BS EN 62149-5:2011

BSI Standards Publication

Fibre optic active components and devices — Performance standards

Part 5: ATM-PON transceivers with LD driver and CDR ICs

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 62149-5:2011. It is identical to IEC 62149-5:2009. It supersedes BS EN 62149-5:2003, which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/3, Fibre optic systems and active devices.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 62225 0

ICS 33.180.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2011.

Amendments issued since publication

Amd. No.	Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62149-5

January 2011

ICS 33.180.20

Supersedes EN 62149-5:2003

English version

Fibre optic active components and devices - Performance standards - Part 5: ATM-PON transceivers with LD driver and CDR ICs

(IEC 62149-5:2009)

Composants et dispositifs actifs à fibres optiques -
Normes de fonctionnement -
Partie 5: Emetteurs-récepteurs ATM-PON avec programme de gestion LD et ICs CDR
(CEI 62149-5:2009)

Aktive Lichtwellenleiterbauelemente und -geräte -
Betriebsverhalten -
Teil 5: ATM-PON Sende- und Empfangsmodule mit Laserdiodentreiberschaltungen und Takt- und Datenrückgewinnungs-ICs
(IEC 62149-5:2009)

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 62149-5:2011 E

Foreword

The text of document 86C/891/FDIS, future edition 2 of IEC 62149-5, prepared by SC 86C, Fibre optic systems and active devices, of IEC TC 86, Fibre optics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 62149-5 on 2011-01-02.

This European Standard supersedes EN 62149-5:2003.

The main changes with respect to EN 62149-5:2003 are listed below:

– Normative references have been updated;

– Incorrect “Letter symbols” have been corrected;

– Some “Notes” in tables have been revised in order to harmonize with EN 62150-2:2004.

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

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-10-02
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2014-01-02

Annex ZA has been added by CENELEC.

———————

Endorsement notice

The text of the International Standard IEC 62149-5:2009 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 60617 series	NOTE	Harmonized in EN 60617 series (not modified).
IEC 60793 series	NOTE	Harmonized in EN 60793 series (partially modified).
IEC 60794 series	NOTE	Harmonized in EN 60794 series (not modified).
IEC 60825 series	NOTE	Harmonized in EN 60825 series (not modified).
IEC 60874 series	NOTE	Harmonized in EN 60874 series (not modified).
IEC 61076 series	NOTE	Harmonized in EN 61076 series (not modified).
IEC 61280 series	NOTE	Harmonized in EN 61280 series (not modified).
IEC 61281-1:1999	NOTE	Harmonized as EN 61281-1:1999 (not modified).
IEC 61754 series	NOTE	Harmonized in EN 61754 series (partially modified).
IEC 62007-1:1999	NOTE	Harmonized as EN 62007-1:2000 (not modified).
IEC 62007-2:1999	NOTE	Harmonized as EN 62007-2:2000 (not modified).
IEC 62148-1:2002	NOTE	Harmonized as EN 62148-1:2002 (not modified).

———————

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application 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.

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 60068-2-6	2007	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	2008
IEC 60068-2-27	2008	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	2009
IEC 60825-1	2007	Safety of laser products - Part 1: Equipment classification and requirements	EN 60825-1	2007
IEC 60950-1 (mod)	2005	Information technology equipment - Safety - Part 1: General requirements	EN 60950-1 + A11	2006 2009
IEC 61000-6-3	-	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments	EN 61000-6-3	-
IEC 61280-1-1	1998	Fibre optic communication subsystem basic test procedures - Part 1-1: Test procedures for general communication subsystems - Transmitter output optical power measurement for single-mode optical fibre cable	EN 61280-1-1	1998
IEC 61280-1-3	1998	Fibre optic communication subsystem basic test procedures - Part 1-3: Test procedures for general communication subsystems - Central wavelength and spectral width measurement	EN 61280-1-3[1)]	1999
IEC 61280-2-2	2008	Fibre optic communication subsystem test procedures - Part 2-2: Digital systems - Optical eye pattern, waveform and extinction ratio measurement	EN 61280-2-2	2008
IEC 61300-2-4	1995	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-4: Tests - Fibre/cable retention	EN 61300-2-4	1997

[1)] EN 61280-1-3 is superseded by EN 61280-1-3:2010, which is based on IEC 61280-1-3:2010.

Publication	Year	Title	EN/HD	Year
IEC 61300-2-17	2003	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-17: Tests - Cold	EN 61300-2-17	2003
IEC 61300-2-18	2005	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	2005
IEC 61300-2-19	2005	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-19: Tests - Damp heat (steady state)	EN 61300-2-19	2005
IEC 61300-2-22	2007	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-22: Tests - Change of temperature	EN 61300-2-22	2007
IEC 61300-3-6	2003	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 3-6: Examinations and measurements - Return loss	EN 61300-3-6[2)]	2003
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/TR 61931	-	Fibre optic - Terminology	-	-
IEC 62150-2	2004	Fibre optic active components and devices - Test and measurement procedures - Part 2: ATM-PON transceivers	EN 62150-2[3)]	2004
ITU-T Recommendation G.983.1	-	Broadband optical access systems based on Passive Optical Networks (PON)	-	-

[2)] EN 61300-3-6 is superseded by EN 61300-3-6:2009, which is based on IEC 61300-3-6:2008.

[3)] EN 62150-2 is superseded by EN 62150-2:2011, which is based on IEC 62150-2:2010.

