BS EN 50288-3-1:2013

BSI Standards Publication

Multi-element metallic cables used in analogue and digital communication and control

Part 3-1: Sectional specification for unscreened cables characterised up to 100 MHz — Horizontal and building backbone cables

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National foreword

This British Standard is the UK implementation of EN 50288-3-1:2013. It supersedes BS EN 50288-3-1:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/46, Cables, wires and waveguides, radio frequency connectors and accessories for communication and signalling.

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

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Multi-element metallic cables used in analogue and digital communication and control - Part 3-1: Sectional specification for unscreened cables characterised up to 100 MHz - Horizontal and building backbone cables

Câbles métalliques à éléments multiples utilisés pour les transmissions et les commandes analogiques et numériques - Partie 3-1: Spécification intermédiaire pour les câbles non blindés pour applications jusqu'à 100 MHz - Câbles horizontaux et verticaux de bâtiment

Mehradrige metallische Daten- und Kontrollkabel für analoge und digitale Übertragung - Teil 3-1: Rahmenspezifikation für ungeschirmte Kabel bis 100 MHz - Kabel für den Horizontal- und Steigbereich

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This document EN 50288-3-1:2013 has been prepared by CLC/SC 46XC "Multicore, Multipair and Quad Data communication cables", of CLC/TC 46X, "Communication cables".

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-03-18
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2016-03-18

This document supersedes EN 50288-3-1:2003.

EN 50288-3-1:2013 includes the following significant technical changes with respect to EN 50288-3-1:2003:

- the addition of the Blank Detail Specification Annex;
- a number minor corrections and updating of references;
- the re-classification of ‘ELFEXT’ to ‘ACR-F’.

This Part 3-1 is to be read in conjunction to EN 50288-1.

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

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

1 Scope

EN 50288-3-1 is a sectional specification for unscreened cables, characterised from 1 MHz up to 100 MHz, to be used in horizontal and building backbone wiring as defined in EN 50173.

This sectional specification contains the electrical, mechanical, transmission and environmental performance characteristics of the cables, when tested in accordance with the referenced test methods.

This sectional specification is to be read in conjunction with EN 50288-1, which contains the essential provisions for its application.

The cables covered in this sectional specification are intended to operate with voltages and currents normally encountered in communication systems. These cables are not intended to be used in conjunction with low impedance sources, for example, the electric power supplies of public utility mains.

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.

EN 50173	Series	*Information technology - Generic cabling systems*
EN 50288-1		*Multi-element metallic cables used in analogue and digital communication and control - Part 1: Generic specification*
EN 50289	Series	*Communication cables - Specifications for test methods*
EN 50290	Series	*Communication cables*
EN 60811	Series	*Electric and optical fibre cables - Test methods for non-metallic materials (IEC 60811 series)*
IEC 60189-2		*Low-frequency cables and wires with PVC insulation and PVC sheath - Part 2: Cables in pairs, triples, quads and quintuples for inside installations*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this document the terms and definitions of EN 50288-1 apply.

3.2 Symbols and abbreviations

For the purposes of this document, the following abbreviations apply.

EX	Exogenous (derived or originating externally)
POE	Power Over Ethernet

4 Cable construction

4.1 Conductor

The conductor shall be solid copper and meet the requirements of EN 50288-1, 4.1.

The conductor shall be plain or metal coated.

The nominal conductor diameter shall be ≥ 0,5 mm and ≤ 0,8 mm.

NOTE Constructions with 'copper clad' conductors **do not** meet the requirements.

4.2 Insulation

The insulation shall be of a suitable material according to the relevant part of EN 50290-2.

4.3 Cabling elements

The cable element shall be a pair or a quad.

4.4 Identification of cabling elements

Unless otherwise specified, the colour coding for identification is given in IEC 60189-2. The colours shall meet the requirements of EN 50288-1, 4.4.

4.5 Screening of cabling elements

Not applicable.

4.6 Cable make-up

The cable elements shall be laid up in concentric layer(s) or units to form the cable core.

4.7 Filling compound

Not applicable.

