IEC 61753-059-2

Edition 1.0 2013-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fibre optic interconnecting devices and passive components – Performance standard –
Part 059-2: Single-mode fibre plug-receptacle style optical limiter for category C – Controlled environment

Dispositifs d'interconnexion et composants passifs à fibres optiques – Norme de performance –
Partie 059-2: Limiteur optique de type fiche-embase pour fibre unimodale pour catégorie C – Environnement contrôlé

IEC 61753-059-2:2013

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

PRICE CODE
CODE PRIX T

ICS 33.180.20

ISBN 978-2-83220-677-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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International Standard IEC 61753-059-2 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:

FDIS	Report on voting
86B/3553/FDIS	86B/3596/RVD

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 the 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

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INTRODUCTION

1) The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning power limiters, registered as follows:

Country	**Patent number**
Israel	147554
European Union	EP 1467239 A2
USA	USP110/398'859
Japan	4587695
Canada	24649043

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2) The optical power limiter is a passive device that regulates the optical power in fibres, producing a controlled, constant output power P_{limit}, as a result of varying input power higher than P_{limit}, and has no influence at powers below P_{limit}. Under normal operation, when the input power is low, the optical power limiter has no effect on the system. However, when the input power is high, the optical output power is limited to a predetermined level (P_{limit}).The optical limiter is wavelength independent over its entire specified spectral range. IEC 60869-1contains the generic information of the optical power limiter. The optical power limiter is used at the input of power-sensitive equipment and at the output of high power devices, such as amplifiers, or wherever power regulation is required. The optical power limiter can serve as an eye safety device. The optical power limiter has a maximum allowed power input $P_{\text{in max}}$. Above this power it is dysfunctional and can let light through. Numerical values for $P_{\text{in max}}$ are given in Annex E.

FIBRE OPTIC INTERCONNECTING DEVICES AND PASSIVE COMPONENTS – PERFORMANCE STANDARD –

Part 059-2: Single-mode fibre plug-receptacle style optical limiter for category C – Controlled environment

1 Scope

This part of IEC 61753 contains the minimum initial test and measurement requirements and severities which an optical power limiter needs to satisfy in order to be categorized as meeting the requirements of single mode fibre plug-receptable style optical limiter used in controlled environments. IEC 60869-1, contains the generic specification of the optical limiter. Optical performances specified in this standard relate to plug-receptacle style configurations optical power limiters only.

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 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 61300-1, *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 61300-2-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-2: Tests – Mating durability*

IEC 61300-2-6, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-6: Tests – Tensile strength of coupling mechanism*

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 61300-3-2, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-2: Examinations 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 61300-3-4, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-4: Examinations and measurements – Attenuation*

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 61300-3-7, *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 61300-3-28, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-28: Examinations and measurements – Transient loss*

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 61754 (all parts), *Fibre optic connector interfaces*

IEC 61755 (all parts, *Fibre optic connector optical interfaces*

IEC/TR 62627-02:2010, *Fibre optic interconnecting devices and passive components – Part 02: Report of round robin test results on SC plug style fixed attenuators*

3 Tests

All test methods are in accordance with the IEC 61300 series.

Some tests require the use of reference connector plugs and reference connector adaptors. These are specified in Annex B. It is essential and recommended that all connector, plugs and reference connector adaptors be inspected and cleaned if dirty and checked again, according to manufacturers' instructions, prior to every mating in all tests.

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

4 Test reports

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

5 Performance requirements

5.1 Sample size and sequencing

Sample sizes for the tests are defined in Annex A.

Test groups shall be performed as shown in Annex A.

5.2 Dimensions

Dimension of mechanical interface for mating, plug and receptacle size, shall comply with IEC optical connector interface standard IEC 61754 series and IEC optical interface standard IEC 61755 series. Other dimensions shall comply with those given in appropriate manufacturer's drawings

When implementing this standard, be aware that there have been problems when using a rigid interface component with SC plug style adapters and plugs. See Clause 6 of IEC/TR 62627-02:2010.

5.3 Test details and requirements

Table 1 specifies the optical, environmental and mechanical performance requirements and related test methods for optical power limiters.

Compliance to this standard requires demonstration of the ability to meet the relevant performance requirement in Table 1.