CONTENTS

INTRODUCTION

Fibre optic transceivers are used to convert electrical signals into optical signals and vice versa. The optical performance criteria are generally well specified for a number of internationally agreed applications areas such as ITU-T Recommendation G.983.1 and IEEE 802.3. This standard aims to assure inter-changeability in performance between fibre optic transceivers for ATM-PON systems supplied by different manufacturers, but does not guarantee operation between fibre optic transceivers.

Manufacturers using the standards are responsible for meeting the required performance and/or reliability and quality assurance under a recognized scheme.

FIBRE OPTIC ACTIVE COMPONENTS AND DEVICES – PERFORMANCE STANDARDS –

Part 5: ATM-PON transceivers with LD driver and CDR ICs

1 Scope

This part of IEC 62149 specifies performance on the transceiver modules for asynchronous-transfer-mode passive optical network (ATM-PON) systems recommended by the International Telecommunication Union (ITU) in ITU-T Recommendation G.983.1.

2 Normative references

The following referenced documents are indispensable for the application 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 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60825-1:2007, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 60950-1:2005, *Information technology equipment – Safety – Part 1: General requirements*

IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for residential, commercial and light-industrial environments*

IEC 61280-1-1:1998, *Fibre optic communication subsystem basic test procedures – Part 1-1: Test procedures for general communication subsystems – Transmitter output optical power measurement for single-mode optical fibre cable*

IEC 61280-1-3:1998, *Fibre optic communication subsystem basic test procedures – Part 1-3: Test procedures for general communication subsystems – Central wavelength and spectral width measurement*

IEC 61280-2-2:2008, *Fibre optic communication subsystem test procedures – Part 2-2: Digital systems – Optical eye pattern, waveform and extinction ratio measurement*

IEC 61300-2-4:1995, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-4: Tests – Fibre/cable retention*

IEC 61300-2-17:2003, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-17: Tests – Cold*

IEC 61300-2-18:2005, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-18: Tests – Dry heat – High temperature endurance*

IEC 61300-2-19:2005, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-19: Tests – Damp heat (steady state)*

IEC 61300-2-22:2007, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-22: Tests – Change of temperature*

IEC 61300-3-6:2003, *Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 3-6: Examinations and measurements – Return loss*

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

IEC 61931, *Fibre optic – Terminology*

IEC62150-2:2004, *Fibre optic active components and devices – Test and measurement procedures - Part 2: ATM-PON transceivers*

ITU-T Recommendation G.983.1: *Broadband optical access systems based on Passive Optical Networks (PON)*

3 Term, definitions and abbreviations

For the purposes of this document, the following terms, definitions and abbreviations apply.

Further terminology concerning related physical concepts, types of devices, general terms, and terms related to ratings and characteristics can be found in IEC 61931.

It is also recommended to refer to ITU-T Recommendation G.983.1.

3.1 Terms and definitions

3.1.1
optical access network
OAN
set of access links sharing the same network-side interfaces and supported by optical access transmission systems.

NOTE The OAN may include a number of ODNs connected to the same OLT.

3.1.2
optical distribution network
ODN
apparatus or component that provides the optical transmission means from the OLT to the users, and vice versa. It utilizes passive optical components

3.1.3
optical line termination
OLT
apparatus that provides the network-side interface of the OAN, and is connected to one or more ODNs

3.1.4
optical network unit
ONU
apparatus that provides (directly or remotely) the user-side interface of the OAN, and is connected to the ODN

3.2 Abbreviations

ATM-PON	Asynchronous transfer mode passive optical network
ATT	Attenuator
BER	Bit error ratio
CDR	Clock and data recovery
DUT	Device under test
ERD	Error ratio detector
EX	Extinction ratio
FTT Cab/C/B/H	Fibre to the cabinet/curb/building/home
IC	Integrated circuit
LD	Laser diode
MLM	Multi-longitudinal mode
PPG	Pulse pattern generator
RMS	Root mean square
SLM	Single-longitudinal modes

4 Classification

Fibre optic transceiver modules are classified into 5 types of forms according to the combination of mating types of electrical and optical interfaces (for details, see IEC 62148-1). Those combinations include the following:

Type 1: Fibre optic connector interface with direct solderable type electrical terminals.

Type 2: Fibre optic connector interface with plug-in type electrical terminals.

Type 3: Fibre optic pigtail interface with direct solderable type electrical terminals.

Type 4: Fibre optic pigtail interface with plug-in type electrical terminals.

Type 5: Modules are not classified into type 1 to type 4. (A typical example is a module that has both electrical connectors and non-connector type terminals as an electrical interface such as a coaxial connector for signal and lead terminals for the power supply.)

5 Product definition

5.1 Description of transceiver module

Information on the following devices constituting the optical transceiver module shall be stated. This statement shall include details of technologies. For example, technologies used for ICs such as CMOS, bipolar, etc., shall be described.

- For a transmitter:
  - laser diode (in this description, a single- or a multi-longitudinal mode type shall be specified);
  - monitoring photodiode;
  - driver IC;
  - thermal sensor (where appropriate).
- For a receiver:
  - photodiode;
  - pre-amp IC;

  - data/clock recovery IC.
- For a wavelength division multiplexer device:
  - technology used for this device.
- For a package:
  - refer to the IEC document number standardized as a package interface standard.

5.2 Description of applied form

According to ITU-T Recommendation G.983.1, applied form of nominal bit rate, class (class B or class C), applied unit (ONU or OLT), and the number of fibres (one for duplex working or two for simplex working) shall be stated.

