IEC 61156-11

Edition 2.0 2023-05
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Multicore and symmetrical pair/quad cables for digital communications – Part 11: Symmetrical single pair cables with transmission characteristics up to ~~600 MHz~~ 1,25 GHz – Horizontal floor wiring – Sectional specification

IEC 61156-11:2023-05 RLV(en)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, …). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC 61156-11

Edition 2.0 2023-05
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Multicore and symmetrical pair/quad cables for digital communications – Part 11: Symmetrical single pair cables with transmission characteristics up to ~~600 MHz~~ 1,25 GHz – Horizontal floor wiring – Sectional specification

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.120.20

ISBN 978-2-8322-6984-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 11: Symmetrical single pair cables with transmission characteristics up to ~~600 MHz~~ 1,25 GHz – Horizontal floor wiring – Sectional specification

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61156-11:2019. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61156-11 has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 2019. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) additional cable type in support of T1-C generic single pair cabling up to 1,25 GHz;
b) introduction of low frequency coupling attenuation as an integral parameter describing screening efficiency at frequencies below 30 MHz.

The text of this International Standard is based on the following documents:

Draft	Report on voting
46C/1254/FDIS	46C/1258/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61156 series, published under the general title *Multicore and symmetrical pair/quad cables for digital communications*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

MULTICORE AND SYMMETRICAL PAIR/QUAD CABLES FOR DIGITAL COMMUNICATIONS –

Part 11: Symmetrical single pair cables with transmission characteristics up to ~~600 MHz~~ 1,25 GHz – Horizontal floor wiring – Sectional specification

1 Scope

~~This part of IEC 61156 describes cables intended to be used for transmission of 1 Gbps over a single twisted pair for office, home and industrial application. An example of existing application is 1000BASE-T1, see ISO/IEC TR 11801-9906[1]. The transmission characteristics of these cables are specified up to a frequency of 600 MHz and at a temperature of 20 °C. The cable type recognised is intended to be used for shielded channels with a nominal length of 40 m. Possible designs are U/FTP, X/UTP and X/FTP, where X stands for F, S or SF.~~ This part of IEC 61156 describes cables intended to be used for single balanced pair (office, home, industrial) applications according to ISO/IEC 11801-1. An example of existing application is 1000BASE-T1, see ISO/IEC TR 11801-9906. The transmission characteristics of these cables are specified up to a frequency of 1,25 GHz and at a temperature of 20 °C. The T1-C type cable is specified up to 600 MHz, the T1-D type cable up to 1,25 GHz. Depending on the MICE environment and the installation conditions either unscreened or screened cables can be used. A blank detail specification can be found in Annex A.

These cables can comprise more than one pair in the event that several systems are operated in parallel. In this case, refer to Clause 7.

The cables covered by this document are intended to operate with voltages and currents normally encountered in communication systems. While these cables are not intended to be used in conjunction with low impedance sources, for example the electric power supplies of public utility mains, they are intended to be used to support the delivery of low-voltage remote powering applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60708~~:2005~~, *Low-frequency cables with polyolefin insulation and moisture barrier polyolefin sheath*

IEC 61156-1~~:2007~~, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*
~~IEC 61156-1:2007/AMD1:2009[2]~~

~~[1] Under consideration.~~

~~[2] A consolidated version of this publication exists, comprising IEC 61156-1:2007 and IEC 61156-1:2007/AMD1:2009.~~

IEC 61156-5~~:2009~~, *Multicore and symmetrical pair/quad cables for digital communications – Part 5: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Horizontal floor wiring – Sectional specification*

IEC 62153-4-3~~:2013~~, *Metallic communication cable test methods – Part 4-3: Electromagnetic compatibility (EMC) – Surface transfer impedance – Triaxial method*

IEC 62153-4-5~~:2006~~, *Metallic communication cables test methods – Part 4-5: Electromagnetic compatibility (EMC) – ~~Coupling~~ Screening or ~~screening~~ coupling attenuation – Absorbing clamp method*

IEC 62153-4-9:2018, *Metallic communication cable test methods – Part 4-9: Electromagnetic compatibility (EMC) – Coupling attenuation of screened balanced cables, triaxial method*
IEC 62153-4-9:2018/AMD1:2020

ISO/IEC TS 29125~~:2017~~, *Information technology – Telecommunications cabling requirements for remote powering of terminal equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61156-1~~:2007 and in IEC 61156-1:2007/AMD1:2009~~ apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

4 Installation considerations

4.1 General remarks

Installation area considerations are defined in IEC 61156-1~~:2007~~. Other areas may be considered.