4.8 Interstitial fillers

Where fillers are used they shall meet the requirements of EN 50288-1, 4.8.

4.9 Screening of the cable core

Not applicable.

4.10 Moisture barriers

Not applicable.

4.11 Wrapping layers

Where wrapping layers are used they shall be in accordance with EN 50288-1, 4.11.

4.12 Sheath

The sheath shall be of a suitable material according to the relevant part of EN 50290-2.

5 Tests and requirements for completed cables

The following tables give the tests to be applied, together with the respective limits, in order to demonstrate compliance with this specification.

5.1 Electrical tests

5.1.1 Low-frequency and d.c. electrical measurements

Table 1 - Low-frequency and d.c. electrical measurements

EN 50288-1 sub-clause	Parameter	Requirement
5.1.1.1	Conductor loop resistance	≤ 19,0 Ω/100 m
5.1.1.2	Conductor resistance unbalance	≤ 2,0 %
5.1.1.3	Dielectric strength conductor/conductor	1,0 kV d.c. or 0,7 kV a.c. for 1 min or 2,5 kV d.c. or 1,7 kV a.c. for 2 s
5.1.1.4	Insulation resistance	≥ 5 000 MΩ.km when tested in accordance with EN 50289-1-4
5.1.1.5	Mutual capacitance	No requirement specified
5.1.1.6	Capacitance unbalance to earth	≤ 1 200 pF/km

5.1.2 High-frequency electrical and transmission measurements

Table 2 - High-frequency electrical and transmission requirements

<table>
<tr><th>EN 50288-1 sub-clause</th><th>Parameter</th><th>Requirement</th></tr>
<tr><td>5.1.2.1</td><td>Velocity of propagation</td><td>Phase delay ≤ 534+36/√f ns/100 m, 1 MHz ≤ f ≤ 100 MHz</td></tr>
<tr><td>5.1.2.2</td><td>Propagation delay difference (skew)</td><td>≤ 45 ns/100 m at 100 MHz</td></tr>
<tr><td>5.1.2.3</td><td>Longitudinal attenuation[2) 3) 4)]</td><td>
<table>
<tr><td>1</td><td>4</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>2,1</td><td>4,0</td><td>6,3</td><td>8,0</td><td>9,0</td><td>11,4</td><td>16,5</td><td>21,3</td><td>dB/100 m</td></tr>
</table>
α ≤1,9108√f+0,0222f+0,2/√f, 1 MHz ≤ f ≤ 100 MHz
</td></tr>
<tr><td>5.1.2.4</td><td>Near-end unbalance attenuation</td><td>≥ 40-10log(f) dB, 1 MHz ≤ f ≤ 100 MHz,</td></tr>
</table>