5.3 Block diagram

Block diagram or equivalent circuit information on the optical transceiver module shall be given.

The following terminals may be distinguished:

- supply terminals, i.e., terminals intended to be connected to the power supplies;
- input and output terminals, i.e., terminals into or out of which signals are passed.

The term “signal” includes both pulse and more complex waveforms, and includes strobe or control pulses.

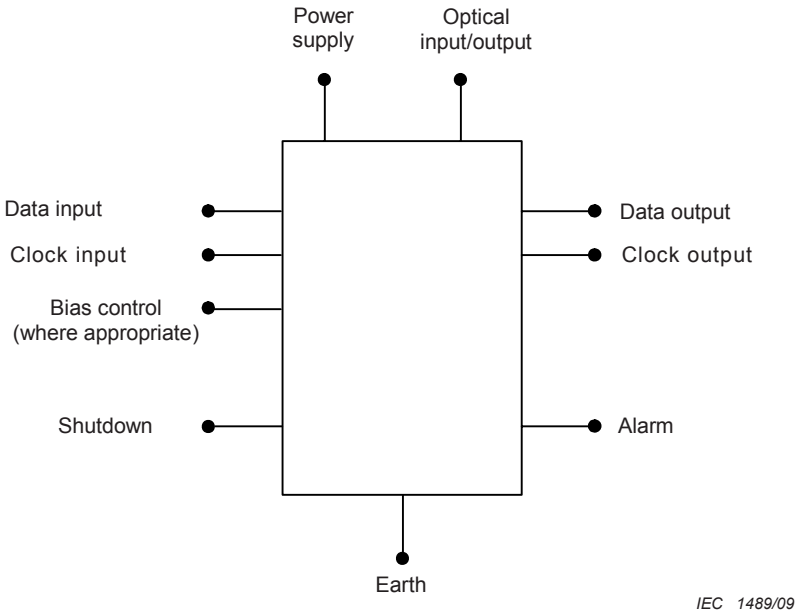

Figure 1 – Functional block diagram (example)

5.4 Absolute limiting rating

Absolute limiting (maximum) ratings imply that no catastrophic damage will occur if the product is subjected to these ratings for short periods, provided each limiting parameter is in isolation and all other parameters have values within the normal performance parameters. It should not be assumed that limiting values of more than one parameter could be applied at any one time.

Table 1 – Absolute maximum ratings

Items	Condition	Letter symbol	Requirements		Units
			Minimum	Maximum	
Storage temperature[a]		T_{stg}	–40	85	°C
Storage humidity		H_{stg}	5	95	%
Bend radius of pigtail for type 3, 4, and 5 transceivers (at specified distance from the case)		r	30		mm
Shock[b]	Pulse cycle: 18 ms 3 times/axis			300	m/s^2
Vibration[c]	10 Hz -55 Hz, 3 axes, 1,5 mm, 2 h			100	m/s^2
Tensile force on devices with pigtail Buffer-coated fibre[d] Reinforced fibre[d]		F		5 100	N
Electrical limiting values					
– Power supply voltage		V_{SUPmax}	–0,5	4,0	V
– Input voltage		V_{INmax}	–0,5	V_{sup}	V
– Output voltage		V_{OUTmax}	0	V_{sup}+0,5	V
– Output current PECL interface LVTTL interface		I_{OUTmax}	0 –20	50 20	mA
Optical limiting values					
– Permissible input power		P_{in}		–5	dBm

[a] Ambient temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

[b] IEC 60068-2-27 shall be referred to for detail.

[c] IEC 60068-2-6 shall be referred to for detail.

[d] For requirements see IEC 61753-1.

5.5 Functional specification

Electro-optical characteristics for the items in Table 3 shall be satisfied at the operating environmental conditions specified in Table 2.

NOTE Optical characteristics specified in ITU-T Recommendation G.983.1 should be satisfied.

Each electrical and optical characteristics of this clause shall be measured under conditions specified in each reference.

Each electrical and optical characteristic of this clause shall be stated under specified worst-case conditions, with respect to the recommended range of operating conditions as stated. The measuring method of each electrical and optical characteristics specified in Table 3 shall be measured based on the method stated in the reference of each row.

Table 2 – Operating environment

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Power supply voltage	V_{SUP}	3,135	3,3	3,465	V
Operating case temperature[a]	T_{case}	–5		75	°C
Ambient humidity[a]	RH	5		95	%

[a] Operating case temperature and humidity for outdoor ONU is under further study in ITU-T Recommendation G.983.1, thus these specifications may be varied in the future.