4.2 Bending radius of installed cable

The minimum bending radius of the cable shall be equal to or less than four times the outside diameter of the cable unless otherwise specified.

4.3 Climatic conditions

Under static conditions, the cable shall operate at least in the temperature range of the environment from −20 °C to +60 °C.

The attenuation increase due to the elevated operating temperature (temperature of the environment) is described in 6.3.3.2.

In the case of application of remote powering, the maximum temperature of the conductor shall not exceed the maximum operation temperature under static conditions (60 °C) in order to maintain the integrity of the dielectric material performance which is aligned to the environmental temperature range.

Extended temperature ranges are permitted and ~~may~~ shall be specified in the relevant detail specification.

5 Materials and cable construction

5.1 General remarks

For the purposes of this document, the requirements of IEC 61156-5~~:2009~~ apply.

The choice of materials and cable construction shall be suitable for the intended application and installation of the cable and in line with the requirements of IEC 61156-1. ~~Particular care shall be taken to meet~~ Ensure that any requirements for EMC and fire performance (such as burning properties, smoke generation, evolution of halogen gas) are met. Regional regulations can apply as well.

5.2 Cable construction

The cable construction shall be in accordance with the details and dimensions given in the relevant detail specification.

5.3 Conductor

The conductor shall be a solid annealed copper conductor in accordance with the requirements of IEC 61156-1~~:2007~~ and should have a nominal diameter between 0,4 mm and 0,65 mm. A conductor diameter of up to ~~1,0~~ 1,05 mm may be used.

NOTE The conductor dimensions seen in practice are wider than those dimensions that correspond to the resistance requirements according to 6.2.1 and are therefore relevant for the design of the contact terminals of connecting hardware.

5.4 Insulation

The conductor shall be insulated with a suitable material. Examples of suitable materials are:

– polyolefin;

– fluoropolymer;

– low-smoke ~~zero~~ halogen-free thermoplastic material.

The colour code shall be in accordance with IEC 60708 if not specified differently in the relevant detail specification.

5.5 Cable element

The cable element shall be a ~~pair and shall be~~ balanced twisted pair. The entire cable may comprise more than one cable element, see 6.3.5 and Clause 7.

5.6 Screening of the cable element

The screen of the cable element (if exists) shall be in accordance with the requirements of IEC 61156-1~~:2007~~.

5.7 Cable make-up

Fillers or spacers may be used in the cable elements and to separate cable elements. The cable elements and their screens, if they are screened, may be covered by an intermediate jacket. This jacket shall be in accordance with 5.9. The core of the cable may be wrapped with a protective layer of non-hygroscopic and non-wicking material.

5.8 Screening of the cable core

For screened cables, a screen for the cable core shall be provided. The screen shall be in accordance with the requirements of IEC 61156-1~~:2007~~.

5.9 Sheath

The sheath material shall consist of a suitable material. Examples of suitable materials are:

– polyolefin;
– PVC;
– fluoropolymer;
– low-smoke ~~zero-~~halogen-free thermoplastic material.

The sheath shall be continuous, having a thickness as uniform as possible. A non-metallic ripcord may be provided. When provided, the ripcord shall be non-hygroscopic and non-wicking.

The colour of the sheath is not specified but it should be specified in the relevant detail specification.

5.10 Identification

Each length of cable shall be identified as to the supplier and, when required, a traceability code, using one or a combination of the following methods:

– appropriately coloured threads or tapes;
– with a printed tape;
– printing on the cable core wrapping;
– marking on the sheath.

Additional markings, such as length marking, are permitted. If used, such markings shall refer to this document.

5.11 Finished cable

The finished cable shall be adequately protected for storage and shipment.

6 Characteristics and requirements

6.1 General remarks

Clause 6 lists the characteristics and minimum requirements of a cable complying with this document. Test methods shall be in accordance with the requirements of IEC 61156-1~~:2007 and IEC 61156-1:2007/AMD1:2009~~, except for the length of the cable under test which shall be as specified in Clause 6.

The computed requirements in dB, rounded to one decimal place, shall be used to determine compliance.

The tests for electrical characteristics in accordance with 6.2 shall be carried out on a cable length of not less than 100 m, unless otherwise specified.

The tests for transmission characteristics in accordance with 6.3 shall be carried out on a cable length of 100 m, unless otherwise specified. For T1-D type cables a length of 50 m may be used to improve accuracy at high frequencies.