<table>
<tr><td>5.1.2.5</td><td>Near-end crosstalk (NEXT) [1) 2)]</td><td>
<table>
<tr><td>1</td><td>4</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>65,3</td><td>56,3</td><td>50,3</td><td>47,3</td><td>45,8</td><td>42,9</td><td>38,4</td><td>35,3</td><td>dB</td></tr>
</table>
≥ 65,3-15log(f), 1 MHz ≤ f ≤ 100 MHz
</td></tr>
<tr><td>5.1.2.6</td><td>Attenuation to crosstalk ratio at the far end [2) 6)] ACR-F</td><td>
<table>
<tr><td>1</td><td>4</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>64</td><td>52</td><td>44</td><td>40</td><td>38</td><td>34</td><td>28</td><td>24</td><td>dB</td></tr>
</table>
≥ 64-20log(f), 1 MHz ≤ f ≤ 100 MHz, values referenced to 100 m
</td></tr>
<tr><td>5.1.2.7.1</td><td>Power sum near-end crosstalk [2)] (PSNEXT)</td><td>
<table>
<tr><td>1</td><td>4</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>62,3</td><td>53,3</td><td>47,3</td><td>44,2</td><td>42,8</td><td>39,9</td><td>35,4</td><td>32,3</td><td>dB</td></tr>
</table>
≥ 62,3-15log(f), 1 MHz ≤ f ≤ 100 MHz
</td></tr>
<tr><td>5.1.2.7.2</td><td>Power Sum Attenuation to crosstalk ratio at the far end [2) 6)] (PSACR-F)</td><td>
<table>
<tr><td>1</td><td>4</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>61</td><td>49</td><td>41</td><td>37</td><td>35</td><td>31</td><td>25</td><td>21</td><td>dB</td></tr>
</table>
≥ 61-20log(f), 1 MHz ≤ f ≤ 100 MHz, values referenced to 100 m
</td></tr>
<tr><td>5.1.2.8</td><td>Mean characteristic impedance</td><td>100 Ω ± 5 Ω, 120 Ω ± 5 Ω, at 100 MHz</td></tr>
<tr><td>5.1.2.9</td><td>Return loss [2) 5)]</td><td>
<table>
<tr><td>4</td><td>8</td><td>10</td><td>16</td><td>20</td><td>31,25</td><td>62,5</td><td>100</td><td>MHz</td></tr>
<tr><td>23,1</td><td>24,5</td><td>25,0</td><td>25,0</td><td>25,0</td><td>23,6</td><td>21,5</td><td>20,1</td><td>dB</td></tr>
</table>
≥ 20+5log(f), 4 MHz ≤ f < 10 MHz; 25dB, 10 MHz ≤ f < 20 MHz;
25-7log(f/20), 20 MHz ≤ f ≤ 100 MHz,
</td></tr>
<tr><td>5.1.2.10</td><td>Coupling attenuation</td><td>≥ 40 dB, 30 MHz ≤ f ≤ 100 MHz;
≥ 40-20log(f/100) dB, 100 MHz < f ≤ 1 000 MHz;</td></tr>
</table>

[1)] For hybrid cables and multi-unit cables, PSNEXT between all non fibre recognised cable units shall be 3 dB better than the specified pair to pair NEXT at all specified frequencies.

[2)] The values in the table are for information only. The formula given shall be used to determine compliance, rounded to one decimal place.

[3)] The attenuation shall meet values adjusted for temperature up to 40 ˚C with a temperature coefficient of 0,4 % per degree rise and for temperatures from 40 ˚C to 60 ˚C with a temperature coefficient of 0,6 %, above 20 ˚C.

[4)] Values between 1 MHz and 4 MHz are for information only.

[5)] For the measurement of return loss a test sample having a round trip loss ≥ 40 dB at any measured frequency should be used.

[6)] ELFEXT is now re-classified as ACR-F, PSELFEXT is now re-classified PSACR-F, see Annex A of EN 50288-1 for an explanation

5.2 Mechanical test requirements

Table 3 - Mechanical test requirements

EN 50288-1 sub-clause	Parameter	Requirement
5.2.1	Conductor elongation at break EN 50289-3-2	≥ 10 %
5.2.2	Shrinkage of insulation EN 50289-3-4	≤ 5 %
5.2.3	Crush resistance of the cable EN 50289-3-5	1 000 N / 1 min / 100 mm Near-end crosstalk, return loss and characteristic impedance shall remain within the specified limits
5.2.4	Impact resistance of the cable EN 50289-3-6	12,5 mm radius / 1 J / 3 impacts at 1 m from the measured end Near-end crosstalk, return loss and characteristic impedance shall remain within the specified limits
5.2.5	Abrasion resistance of the sheath markings EN 50289-3-8	Marking shall remain legible after 10 strokes Force 4 N
5.2.6	Simulated installation testing of the cable	
5.2.6.1	Simulated installation testing of the cable Single bend EN 50289-3-9:2001, Clause 4, procedure 2	Single bend 4 × dia / 4 cycles Near-end crosstalk, return loss, characteristic impedance and coupling attenuation (u/c) shall remain within the specified limits
5.2.6.2	Simulated installation testing of the cable “S” bend EN 50289-3-9:2001, Clause 8	“S” bend 8 × dia / 100 m / 1 cycle / 120 deg / 1 m/s Near-end crosstalk, return loss, characteristic impedance and coupling attenuation (u/c) shall remain within the specified limits
5.2.7	Tensile performance EN 50289-3-16 combined with 5.2.6 of this standard	Load shall be 25 N per pair (i.e.100 N for 4 pairs) Near-end crosstalk, return loss, characteristic impedance and coupling attenuation (u/c) shall remain within the specified limits