Table 3 – Electrical and optical characteristics

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
1	Nominal bit rate	B		155,52		Mb/s	
2	Mean launched power[a] – Class B – Class C	P_{mean}	–4 –2		+2 +4	dBm	IEC 61280-1-1
3	Transmitter wavelength	λ	1260		1 360	nm	IEC 61280-1-3
4	Mask of transmitter eye diagram[b]	–					
5	Extinction ratio	Ex	10			dB	IEC 61280-2-2
6	For MLM laser, maximum RMS width	$\Delta\lambda$			5,8	nm	IEC 61280-1-3
7	For SLM laser, maximum -20 dB width	$\Delta\lambda$			1,0	nm	IEC 61280-1-3
8	For SLM laser, minimum side mode suppression ratio	SMSR	30			dB	IEC 61280-1-3
9	Maximum reflectance, measured at transmitter wavelength	R_{TX}	–6			dB	IEC 61300-3-6, 4.1
10	Receiver overload: – Class B – Class C	S_O	–8 –11			dBm	IEC 62150-2
11	Receiver sensitivity: – Class B – Class C	S			–30 –33	dBm	IEC 62150-2
12	Maximum reflectance, measured at receiver wavelength	R_{RX}	–20			dB	IEC 61300-3-6, 4.1
13	Tolerance to the reflected optical power[c]				10	dB	ITU-T G.957 Appendix III
14	Clock input voltage (high)	See Tables 4 and 5					
15	Clock input voltage (low)	See Tables 4 and 5					
16	Clock input voltage (swing centre)	See Tables 4 and 5					
17	Data input voltage (high)	See Tables 4 and 5					
18	Data input voltage (low)	See Tables 4 and 5					
19	Data input voltage (swing centre)	See Tables 4 and 5					

Table 3 (*continued*)

Item number	Items	Letter symbol	Requirements			Units	Reference
			Minimum	Typical	Maximum		
20	Clock output voltage (high)	See Tables 4 and 5					
21	Clock output voltage (low)	See Tables 4 and 5					
22	Data output voltage (high)	See Tables 4 and 5					
23	Data output voltage (low)	See Tables 4 and 5					
24	Alarm output voltage (high)[d]	See Tables 6 and 7					IEC 62150− 2
25	Alarm output voltage (low)[d]	See Tables 6 and 7					IEC 62150− 2
26	Shutdown input voltage (high)[e]	See Table 8					IEC 62150− 2
27	Shutdown input voltage (low)[e]	See Table 8					IEC 62150− 2
28	Bias control voltage (high)[f]	V_{BiasH}					
29	Bias control voltage (low)[f]	V_{BiasL}					
30	Line code		Scrambled NRZ				
31	Launched optical power without input to transmitter[g] - Class B - Class C		 –40 –43			dBm	IEC 61280-1-1
32	Tolerance to the transmitter incident light power[g]		–15			dB	
33	Consecutive identical digit immunity[b]						
34	Jitter generation[b]						
35	Jitter tolerance[b]						
36	Jitter transfer[b]						

Table 3 (*continued*)

[a]	Pseudo random data shall be put into the transmitter according to the specification of 8.2.6.3 of ITU-T Recommendation G.983.1.
[b]	These items shall be specified so as to meet the specifications of ITU-T Recommendation G. 983.1.
[c]	This item shall be measured based on the measuring method described in the reference. See Annex A for more detail.
[d]	With logic ‘Low’, an alarm signal is effective. The alarm test shall be done whether logic ‘Low’ is put out when no optical power is launched to the transceiver, and logic ‘High’ is put out when optical power more than that specified in Item 11 is launched to the transceiver (see Annex B).
[e]	With logic ‘Low’, a shutdown signal is effective. The shutdown test shall be done whether optical power less than that specified in Item 31 is launched when logic ‘Low’ is put into the ‘Shutdown’ terminal, and optical powerwithin the range specified in Item 2 is launched when logic ‘High’ is put into the ‘Shutdown’ terminal (see Annex B).
[f]	These items shall be specified between vendors and users.
[g]	Measurement methods on these items are stated in this clause.

The clock and data input/output interface shall be satisfied with either the specification listed in Table 4 or that in Table 5. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 4 – Electrical interface characteristics (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	$V_{CINH} - V_{SUP}$	–1,17		–0,88	V
Clock input voltage (low)	$V_{CINL} - V_{SUP}$	–1,81		–1,43	V
Data input voltage (high)	$V_{DINH} - V_{SUP}$	–1,17		–0,88	V
Data input voltage (low)	$V_{DINL} - V_{sup}$	–1,81		–1,43	V
Clock output voltage (high)[a]	$V_{COUTH} - V_{SUP}$		–0,96		V
Clock output voltage (low) [a]	$V_{COUTL} - V_{SUP}$		–1,71		V
Data output voltage (high) [a]	$V_{DOUTH} - V_{SUP}$		–0,96		V
Data output voltage (low) [a]	$V_{DOUTL} - V_{SUP}$		–1,71		V
[a] Outputs terminated to V_{SUP} –2V.					

Table 5 – Electrical interface characteristics (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Clock input voltage (high)	V_{CINH}	V_{CINL} +0,3		V_{SUP}	V
Clock input voltage (low)	V_{CINL}	0		V_{CINH} –0,3	V
Clock input voltage (swing centre)	$V_{Ccenter}$	V_{SUP}/2 –0,1		V_{SUP}/2 +0,1	V
Data input voltage (high)	V_{DINH}	V_{DINL} +0,3		V_{SUP}	V
Data input voltage (low)	V_{DINL}	0		V_{DINH} +0,3	V
Data input voltage (swing centre)	$V_{Dcenter}$	V_{SUP}/2 –0,1		V_{SUP}/2 +0,1	V
Clock output voltage (high)[a]	V_{COUTH}	V_{TT} +0,4			V
Clock output voltage (low) [a]	V_{COUTL}			V_{TT} –0,4	V
Data output voltage (high)[a]	V_{DOUTH}	V_{TT} +0,4			V
Data output voltage (low) [a]	V_{DOUTL}			V_{TT} –0,4	V
[a] V_{TT} = 1,5 V to 1,8 V.					

