IEC 61935-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Specification for the testing of balanced and coaxial information technology cabling –
Part 2: Cords as specified in ISO/IEC 11801 and related standards

Spécification relative aux essais des câblages symétriques et coaxiaux des technologies de l'information –
Partie 2: Cordons tels que spécifiés dans l'ISO/CEI 11801 et normes associées

IEC 61935-2:2010

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SPECIFICATION FOR THE TESTING OF BALANCED AND COAXIAL INFORMATION TECHNOLOGY CABLING –

Part 2: Cords as specified in ISO/IEC 11801 and related standards

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International Standard IEC 61935-2 has been prepared by IEC technical committee 46: Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories.

This third edition cancels and replaces the second edition published in 2005.

This third edition of IEC 61935-2 differs from the second edition in that it covers category 6_A to category 7_A cords as defined in ISO/IEC 11801.

The text of this standard is based on the following documents:

FDIS	Report on voting
46/351/FDIS	46/364/RVD

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

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61935 series, under the general title: *Specification for the testing of balanced and coaxial information technology cabling*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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IMPORTANT – The 'colour inside' logo on the cover page of this publication 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.

INTRODUCTION

Balanced cords are constructed for connecting equipment using free connectors according to IEC 60603-7 series, IEC 61076-3-104 and IEC 61076-3-110. It is known that connecting hardware performance is subject to influence by the properties of the free connector termination and therefore balanced cords should be tested to determine the quality of the assembly. Moreover, the performance of balanced cords may differ due to the performances of the involved separate components depending upon the efficiency of the manufacturing procedure. Manufacturing procedures also impact upon the reliability of these balanced cords. Therefore, the primary object of this standard is to provide test methods to ensure compatibility of balanced cords to be used in cabling according to ISO/IEC 11801. Another object is to provide test methods and associated requirements to demonstrate the performance and reliability of these balanced cords during their operational lifetime.

The test methods described in this standard may also be used for any balanced cords that include twisted pairs terminated at each end.

SPECIFICATION FOR THE TESTING OF BALANCED AND COAXIAL INFORMATION TECHNOLOGY CABLING –

Part 2: Cords as specified in ISO/IEC 11801 and related standards

1 Scope

This International Standard provides methods to ensure compatibility of balanced cords to be used in cabling according to ISO/IEC 11801 and provides test methods and associated requirements to demonstrate the performance and reliability of these balanced cords during their operational lifetime. This International Standard may also be used for providing test methods for assessing the behaviour of other balanced cords.

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 60068-2-61, *Environmental testing – Part 2: Test methods – Test Z/AMB: Climatic sequence*

IEC 60603-7 (all parts), *Connectors for electronic equipment – Part 7: Detail specifications*

IEC 60603-7:2008, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

IEC 60603-7-51, *Connectors for electronic equipment – Part 7-51: Detail specification for 8-way, shielded, free and fixed connectors, for data transmission with frequencies up to 500 MHz*

IEC 61076-3-104, *Connectors for electronic equipment – Product requirements – Part 3-104: Detail specification for 8-way, shielded free and fixed connectors for data transmissions with frequencies up to 1000 MHz*

IEC 61076-3-110, *Connectors for electronic equipment – Product requirements – Part 3-110: Rectangular connectors – Detail specification for shielded, free and fixed connectors for data transmission with frequencies up to 1000 MHz*

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61156-1, *Multicore and symmetrical pair/quad cables for digital communications – Part 1: Generic specification*

IEC 61156-6, *Multicore and symmetrical pair/quad cables for digital communications – Part 6: Symmetrical pair/quad cables with transmission characteristics up to 1 000 MHz – Work area wiring – Sectional specification*

IEC 61935-1:2009, *Specification for the testing of balanced and coaxial information technology cabling – Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards*

IEC 612153-4-11, *Metallic communication cable test methods – Part 4-11: Electromagnetic compatibility (EMC) – Coupling attenuation or screening attenuation of patch cords, coaxial cable assemblies, pre-connectorized cables – Absorbing clamp method*

ISO/IEC 11801, *Information technology – Generic cabling for customer premises*

3   Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61935-1 and the following apply.

3.1
cord
a cable assembly as defined in IEC 61935-1 whatever its targeted use

NOTE   In this document, the usage of balanced cord covers, amongst others, work area cord, patch cord and equipment cord. The terminology "modular plug cord" is an alternative expression.

4   General requirements and test configuration

4.1   Cable and connector design

When compliance with ISO/IEC 11801 is required, the design of the cables and connectors should conform to the applicable parts of IEC 61156 and IEC 60603-7, IEC 61076-3-110 and IEC 61076-3-104 respectively.