Table 1 – Performance requirements for optical limiters *(1 of 6)*

No.	Tests	Requirements	Details	
1	Insertion loss	Operating wavelength range: 1 520 nm to 1 625 nm Insertion loss: ≤ 2 dB for P_{limit} > 9 dBm ≤ 5 dB for 0 dBm P_{limit} ≤ 9 dBm ≤ 7 dB for P_{limit} ≤ 0 dBm Insertion loss is measured with input power ≤ –5 dBm this power level is always below P_{limit} , at the linear behaviour of the limiter	Method: Launch patchcord length: Other requirements: Launch conditions: Source power stability: Wavelength range: Total uncertainty:	IEC 61300-3-7, method B.2.1. Test sample configuration in accordance with IEC 61300-3-4, substitution method. ≥ 2 m. Only the fundamental mode shall propagate at the limiter interface and at the detector. This test shall be performed against two reference plug[a,b] and reference adapter. The wavelength of the source shall be longer than cut-off wavelength of the fibre. ≤ ± 0,05 dB over the measuring period or at least 1 h. 1 520 nm to 1 625 nm ≤ ± 0,05 dB
2	Return loss	Up to P_{limit}: ≥40 dB return loss is measured with input power ≤ –5 dBm. This power level is always below P_{limit} , at the linear behaviour of the limiter. Above P_{limit}: ≥ 30 dB return loss is measured with input power of +3 dB above P_{limit}	Method: Optical source wavelength: Total uncertainty	IEC 61300-3-6 (against 2 reference plugs[a]) measurement method 1, OCWR. 1 520 nm and 1 625 nm Test every sample with the two wavelengths. ≤ ±2 dB over the dynamic range to be measured
3	Polarization dependent loss	≤0,2 dB Over the specified operating wavelength. The samples shall be terminated onto single-mode fibres as per future IEC 60793-2-50, Type B 1.1, in either coated fibres (primary and secondary) or reinforced cable format	Method: Optical source wavelength: Total uncertainty:	IEC 61300-3-2, method 1 OCWR. 1 550 nm ± 10 nm ≤ ±0,05 dB over the dynamic range to be measured
4	Polarization mode dispersion	≤0,2 ps (max. value) Over the specified operating wavelength range. Measurements carried out only in low power ≤ –5 dBm	Method: Optical source wavelength: Total uncertainty:	IEC 61300-3-32, MPS method 1 550 nm ± 10 nm ≤ ±0,05 dB over the dynamic range to be measured

Table 1 *(2 of 6)*

No.	Tests	Requirements	Details	
5	High optical power	Before and after the test the insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2	Method:	Future IEC 61300-2-14: Full characterization at a specific wavelength.
			Test temperature:	25 °C ± 2 °C
			Power loads for testing:	For P_{limit} ≤ 10 dBm: P_{limit} +5 dB for CW operation, tested for 96 h. P_{limit} + 8 dB for short bursts, up to 1 s/min for 1 h. For P_{limit} > 10 dBm: P_{limit} +3 dB for CW operation, tested for 96 h. P_{limit} +5 dB for short bursts, up to 1 s/min for 1 h.
			Optical source wavelength:	1 550 nm
			Test duration:	Duration of long-term test: 96 h at max. power. For short bursts, up to 1 s/min.
			Launch patchcord length and launch conditions:	Same as in test No.1
6	Limit power	P_{limit} as specified ± 0,5 dB P_{limit} example is shown in Annex C. The limiter will meet the limit power requirements as specified in Annex E, when operated at the 3 specified temperatures. This test uses a slowly varying optical power source starting at –5 dBm and up to +8 dB above P_{limit}., giving results of insertion loss and P_{limit} for the whole range of input powers	Method:	See Annex G.
			Source:	Slowly varying optical power source from –5 dBm and up to +8 dB above P_{limit}
			Optical source wavelength:	1 550 nm
			Optical source power increment:	100 mW power increments, at a rate of 1 increment of 100 mW/s.
			Test temperature:	10 °C ± 2 °C 25 °C ± 2 °C 60 °C ± 2 °C
			Detector system:	Linearity within ± 0,05 dB. Spectral response matched to source. Dynamic range between –5 dBm to +8 dB above P_{limit}
7	Response time	500 µs ± 10 µs Response time example see Annex D. The limiter will meet the requirements as specified when operated at the 3 specified temperatures	Method:	See Annex G.
			Optical source:	Laser source having adjustable power up to 8 dB above $P_{limit.}$ Square wave input power, having rise time of 10 µs.
			Optical source wavelength:	1 550 nm
			Test temperature:	10 °C ± 2 °C 25 °C ± 2 °C 60 °C ± 2 °C
			Launch patchcord length and launch conditions	Same as in test No.1