Alarm output interface shall be satisfied with either specification listed in Table 6 or that in Table 7. The interface specifications characterized by each table are normally referred to as PECL and LVTTL interfaces, respectively. New interface dimensions will be added properly.

Table 6 – Electrical interface characteristics of alarm output voltage (PECL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	V_{ALH}	2,4			V
Alarm output voltage (low) [a]	V_{ALL}			0,4	V
[a] Test shall be performed with current at high level (I_{ALH}) = –2 mA and current at low level (I_{ALL}) = 2 mA at V_{SUP} between 3,135 V and 3,465 V.					

Table 7 – Electrical interface characteristics of alarm output voltage (LVTTL type)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Alarm output voltage (high) [a]	V_{ALH}	V_{SUP} - 0,2			V
Alarm output voltage (low) [a]	V_{ALL}			0,2	V
[a] Test shall be performed with current at high level (I_{ALH}) = –100 µA and current at low level (I_{ALL}) = 100 µA at V_{SUP} between 3,135 V and 3,465 V.					

Shutdown input interface shall be satisfied with either specifications listed in Table 8. New interface dimensions will be added properly.

Table 8 – Electrical interface characteristics of shutdown input voltage (both PECL and LVTTL types)

Items	Letter symbol	Requirements			Units
		Minimum	Typical	Maximum	
Shutdown input voltage (high)[a]	V_{SDH}	2,0		V_{SUP} + 0,3	V
Shutdown input voltage (low)[a]	V_{SDL}	–0,3		0,8	V
[a] Test shall be performed with V_{SUP} between 3,135 V and 3,465 V.					

NOTE The interfaces listed in Tables 6, 7 and 8 refer to EIA/JEDEC JESD8-B, with the exception of power supply voltage V_{SUP} that is definitely specified in Table 2.

Relationship of the phase between clock and data signals is shown in Figure 2. Phase of data signals are timed so that data signals are latched at a fall time of clock.

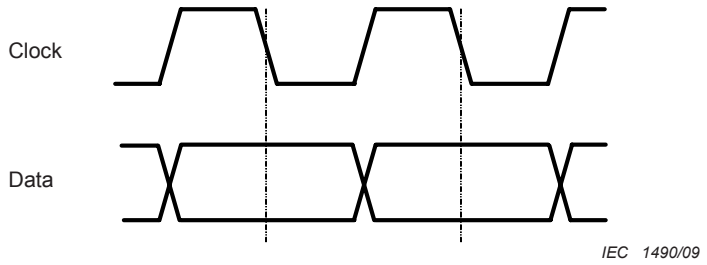

Figure 2 – Relationship of phase between clock and data signals

Examples of recommended electrical circuit diagrams for LVTTL-type interface are shown in Figure 3.

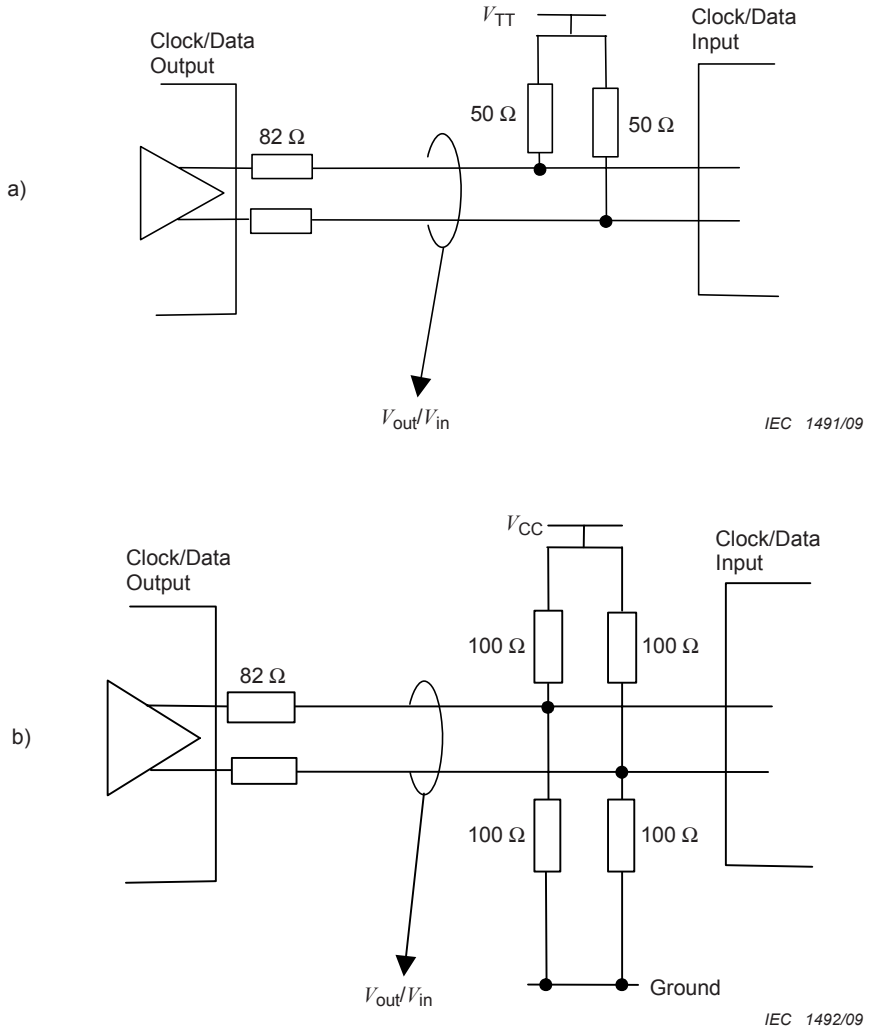

Figure 3 – Recommended electrical circuit diagram for LVTTL-type interface (example)

Launched optical power without input to transmitter (Table 3, Item 31) is schematically defined in Figure 4. The measuring method of the power shall basically follow IEC 61280-1-1, but it shall be specified in detail between vendors and users.