5.3 Environmental tests

Table 4 - Environmental test requirements

EN 50288-1 sub-clause	Parameter	Requirement
5.3.1	Cold bend performance of the cable EN 50289-3-9	Mandrel diameter 8 × OD, No. of turns 4, temp -20 ˚C ± 2 ˚C No cracks when examined visually without magnification
5.3.5	Temperature cycling EN 50289-4-6	The attenuation shall meet the adjusted values according to footnote 3 in Table 2 when subjected to 2 temperature cycles between 20 ˚C and 60 ˚C
5.3.6	Hot shock performance (test)	As specified in EN 60811-509

5.4 Fire performance tests

Fire performance tests shall be in accordance with EN 50288-1, 5.4

Annex A
(informative)

Maximum voltage, current and temperature rating for cables used for POE applications

Table A.1 specifies the maximum recommended voltage, current, current density and conductor temperature for cables when used for POE applications (IEEE 802.3 AN (POE) IEEE 802.3 AF (POE plus))

Table A.1 - Maximum recommended voltage, current, current density and conductor temperature for cables when used for POE applications

Parameter	Unit	Requirement
Maximum communication service voltage [1)]	V	100
Maximum current density	A/mm²	3
Maximum short circuit power density for periods < 1 s	W/mm²	350
Maximum service power density	W/mm²	100
Maximum conductor surface temperature in service	°C	60
[1)] 300V for Bell Voltage for some telephone installation is allowed		

WARNING - The maximum voltages, currents and temperatures shown in Table A.1 apply to cables specified in this standard, which are intended to be used solely for communication technologies. The cables specified in this standard are **not intended** for and **must not** be connected to and/or used on the mains utility electricity supply.

Annex B
(Informative)

Blank Detail Specification

B.1 General

Annex B is a Blank Detail Specification for un-screened cables characterised from 1 MHz up to 100 MHz, for industrial or environmental demanding areas for horizontal and building backbone wiring applications for information technology generic cabling systems. The following pages detail the required information which should be entered in the spaces provided.

B.2 Document Details

B.2.1 Name and address of the organisation that has prepared the document

B.2.2 EN document number, issue number and date of issue

B.2.3 Address of the organisation from which the document is available

B.2.4 Related documents

B.2.5 Any other reference to the cable, national reference, trade name, etc.

B.2.6 A complete description of the cable which shall include:

B.2.6.1 Type and number of elements

B.2.6.2 Nominal impedance

B.2.6.3 Screening

B.2.6.4 Application

B.2.6.5 Category, found in EN 50173

B.2.6.6 Other distinguishing performance characteristics

EXAMPLE: 4 pair, unscreened twisted pair cable for use in horizontal floor wiring, having a nominal impedance of 100Ω, meeting the transmission requirements of Category 6, the coupling attenuation requirements of Type III and M_2.

B.2.6.7 Details of the cable material and construction

B.2.6.8 Special requirements for bending radius or operating temperatures.

B.2.6.9 List of cable characteristics. They are separated into electrical, transmission, mechanical and environmental characteristics.

NOTE 1 The recommended environmental severities are derived from the MICE table requirements of EN 50173-1. These recommendations were made to better reflect the cable behaviour.

NOTE 2 When these severities are noted ‘‘na’’ the cable is expected to meet the requirement of the related environment by design without the need to be tested.

NOTE 3 Ingress requirements using particles is not applicable to cable.

NOTE 4 Electromagnetic requirements coming from the MICE table of EN 50173-1 have been dealt with by using the requirements that are given for Transfer impedance, Screening attenuation and coupling attenuation. ESD requirements are considered non-applicable.

