IEC 61753-053-2

Edition 1.0 2014-03

INTERNATIONAL STANDARD

Fibre optic interconnecting devices and passive components – Performance standard –
Part 053-2: Non-connectorized, single-mode fibre, electrically controlled, variable optical attenuator for category C – Controlled environments

IEC 61753-053-2:2014-03(en)

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International Standard IEC 61753-053-2 has been prepared by subcommittee 86B: Fibre optic interconnecting devices and passive components, of IEC technical committee 86: Fibre optics.

The text of this standard is based on the following documents:

CDV	Report on voting
86B/3645/CDV	86B/3719/RVC

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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 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

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

A bilingual version of this publication may be issued at a later date.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 053-2: 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 61753-1:2007.

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*

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/cable retention*

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

IEC 61300-2-14, *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 – 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)*

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 61300-3-2, *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 – Accuracy and repeatability of the attenuation settings of a variable 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 and bounce time*

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

IEC TR 62343-6-5, *Dynamic modules – Part 6-5: Investigation of operating mechanical shock and vibration tests for dynamic modules*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60869-1, as well as the following, apply.

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 are in accordance with the IEC 61300 series. The samples shall be terminated onto 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 as per IEC 60794-2-50. Non-connectorized single-mode fibre electrically controlled variable optical

attenuator 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
NOTE Source: ITU-T G. Supplement 39.		

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 Dimensions

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

7.2 Test details and requirements

The test details and requirements are shown in Table 2. The word "Att." means attenuation value of the device under test. 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.

Table 2 – Test details and requirements

No	Tests	Requirements	Details	
1	Attenuation (insertion loss) IEC 61300-3-7	≤1,5 dB	Launch fibre length: Source: Measurement uncertainty: Note:	≥ 2,0 m Unpolarized ± 0,1 dB Attenuation (insertion loss) with Att. = 0 dB
2	Variable attenuation range IEC 61300-3-7	≥20 dB	Launch fibre length: Source: Measurement uncertainty:	≥ 2,0 m Unpolarized ± 0,5 dB
3	Wavelength dependent loss IEC 61300-3-7	≤ 0,7 dB (Att. ≤ 10 dB) ≤ 1,0 dB (Att. > 10 dB)	Launch fibre length: Source: Measurement uncertainty:	≥ 2,0 m Unpolarized ±0,05 dB
4	Polarization dependent loss (PDL) IEC 61300-3-2	≤ 0,3 dB (Att. ≤ 10 dB) ≤ 0,5 dB (Att. > 10 dB)	Launch fibre length: Measurement uncertainty:	≥ 2,0 m ± 0,05 dB
5	Return loss IEC 61300-3-7	≥ 40 dB	Launch fibre length: Source: Measurement uncertainty:	≥2,0 m Unpolarized ±1 dB
6	Response time IEC 61300-3-21	≤ 20 ms	Launch fibre length: Measurement uncertainty:	≥ 2,0 m ± 1 ms
7	Accuracy of the setting attenuation value (if applicable) IEC 61300-3-14	±15 % of set value (in dB)	Launch fibre length: Source: Measurement uncertainty:	≥ 2,0 m Unpolarized ± 0,1 dB
8	Repeatability of the setting attenuation value (if applicable) IEC 61300-3-14	± 5 % of set value (in dB)	Launch fibre length: Source: Measurement uncertainty:	≥ 2,0 m Unpolarized ± 0,1 dB
9	High optical power 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. 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 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	Optical power: Wavelength: Duration of the optical power exposure: Temperature: Relative humidity:	300 mW 1 550 nm 30 min 60 °C ± 2 °C $93\ ^{+2}_{-3}$ % RH

Table 2 (*continued*)

No	Tests	Requirements	Details	
10	Cold 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. 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
11	High temperature endurance 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. 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
12	Damp heat (steady state) 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. 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	Temperature: Relative humidity: Duration of exposure:	+ 40 °C ± 2 °C $93\ ^{+2}_{-3}$ % RH 96 h
13	Change of temperature 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. During the test, the insertion loss change is monitored. During and after the test, the insertion loss change shall be within ± 0,5 dB of the initial value	High temperature: Low temperature: Number of cycles: Duration at extreme temperature: Rate of change:	+ 60 °C ± 2 °C. –10 °C ± 2 °C. 5 cycles 60 min 1 °C/min
14	Vibration 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. The insertion loss change after the test shall be within ± 0,3 dB of the initial value	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
15	Optical fibre cable flexing IEC 61300-2-44	Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 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°

Table 2 (*continued*)

No	Tests	Requirements	Details	
16	Fibre/cable retention IEC 61300-2-4	Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 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
17	Static side load IEC 61300-2-42	Before and after the test, the limits of insertion loss and return loss of test no. 1 and 5 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
18	Shock IEC 61300-2-9	Before and after the test, the limits of insertion loss and return loss of tests 1 and 5 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
19	Operational vibration IEC 61300-2-1	During the test the insertion loss shall be within ± 0,3 dB of initial value under ambient environmental conditions	Frequency range: Condition: Duration: Sampling rate: Note:	50 – 500 Hz 2 G for three orthogonal axes 2 sweeps/direction 5 KHz Test condition is based on IEC TR 62343-6-5
20	Operational shock IEC 61300-2-9	During the test the insertion loss shall be within ± 0,3 dB of original value under ambient environmental conditions	Condition: Duration: Sampling rate: Note:	40 G, 5 ms for three orthogonal axes 3 times/direction 5 KHz Test condition is based on IEC TR 62343-6-5

Annex A
(normative)

Sample size

All samples shall be subjected to tests 1 – 5. All other tests may be done in any order. Consecutive testing on the same optical sample is allowed, but in case of failure during the consecutive testing, a new sample shall be prepared and the failed test shall be redone.

Table A.1 – Number of samples for each test

No	Tests	Sample size
1	Insertion loss	12
2	Variable attenuation range	12
3	Wavelength dependent loss	12
4	Polarisation dependent loss (PDL)	12
5	Return loss	12
6	Response time	6
7	Accuracy of the setting attenuation value	6
8	Repeatability of the setting attenuation value	6
9	High optical power	6
10	Cold	6
11	High temperature endurance	6
12	Damp heat (steady state)	6
13	Change of temperature	6
14	Vibration (sinusoidal)	6
15	Optical fibre cable flexing	6
16	Fibre/cable retention	6
17	Static side load	6
18	Shock	6
19	Operational vibration	3
20	Operational shock	3

Bibliography

ITU-T Recommendation G series – Supplement No. 39, *Optical system design and engineering considerations*

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