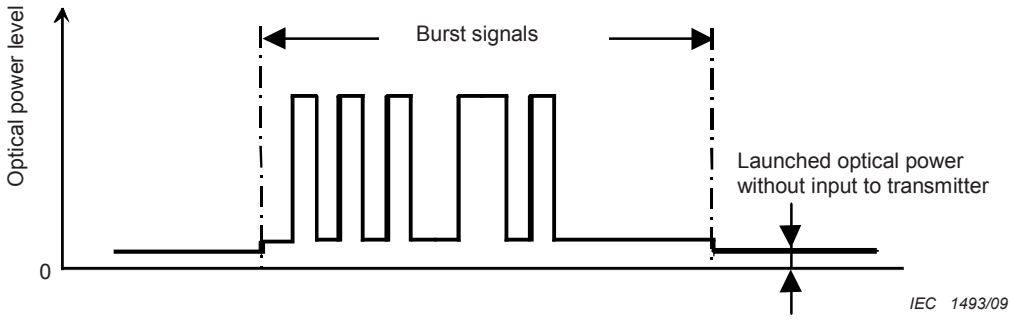

Figure 4 – Schematic drawing for defining launched optical power without input to transmitter

Tolerance to the transmitter incident light power (Table 3, Item 32) is measured, for example, by an experimental setup shown in Figure 5. The value of reflection at the reflector is set so that incident light power back to the transmitter is 15 dB less than that of mean transmitter

launching power. Pass/fall criteria depend on whether or not the waveform of signals transmitted from the DUT and monitored at the waveform monitor satisfies the eye mask specified in Table 3, Item 4.

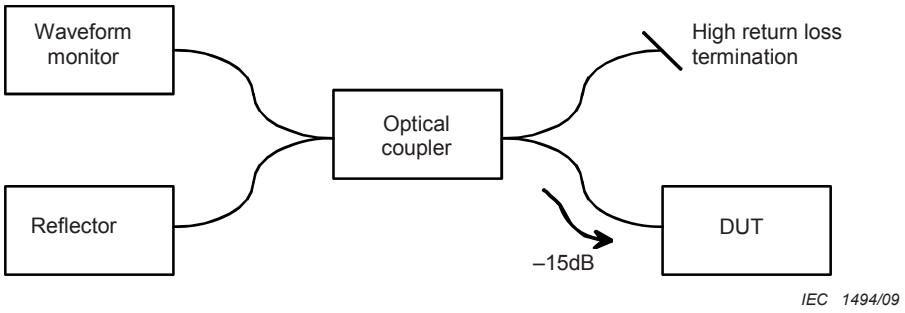

Figure 5 – Schematic drawing for defining launched optical power without input to transmitter

6 Testing

Initial characterization and qualification shall be undertaken. Qualification maintenance is carried using periodic testing programs. Test conditions for all tests unless otherwise stated are 25 °C ± 2 °C

6.1 Characterization testing

Characterization testing including both transmitter and receiver sections shall be carried out based on the specifications listed in Table 9 for the transmitter section and Table 10 for the receiver section. These testing shall be carried out on at the least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. If any changes occur in the design of the transceiver, the testing shall be carried out again.

6.1.1 Characterization: transmitter section

Table 9 – Transmitter section characterization tests

Parameters	Test conditions	Test limit Minimum	Test limit Maximum	Unit
	As a minimum, 11 devices taken from a manufacturing lot for each user to be measured at case temperatures of (–5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and V_{cc} at (V_{nom} –5 %) V, (V_{nom}) V and (V_{nom} + 5 %) V			
Mean launched power	Single-mode fibre, PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – Class B – Class C	 –4,0 –2,0	 +2,0 +4,0	dBm
Central wavelength	PRBS 2^{23} – 1at 155,52 Mbit/s modulation	1 260	1 360	nm
Spectral width	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation – MLM laser – SLM laser		 5,8 1,0	nm
Extinction ratio	155,52 Mbit/s square wave	10		dB
Mask test of eye diagram[a]	Fourth-order Thomson filter (Cut-off frequency is (0,75 × 155,52) MHz), PRBS 2^{23} – 1 at 155,52 Mbit/s	No hits	No hits	
Shutdown test of launched power	PRBS 2^{23} – 1 at 155,52 Mbit/s modulation, Shutdown input voltage: low level – Class B – Class C		 –40 –43	dBm

[a] Mask of the eye diagrams for downstream and upstream transmissions are specified in ITU-T Recommendation G.983.1.