B.3 Generic specification EN 50288-1

B.3.1 Appropriate sub clause references in the generic specification EN 50288-1

B.3.2 Requirements applicable to this cable. The values entered shall meet as a minimum the requirements of sectional specification EN 50288-3-1

B.3.3 Comments – Relevant remarks

Table B.1 - Blank detail specification for symmetrical pair/quad cables for digital communications

Cable Construction	**EN 50288-3-1 sub-clause**	**Requirement**	**Comments**
	4.1	Conductor description:	
	4.2	Insulation description: Maximum diameter	
	4.3	Elements: (pair or quad)	
	4.4	Identification of cable elements:	
	4.6	Cable make-up: (number of cable elements, layers, etc)	
	4.7	Filling compounds:	
	4.8	Interstitial fillers:	
	4.10	Moisture barriers:	
	4.11	Protective wrappings:	
	4.12	Sheath: Material Nominal thickness Colour Maximum overall diameter	
	The following sub-clauses are to be found in EN 50288-1		
	4.13	Bedding layers for metallic protection:	
	4.14	Metallic protection:	
	4.15	Cable integral suspension strand:	
	4.16	Oversheath: Material Nominal thickness Colour Maximum overall diameter	
	4.17	Fauna proofing:	
	4.18	Chemical and / or environmental proofing:	

Electrical Characteristics All electrical characteristics at 20 °C	**EN 50288-1** 5.1.1	**Requirement**	**Comments**
Conductor loop resistance	5.1.1.1	≤. …..Ω/km	
Conductor resistance unbalance (inside pair or quad)	5.1.1.2	≤. ….. %	
Resistance unbalance between pairs		≤. ….. %	
Dielectric strength - Conductor/conductor	5.1.1.3	……..kV	
Insulation resistance - Conductor/conductor	5.1.1.4	≥. … MΩkm	
Mutual capacitance	5.1.1.5	≤. … nF/km	
Capacitance unbalance to earth	5.1.1.6	≤. … pF/km	

Transmission characteristics (at 20 °C)	5.1.2	Relevant sectional specification office area: EN 50288-3-1 (all electrical characteristics at 20 °C) – only special agreed values are described in following sub clauses	
Velocity of propagation	5.1.2.1	≥. …ns/100m	
Propagation delay difference (skew)	5.1.2.2	≤. …ns/100 m at f [MHz]	
Longitudinal attenuation	5.1.2.3	≤. …dB/100 m at f [MHz]	
Temperature effects		≤. … %/°C	
Environmental effects		≥. … %	
Near-end unbalance attenuation	5.1.2.4	≥. … dB at f [MHz]	
Power sum near-end crosstalk (PSNEXT)	5.1.2.7.1	≥. … dB at f [MHz]	
Near-end crosstalk (NEXT)	5.1.2.5	≥. … dB at f [MHz]	
Attenuation to crosstalk at the far-end (ACR-F)	5.1.2.6	≥. … dB at f [MHz]	
Power Sum Attenuation to crosstalk ratio at the far end (PSACR-F)	5.1.2.7.2	≥. … dB at f [MHz]	
PSExNEXT	5.1.2.7.4	≥. … dB at f [MHz]	
PSExACR-F	5.1.2.7.6	≥. … dB at f [MHz]	
Mean characteristic impedance	5.1.2.8	…. Ω	
Return loss	5.1.2.9	≥. … dB at f [MHz]	
Coupling attenuation	5.1.2.10	≥ dB, 30MHz ≤ f ≤100MHz ≥ dB-20log(f/100) dB, 100MHz ≤ f ≤1000MHz	

Mechanical Parameters	EN 50288-1 sub-clause	Requirement	Comments
	5.2.1	Conductor elongation at break EN 50289-3-2	
	5.2.2	Shrinkage of insulation EN 50289-3-4	
	5.2.3	Crush resistance of the cable EN 50289-3-5	
	5.2.4	Impact resistance of the cable EN 50289-3-6	
	5.2.5	Abrasion resistance of the sheath markings EN 50289-3-8	
	5.2.6.1	Simulated installation testing of the cable Single bend EN 50289-3-9, Clause 4, procedure 2	
	5.2.6.2	Simulated installation testing of the cable “S” bend EN 50289-3-9, Clause 8	
	5.2.7	Tensile performance EN 50289-3-16 combined with 5.2.6 of this standard	

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