well as the following, apply.

ISO and IEC maintain terminological 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

**3.1**
**operational vibration**
vibration test in which relevant parameters should be monitored during the test

**3.2**
**operational shock**
shock test in which relevant parameters should be monitored during the test

**3.3**
**response time**
elapsed time from the time the control energy (voltage or current) is applied (changed) to the time attenuation reaches between 90 % and 110 % dB of steady-state value

## 4 Test conditions

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 in either coated fibres (primary and secondary) or reinforced cable format as per IEC 60794-2-50. Non-connectorized single-mode fibre electrically controlled variable optical attenuators used for each 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 under standard atmospheric conditions, unless otherwise stated. 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 port.

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 specified between the customer and supplier, or shall be as defined in the manufacturer's specification.



**Table 1 – Single-mode spectral bands**



| 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 | Ultra long wavelength | 1 625 to 1 675 |
| Source: ITU-T G. Supplement 39 [1][1]. | | |

## 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.

[1] Numbers in square bracket refer to the Bibliography.

# 7 Performance requirements

## 7.1 Dimensions

Dimensions shall comply with those given in appropriate manufacturers' drawings.

## 7.2 Sample size

Sample sizes for the tests are defined in Annex A.

## 7.3 Test details and requirements

The test details and requirements are shown in Table 2. The requirements are given only for a pigtailed electrically controlled variable optical attenuator. A minimum length of fibre or cable of 2,0 m per port shall be included in all climatic and environmental test chambers.

Fibre for input and output ports may be connected by fusion splice as temporary joints to achieve more than or equal to 2 m during the test.

**Table 2 – Test details and requirements**

| No | Tests | Requirements | Details | |
|---|---|---|---|---|
| 1 | Minimum insertion loss<br>(Minimum attenuation)<br>IEC 61300-3-7 | ≤ 1,5 dB | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 0,1 dB |
| 2 | Variable attenuation range<br>IEC 61300-3-7 | ≥ 20 dB | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 0,5 dB |
| 3 | Wavelength dependent loss<br>IEC 61300-3-7 | ≤ 0,7 dB (attenuation ≤ 10 dB)<br>≤ 1,0 dB (attenuation > 10 dB) | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 0,05 dB |
| 4 | Polarization dependent loss (PDL)<br>IEC 61300-3-2 | ≤ 0,3 dB (attenuation ≤ 10 dB)<br>≤ 0,5 dB (attenuation > 10 dB) | Launch fibre length:<br>Measurement uncertainty: | ≥ 2,0 m<br>≤ 0,05 dB |
| 5 | Return loss<br>IEC 61300-3-7 | ≥ 40 dB | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 1 dB |
| 6 | Response time<br>IEC 61300-3-21 | ≤ 20 ms | Launch fibre length:<br>Measurement uncertainty: | ≥ 2,0 m<br>≤ 1 ms |
| 7 | Error of the setting attenuation value<br>(if applicable)<br>IEC 61300-3-14 | ±15 % of set value (in dB) | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 0,1 dB |

| No | Tests | Requirements | Details | |
|---|---|---|---|---|
| 8 | Repeatability of the setting attenuation value<br>(if applicable)<br>IEC 61300-3-14 | ±5 % of set value (in dB) | Launch fibre length:<br>Source:<br>Measurement uncertainty: | ≥ 2,0 m<br>Unpolarized<br>≤ 0,1 dB |
| 9 | High optical power<br>IEC 61300-2-14 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>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.<br>During the test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 5.<br>Insertion loss (attenuation) change shall be monitored by IEC 61300-3-3. | Optical power:<br>Wavelength:<br>Duration of the optical power exposure:<br>Temperature:<br>Relative humidity: | 300 mW<br>1 550 nm<br>30 min<br>60 °C ± 2 °C<br>93 % $^{+2}_{-3}$ % RH |
| 10 | Cold<br>IEC 61300-2-17 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>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.<br>During the test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 5.<br>Insertion loss (attenuation) change shall be monitored by IEC 61300-3-3. | Temperature:<br>Duration of exposure: | −10 °C ± 2 °C<br>96 h |

| No | Tests | Requirements | Details | |
|---|---|---|---|---|
| 11 | Dry heat - High temperature endurance<br>IEC 61300-2-18 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>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.<br>During the test, the return loss change is monitored. The sum of the initial value and the change of the return loss shall be within the value defined at test no. 5.<br>Insertion loss (attenuation) change shall be monitored by IEC 61300-3-3. | Temperature:<br>Duration of exposure: | +60 °C ± 2 °C<br>96 h |
| 12 | Damp heat (steady state)<br>IEC 61300-2-19 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>During the test, the insertion loss change is monitored.<br>During and after the test, the insertion loss change shall be within ±0,3 dB of the initial value.<br>Insertion loss (attenuation) change shall be monitored by IEC 61300-3-3. | Temperature:<br>Relative humidity:<br>Duration of exposure: | +40 °C ± 2 °C<br>93 % $^{+2}_{-3}$ % RH<br>96 h |
| 13 | Change of temperature<br>IEC 61300-2-22 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>During the test, the insertion loss change is monitored.<br>During and after the test, the insertion loss change shall be within ±0,3 dB of the initial value.<br>Insertion loss (attenuation) change shall be monitored by IEC 61300-3-3. | High temperature:<br>Low temperature:<br>Number of cycles:<br>Duration at extreme temperature:<br>Rate of change: | +60 °C ± 2 °C<br>−10 °C ± 2 °C<br>5 cycles<br>60 min<br>≤ 1 °C/min |
| 14 | Vibration<br>IEC 61300-2-1 | Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 shall be met.<br>The insertion loss change after the test shall be within ±0,3 dB of the initial value | Frequency range:<br>Number of axes:<br>Number of sweeps:<br>Sweep rate:<br>Amplitude: | 10 Hz to 55 Hz to 10 Hz<br>3 orthogonal axes<br>15/axis<br>1 octave/min<br>0,75 mm |