BS EN 50288-2-2:2013

BSI Standards Publication

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

Part 2-2: Sectional specification for screened cables characterised up to 100 MHz — Work area and patch cord cables

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National foreword

This British Standard is the UK implementation of EN 50288-2-2:2013. It supersedes BS EN 50288-2-2:2003 which is withdrawn.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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Published by BSI Standards Limited 2013

ISBN 978 0 580 77095 1
ICS 33.120.20

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 30 September 2013.

Amendments/corrigenda issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50288-2-2

May 2013

ICS 33.120.20

Supersedes EN 50288-2-2:2003

English version

Multi-element metallic cables used in analogue and digital communication and control - Part 2-2: Sectional specification for screened cables characterised up to 100 MHz - Work area and patch cord cables

Câbles métalliques à éléments multiples utilisés pour les transmissions et les commandes analogiques et numériques - Partie 2-2: Spécification intermédiaire pour les câbles blindés pour applications jusqu'à 100 MHz - Câbles de zone de travail et de brassage

Mehradrige metallische Daten- und Kontrollkabel für analoge und digitale Übertragung - Teil 2-2: Rahmenspezifikation für geschirmte Kabel bis 100 MHz - Geräteanschlusskabel und Schaltkabel

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 50288-2-2:2013 E

Contents

Foreword

This document EN 50288-2-2:2013 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 50288-2-2:2003.

EN 50288-2-2:2013 includes the following significant technical changes with respect to EN 50288-2-2:2003:

- 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 2-2 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).

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1 Scope

EN 50288-2-2 is a sectional specification for screened cables, characterised from 1 MHz up to 100 MHz, to be used as work area cables to connect a telecommunications outlet to the terminal equipment and for patch cord cables to establish connections on a patch panel as defined in EN 50173. Work area and data centres cables may also be used as patch cord cables in any distributor of a generic building wiring system to interconnect with equipment or to cross-connect between cabling systems

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 given in EN 50288-1 and the following apply.

3.1.1
screening of cable
cable that is considered screened when the cable core is covered by a continuous conductive layer forming part of the shielding and grounding system

Note 1 to entry: d.c. continuity has to be given and minimum shielding requirements have to be met.

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 or stranded copper and meet the requirements of EN 50288-1, 4.1.

The stranded conductor shall consist of seven wires each with a nominal diameter of ≥ 0,10 mm to ≤ 0,21 mm.

The conductor shall be plain or metal coated.

The solid conductor nominal diameter shall be ≥ 0,4 mm to ≤ 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

Where appropriate, screening of the cabling elements shall be applied in accordance with 4.5 of EN 50288-1, Coverage is defined in EN 50290-2-1.

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 and 4.9.

4.9 Screening of the cable core

The screening of the cable core shall be applied in accordance with EN 50288-1, 4.9. Coverage is defined in EN 50290-2-1.

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	(D1)≤ 28,0 Ω/100 m (D2)≤ 34,0 Ω/100 m
5.1.1.2	Conductor resistance unbalance	≤ 2,0 %
5.1.1.3	Dielectric strength conductor/conductor and conductor/screen	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

EN 50288-1 sub-clause	Parameter	Requirement
5.1.2.1	Velocity of propagation	Phase delay $\leq 534+36/\sqrt{f}$ ns/100 m, 1 MHz $\leq f \leq$ 100 MHz
5.1.2.2	Propagation delay difference (skew)	$\leq$ 45 ns/100 m at 100 MHz
5.1.2.3.1	D1 Longitudinal attenuation [2) 3) 4) 7)]	1 / 4 / 10 / 16 / 20 / 31,25 / 62,5 / 100 MHz 3,2 / 6,0 / 9,5 / 12,1 / 13,6 / 17,1 / 24,8 / 32,0 dB/100 m $\alpha \leq 1,5\ (1,9108\sqrt{f}+0,0222f+0,2/\sqrt{f})$, 1 MHz $\leq f \leq$ 100 MHz
5.1.2.3.2	D2 Longitudinal attenuation [2) 3) 4) 7) 8)]	1 / 4 / 10 / 16 / 20 / 31,25 / 62,5 / 100 MHz 3,6 / 6,7 / 10,7 / 13,5 / 15,1 / 19,1 / 27,6 / 35,6 dB/100 m $\alpha \leq 3.225\sqrt{f}+0,0333f+0,3/\sqrt{f})$, 1 MHz $\leq f \leq$ 100 MHz
5.1.2.4	Near-end unbalance attenuation	$\geq$ 40-10log(f) dB, 1 MHz $\leq f \leq$ 100 MHz;
5.1.2.5	Near-end crosstalk (NEXT) [2)]	1 / 4 / 10 / 16 / 20 / 31,25 / 62,5 / 100 MHz 65,3 / 56,3 / 50,3 / 47,2 / 45,8 / 42,9 / 38,4 / 35,3 dB $\geq$ 65,3-15log(f), 1 MHz $\leq f \leq$ 100 MHz
5.1.2.6	Attenuation to crosstalk ratio at the far end [2) 6)] (ACR-F)	1 / 4 / 10 / 16 / 20 / 31,25 / 62,5 / 100 MHz 64 / 52 / 44 / 40 / 38 / 34 / 28 / 24 dB $\geq$ 64-20log(f), 4 MHz $\leq f \leq$ 100 MHz; Values referenced to 100 m
5.1.2.7.1	Power sum near-end crosstalk [4)] (PSNEXT)	1 / 4 / 10 / 16 / 20 / 31,25 / 62,5 / 100 MHz 62,3 / 53,3 / 47,3 / 44,2 / 42,8 / 39,9 / 35,4 / 32,3 dB $\geq$ 62,3-15log(f), 1 MHz $\leq f \leq$ 100 MHz