6.1.2 Characterization: receiver section

Table 10 – Receiver section characterization tests

Parameters	Test conditions	Test limit Minimum	Test limit Maximum	Unit
	As minimum, 11 devices taken from an initial manufacturing lot to be measured at case temperatures of (–5 ± 2) °C, (25 ± 2) °C and (75 ± 2) °C and V_{cc} at (V_{nom} – 5 %) V, (V_{nom}) V and (V_{nom} + 5 %) V			
Sensitivity at 1E-10 BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10dB extinction ratio source – Class B – Class C		 –30,0 –33,0	dBm
Overload at 1E-10 BER	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	 –8 –11		dBm
Alarm on threshold[a]	PRBS modulation NRZ at 155,52 Mbit/s assuming 10 dB extinction ratio source – Class B – Class C	 –30,0 –33,0		dBm

[a] Alarm signal is effective with logic 'low' specified in Tables 6 and 7 when optical power less than that of threshold is launched to the transceiver.

6.2 Performance testing

Performance testing is undertaken to assure reliability of products when characterization testing is complete. The testing items, definite testing conditions and pass/fail criteria are listed in Table 11. This testing shall be carried out on at least 11 products taken from a manufacturing lot for each user. The testing lot shall be specified by each supplier. The products may be new or sourced from a previous test.

Table 11 – Performance testing plan

Items	Reference	Condition	Criteria [a]	Failure
Mechanical shock	IEC 60068-2-27	300 m/s^2, 18 ms 3 times/axis	$\lvert \Delta P_{mean} \rvert \leq 1$ dB $\lvert \Delta S_{min} \rvert \leq 1$ dB at 25 °C	0/11
Vibration	IEC 60068-2-6	100 m/s^2, 10-55 Hz, 3 axes, 1,5 mm, 2 h		
Fibre pull[b]	IEC 61300-2-4	100 N ± 2 N at 5 N/s, 120 s duration for reinforced cables 5 N ± 0,5 N at 0,5 N/s, 60 s duration for buffered fibres		
Temperature cycling[b]	IEC 61300-2-22	–40 °C to + 85 °C 1 h duration at extremes, more than 12 cycles		
High temperature storage[b]	IEC 61300-2-18	+85 °C, more than 96 h duration		
Low temperature storage[b]	IEC 61300-2-17	–40 °C, more than 96 h duration		
Damp heat[b]	IEC 61300-2-19	+40 °C ± 2 °C, RH: 93 % ± 2 %, 96 h duration		
Flammability	IEC 60332-3-24			

[a] Pass/fail criteria are specified to be 1 dB maximum change (or less) in mean launched power and receiver sensitivity, respectively. The quantity of 1 dB is determined to include the 0,5 dB pass/fail criteria specified in Telecordia GR-468-CORE and a 0,5 dB margin in measurement error.

[b] The testing conditions of these items may refer to Telcordia GR-468-CORE instead of IEC 61753-1 if a user requires it.

7 Environmental specifications

7.1 General safety

All products meeting this standard shall conform to IEC 60950-1.

7.2 Laser safety

Fibre optic transceivers shall be class 1 laser-certified under any condition of operation. This includes single-fault conditions whether coupled into a fibre or out of an open bore. Transceivers shall be certified to be in conformance to IEC 60825-1.

Laser safety standards and regulations require that the manufacturer of a laser product provide information about the product's laser, safety features, labelling, use, maintenance and service. This documentation shall explicitly define requirements and usage restrictions on the host system necessary to meet these safety certifications.

7.3 Electromagnetic emission

Products defined in this specification shall comply with IEC 61000-6-3 for the limitation of electromagnetic interference.

Annex A
(informative)

Measurement on tolerance to the reflected optical power (Table 3, Item 13)

Tolerance to the reflected optical power is defined in ITU-T Recommendation G.983.1 as the allowable ratio of optical input average power of O_{rd} to reflected optical average power at minimum receiving sensitivity when multiple reflected light is regarded as a noise light at O_{rd}. Here, O_{rd} is the optical interface at the reference point between ONU and the ODN for the downstream directions. A specified value of 10 dB in Item 13 means that the BER specification shall be satisfied even if noise light with a power of 10 dB less than the receiver sensitivity is put into the transceiver. In addition, the influence of reflectance into ONU receiver is described in Appendix B.2.2. in ITU-T Recommendation G.983.1. Figure A.1 shows the model for the incidence into the ONU receiver that is described in the Appendix B.2.2. This model considers that transmitted signals from the ONU No. 1 returns to the ONU No. 1 receiver as a noise through the reflection of ODN and through a WDM. Thus the noise light is the reflected light of burst signals transmitted from the ONU itself with wavelength between 1 260 nm and 1 360 nm that is specified in Table 3, Item 3.

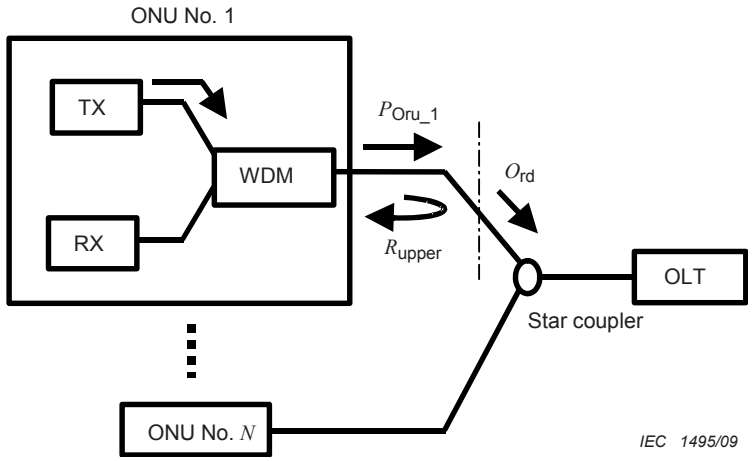

Figure A.1 – Model for incidence into ONU receiver

According to the model described above, burst signals with 1 300 nm band wavelength shall be used as a noise by an example measuring system shown in Figure A.2. It should be noted that the reflected optical power to the receiver section (RX) in the ONU, which is the specification of Item 13, is determined by the input power of a noise light ($P_{in_}$noise) and WDM isolation. As WDM isolation is not directly measured because WDM device is inside the ONU, it is impossible to measure the true value specified in Item 13.