Table 1 *(3 of 6)*

No.	Tests	Requirements	Details	
8	Damp heat (steady state)	Before and after the test the insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. The insertion loss change during the test shall be within ± 0,5 dB of the initial value Above measurements carried out in power ≤ -5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Pre conditioning procedure: Temperature: Relative humidity: Duration of exposure: Specimen optically functioning: Optical source wavelength: Recovery procedure:	Future IEC 61300-2-19. During the test the change in insertion loss shall be measured by test method IEC 61300-3-3. Standard atmospheric conditions as defined in IEC 61300-1 for 2 h. +40 °C ± 2 °C 93 $^{+2}_{-3}$ % 96 h Yes 1 550 nm Allow specimens to return to standard atmospheric conditions in 2 h
9	Change of temperature	Before and after the test the Insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. The insertion loss change during the test shall be within ±0,5 dB of the initial value. The above measurements are carried out at a power of ≤–5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Pre conditioning procedure: High temperature: Low temperature: Duration at extreme temperature: Temperature rate of change: Number of cycles: Specimen optically functioning: Maximum sampling interval during the test: Optical source wavelength: Recovery procedure: Pre-conditioning procedure:	IEC 61300-2-22. During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3. Standard atmospheric conditions as defined in IEC 61300-1 for 2 h. +60 °C ± 2 °C –10 °C ± 2 °C 1 h 1 °C/min 5 Yes 15 min 1 550 nm Allow specimens to return to standard atmospheric conditions in 2 h. Clean plug and adaptor according to the manufacturers' instructions

Table 1 *(4 of 6)*

No.	Tests	Requirements	Details	
10	Dry heat – High temperature endurance	Before and after the test the insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. The insertion loss change during the test shall be within ± 0,5 dB of the initial value. The above measurements are carried out at a power of ≤ –5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Pre-conditioning procedure: Specimen optically functioning: Temperature: Duration of the exposure: Optical source wavelength: Maximum sampling interval during the test: Recovery procedure:	IEC 61300-2-18. During the test the change in insertion loss shall be measured by test method IEC 61300-3-3. Standard atmospheric conditions as defined in IEC 61300-1 for 2 h. Yes +60 °C ± 2 °C 96 h 1 550 nm 1 h Allow specimen to return to standard atmospheric conditions as defined in IEC 61300-1 within 2 h
11	Cold	Before and after the test the insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. The insertion loss change during the test shall be within ±0,5 dB of the initial value. The above measurements are carried out at a power of ≤ –5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Pre-conditioning procedure: Specimen optically functioning: Temperature: Duration of the exposure: Optical source wavelength: Maximum sampling interval during the test: Recovery procedure:	IEC 61300-2-17. During the test the change in Insertion loss shall be measured by test method IEC 61300-3-3. Standard atmospheric conditions as defined in IEC 61300-1 for 2 h. Yes –10 °C ± 2 °C 96 h 1 550 nm 1 h Allow specimen to return to standard atmospheric conditions as defined in IEC 61300-1 within 2 h
12	Vibration (sinusoidal)	Before and after the test the insertion loss shall meet the requirements of test 1. The insertion loss change between value before test and value after test shall be within ±0,5 dB of the initial value. Before and after the test the return loss shall meet the requirements of test 2. Above measurements carried out in power ≤ –5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Frequency range: Vibration amplitude: Number of cycles: Rate of change: Number of axes: Specimen optically functioning: Optical source wavelength:	IEC 61300-2-1. During the test the change in insertion loss shall be measured by test method IEC 61300-3-3. 10 Hz – 55 Hz 0,75 mm 15 1 octave/min 3 orthogonal axes No 1 550 nm

Table 1 *(5 of 6)*

No.	Tests	Requirements	Details	
13	Shock	Before and after the test the Insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. Above measurements carried out in power ≤ –5 dBm. Before and after the test the P_{limit} shall meet the requirements of test 6. Before and after the test specimen tested in mated position	Method: Acceleration force: Number of axes: Number of cycles: Duration per axis: Measurements required: Specimen optically functioning: Optical source wavelength:	IEC 61300-2-9. 500 g 3 axes, 2 directions 2 shocks per direction, 12 shocks total Nominal 1 ms duration, half sine pulse Before, after each axis, and after the test No 1 550 nm
14	Strength of coupling mechanism	Before and after the test the Insertion loss shall meet the requirements of test 1. Before and after the test the return loss shall meet the requirements of test 2. The insertion loss change during the test shall be within ±0,5 dB of the initial value Above measurements carried out in power ≤– dBm. Before and after the test the P_{limit} shall meet the requirements of test 6	Method: Magnitude of the load: Load application point: Duration of the load: Specimen optically functioning: Optical source wavelength:	IEC 61300-2-6. During the test the change insertion loss shall be measured by transient loss test method IEC 61300-3-28 (Transient loss). 40 N, at a rate of 2 N/s 0,2 m from the optical interface 120 s Yes 1 550 nm