<table>
<tr><th>EN 50288-1 sub-clause</th><th>Parameter</th><th>Requirement</th></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), 4 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</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>23,0</td><td>24,1</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>Type I ≥ 85dB , 30 MHz ≤ f ≤ 100 MHz 85 - 20 log f/100 dB 100 MHz ≤ f ≤ 1000 MHz

Type Ib ≥ 70dB , 30 MHz ≤ f ≤ 100 MHz 70 - 20 log f/100 dB 100 MHz ≤ f ≤ 1000 MHz

Type II ≥ 55dB, 30 MHz ≤ f ≤ 100 MHz 55 - 20 log f/100 dB 100 MHz ≤ f ≤ 1000 MHz</td></tr>
<tr><td>5.1.2.11</td><td>Transfer impedance</td><td>Grade 1
≤ 10 mΩ/m at 1 MHz;
≤ 10 mΩ/m at 10 MHz;
≤ 30 mΩ/m at 30 MHz;
≤ 100 mΩ/m at 100 MHz
Grade 2
≤ 50 mΩ/m at 1MHz;
≤ 100 mΩ/m at 10 MHz;
≤ 200 mΩ/m at 30 MHz
≤ 1000mΩ/m at 100 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 60 ˚C with a temperature coefficient of 0,2 % per degree rise 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
[7)] Bundled cables have a greater attenuation, Maximum 10 % increase
[8)] D2 is intended for data centres but not restricted to.

5.2 Mechanical tests

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 50 N per mm² per conductor Near-end crosstalk, return loss, characteristic impedance and coupling attenuation (u/c) shall remain within the specified limits
5.2.8	Flexing performance of the cable (Only applicable for cables with stranded conductors for patch and work area)	Test and requirements as given in EN 50289-3-9:2001, Clause 5. Mandrel diameter 40 mm. Number of cycles 100, Force 50 N per mm^2. Return loss, characteristic impedance and NEXT 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 sec	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.

NOTE data centre cables are not intended to have POE and therefore do not require current rating.

Annex B
(informative)

Blank Detail Specification

B.1 General

Annex B is a Blank Detail Specification for screened work area patch cord and data centre cables characterised from 1 MHz up to 100 MHz, for industrial or environmentally demanding areas 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, screened 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 50288-2-2

B.3.3 Comments – Relevant remarks

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

Cable Construction	**EN 50288-2-2 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:	
	4.5	Screening of the cable element: (screening elements, materials, construction)	
	4.6	Cable make-up: (number of cable elements, layers, etc)	
	4.7	Filling compounds:	
	4.8	Interstitial fillers:	
	4.9	Screen of the cable core: (screening elements, materials, construction)	
	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	**EN 50288-1**	**Requirement**	**Comments**
All electrical characteristics at 20°C	5.1.1		
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	
- Conductor/screen	5.1.1.3	……..kV	
Insulation resistance			
- Conductor/conductor	5.1.1.4	≥ …. MΩkm	
- Conductor/screen	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 50288-2-2 (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]	
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 near-end crosstalk (PSNEXT)	5.1.2.7.1	≥. … 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]	
Mean characteristic impedance	5.1.2.8	…. Ω	
Return loss	5.1.2.9	≥. … dB at f [MHz]	
Screening characteristics (at 20 °C)	5.1.2	Values to be agreed between the purchaser and the manufacturer	
Coupling attenuation	5.1.2.10	≥ dB, 30MHz ≤ f ≤ 100MHz ≥ dB-20log(f/100) dB, 100MHz ≤ f ≤ 1000MHz	
Transfer impedance	5.1.2.11	≤ mΩ/m at 1MHz ≤ mΩ/m at 10MHz ≤ mΩ/m at 30MHz ≤ mΩ/m at 100 MHz	

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 50289-3-9:2001, Clause 4, procedure 2	
	5.2.6.2	Simulated installation testing of the cable “S” bend EN 50289-3-9:2001, Clause 8	
	5.2.7	Tensile performance EN 50289-3-16 combined with 5.2.6 of this standard	

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