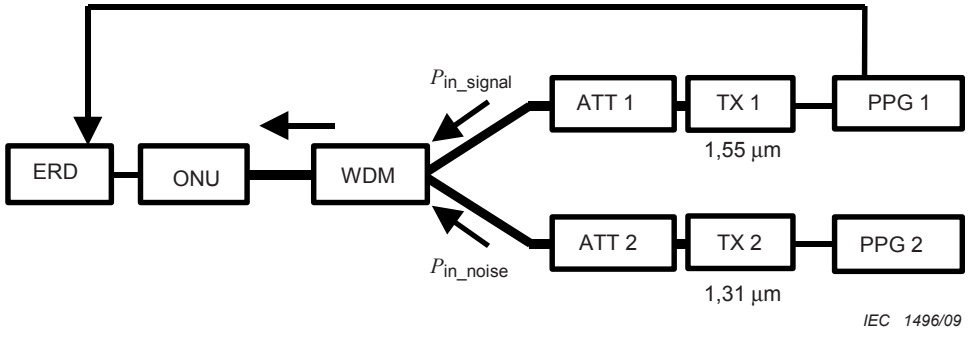

Figure A.2 – An example system to measure tolerance to the reflected optical power

This standard recommends the measuring system shown in Figure A.3 to examine the tolerance to the reflected optical power. A key feature of the system is that continuous optical light with the same wavelength band (between 1 480 nm and 1 580 nm) as the downstream input signal is used as a noise. This quasi-noise light is modulated at the same bit rate (155,52 Mb/s) as the downstream input signal. Note that modulation of the quasi-noise light is not necessarily synchronized with the signal. Input power of the signal light ($P_{\text{in_}}$signal) is set to the minimum receiver sensitivity specified in Table 3, Item 11 by using an attenuator (ATT). Input power of the noise light ($P_{\text{in_}}$noise) is set to 10 dB less than $P_{\text{in_}}$signal by using an ATT. The pass/fail criterion is whether bit error ratio (BER) specification is satisfied at this condition. By this measuring system, the specified value of Item 13 is directly set by using the ATT.

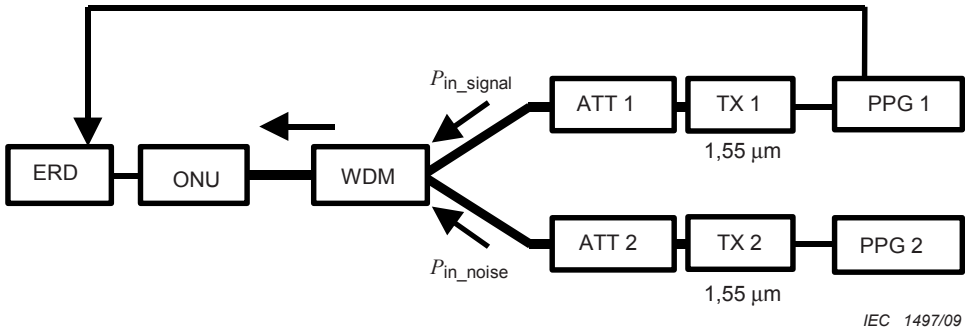

Figure A.3 – A recommended system to measure tolerance to the reflected optical power

Annex B
(informative)

Logic level of alarm and shutdown signal

This annex specifies that alarm and shutdown signals are effective when the logic level is “low” (see 5.5 of this standard). In the transceivers used for data communication systems, such as SFF transceivers, function “signal detect” is adopted with active “high” logic level. Active “low” logic for the alarm signals for the transceivers specified in this annex is compatible with the idea of those for data communication systems. Concerning the logic level of shutdown signals, active “low” is based on the idea of “fail safe”. The logic level is also harmonized with the general logic in the digital optical communications systems that the state of “light on” is “high” and “light off” is “low”.

Bibliography

IEC 60617 (all parts), *Graphical symbols for diagrams*

IEC 60793 (all parts), *Optical fibres*

IEC 60794 (all parts), *Optical fibre cables*

IEC 60825 (all parts), *Safety of laser products*

IEC 60874 (all parts), *Connectors for optical fibres and cables*

IEC 61076 (all parts), *Connectors for electronic equipment – Product requirements*

IEC 61280 (all parts), *Fibre optic communication subsystem basic test procedures*

IEC 61281-1:1999, *Fibre optic communication subsystems – Part 1: Generic specification*

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

IEC 62007-1:1999, *Semiconductor optoelectronic devices for fibre optic system applications – Part 1: Essential ratings and characteristics*

IEC 62007-2:1999, *Semiconductor optoelectronic devices for fibre optic system applications – Part 2: Measuring methods*

IEC 62148-1:2002, *Fibre optic active components and devices – Package and interface standards – Part 1: General and guidance*

ISO 1101:1983, *Technical drawings – Geometrical tolerancing – Tolerancing of form, orientation, location and run-out – Generalities, definitions, symbols, indications on drawings*

_____

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™