For measurements over a wide frequency range as required for T1-D type cable, a balun-less measurement technique is recommended, see IEC TR 61156-1-2[3].

6.2 Electrical characteristics and tests

6.2.1 Conductor resistance

The maximum conductor resistance at or corrected to 20 °C shall not exceed ~~145~~ 72,5 Ω/km.

6.2.2 Resistance unbalance

6.2.2.1 Resistance unbalance within a pair

The resistance unbalance shall not exceed 2,0 %.

6.2.2.2 Resistance unbalance between pairs

If applicable, for example in the case of bundled cables (see Clause 7), the pair-to-pair resistance unbalance shall not exceed 5,0 %.

6.2.3 Dielectric strength

There shall be no failures when a test is performed on a conductor/conductor and, where screens are present, on a conductor/screen with 1,0 kV DC for 1 min or, alternatively, with 2,5 kV DC for 2 s. An AC voltage may be used. The AC voltage levels in these cases shall be 0,7 kV AC for 1 min or alternatively 1,7 kV AC for 2 s.

6.2.4 Insulation resistance

The test shall be performed on:

– conductor/conductor;

– conductor/screen (if exists).

The minimum insulation resistance at or corrected to 20 °C shall be not less than ~~5 GΩ·km~~ 5 000 MΩ·km when tested immediately after the dielectric strength test.

6.2.5 Mutual capacitance

The mutual capacitance is not specified but may be indicated in the relevant detail specification.

6.2.6 Capacitance unbalance

The maximum capacitance unbalance pair to ground shall not exceed 1 200 pF/km at a frequency of 800 Hz or 1 000 Hz.

6.2.7 Transfer impedance

For screened cables, ~~Two~~ three grades of performance are recognised for transfer impedance. The transfer impedance measured in accordance with IEC 62153-4-3 shall not exceed the values of at least one grade shown in Table 1. Requirements at frequencies below 1 MHz are for further studies (ffs).

---

[3] Currently under revision to become a TS.

Table 1 – Transfer impedance

~~Frequency range MHz~~	~~Maximum surface transfer impedance mΩ/m~~	
	~~Grade 1~~	~~Grade 2~~
~~1 to 10~~	~~$Z_t \leq 15f^{-0,176}$~~	~~$Z_t \leq 50f^{0,301}$~~
~~10 to 30~~	~~$Z_t \leq 10^{f/10}$~~	~~$Z_t \leq 23,392f^{0,631}$~~
~~Where f is the frequency in MHz.~~		

Frequency range f in MHz	Maximum surface transfer impedance in mΩ/m		
	Grade 1	Grade 1b	Grade 2
0,1 to 1	15	30	50
1 to 10	$Z_t \leq 15(f)^{-0,176}$	$Z_t \leq 30(f)^{-0,176}$	$Z_t \leq 50(f)^{-0,301}$
10 to 20	$Z_t \leq 10\frac{f}{10}$	$Z_t \leq 20\frac{f}{10}$	$Z_t \leq 23,392(f)^{0,631}$

6.2.8 Coupling attenuation and low frequency coupling attenuation

~~Four~~ Three performance types for coupling attenuation are recognised. Coupling attenuation shall be measured using either the absorbing clamp method (IEC 62153-4-5) or the triaxial method for screened cables (IEC 62153-4-9). When measured using one of these methods, the coupling attenuation in the frequency range from f = 30 MHz to ~~1 000 MHz~~ 1 GHz for T1-C type cables or 1,25 GHz for T1-D type cables shall meet the requirements of Type I, Type Ib or Type II indicated in Table 2.

Table 2 – Coupling attenuation

Coupling attenuation type	Frequency range MHz	Coupling attenuation dB
Type I	30 to 100	≥ 85
	100 to1 000 for T1-C type cables 100 to ~~1 000~~ 1 250 for T1-D type cables	≥ 85 – 20 $\log_{10}$ (f/100); f in MHz
Type Ib	30 to 100	≥ 70
	100 to 1 000 for T1-C type cables 100 to 1 250 for T1-D type cables	≥ 70 – 20 $\log_{10}$ (f/100); f in MHz
Type II	30 to 100	≥ 55
	100 to 1 000 for T1-C type cables 100 to 1 250 for T1-D type cables	≥ 55 – 20 $\log_{10}$ (f/100); f in MHz

For frequencies below 30 MHz three performance types for low frequency coupling attenuation are recognised (see Table 3). Low frequency coupling attenuation shall be measured using the triaxial method according to IEC 62153-4-9 in a tube of 3 m length.