4.2   Balanced cord, cable and connector tests

For balanced cords complying with ISO/IEC 11801, cables and connectors used in cable assemblies should be assessed separately in accordance with IEC 61156-1 and IEC 60603-7, IEC 61076-3-104 or IEC 61076-3-110 respectively. These component tests do not need to be repeated on the balanced cord, but the terminated contact height should be assessed (e.g. dimension K2 of Table 1 of IEC 60603-7).

For other cords, the cables and connectors shall be assessed separately according to their respective standard unless there are no component standards. In this case, all tests will be performed on the cords, including interface tests. The acceptance tests described in this document shall be performed on a balanced cord on a lot-by-lot basis.

The periodic tests described in this document are type tests that have to be performed according to the quality system of the manufacturer.

4.3   Test configuration and equipment

The reference measurement procedures that are described in this standard require the use of a network analyser, coaxial interface cables, r.f. transformers (baluns), twisted pair test leads and impedance matching terminations. Refer to IEC 61935-1 for requirements of test equipment, including baluns (see 4.2.6 of IEC 61935-1). The nominal impedance for the test set-up and the terminations is 100 Ω. The same tests may be used for 120 Ω and 150 Ω cords, but the measurement methods have not been evaluated for these nominal impedance values.

The test configuration includes termination test heads at each end of the cord. For NEXT and return loss, the test configuration is as shown in Figure 1. The terminals on the test heads interface with the test equipment. Refer to IEC 61935-1 for detailed connection diagrams. All pairs shall be terminated with differential plus common mode terminations per IEC 61935-1. Resistive type terminations are preferred.
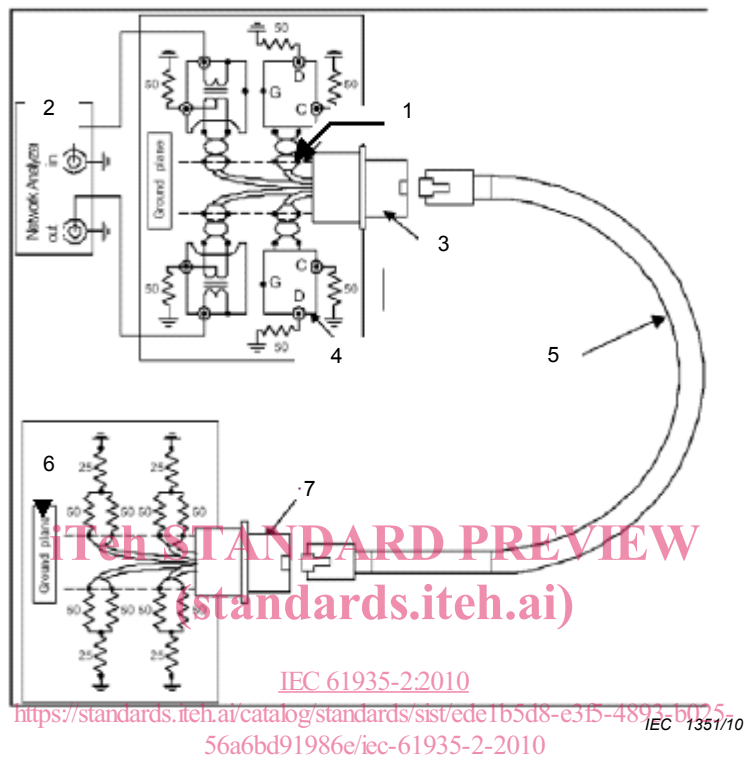
Key

1 test interface

2 network analyser (receiver, in –50 Ω)

3 near end test head

4 balun

5 cord under test

6 ground plane

7 far end test head

Figure 1 – Test configuration for balanced cord for NEXT and return loss measurements

4.4 Balanced cord tests requirements

The test methods described in this specification characterise balanced cords according to ISO/IEC 11801. They may be also used for other cords. For certification purposes, the test schedule refers to these tests.

The cord test requirements include tests that can be performed on each cord or representative samples produced, and tests that are only performed on representative samples of cords. The sampling only tests (known as periodic tests) include:

- tensile strength;
- flexure;
- bending/twisting;
- crushing;
- dust test;

- climatic sequence;

- coupling attenuation.

The periodic tests are described in detail in Clause 7.

The acceptance tests that can be performed on each cord include:

- visual inspection;

- wire map;

- return loss;

- pair-to-pair NEXT.

If all components used to assemble the cord are not assured to be compliant to their respective component standards, the following additional tests should be performed:

- insertion loss (attenuation);

- propagation delay;

- delay skew;

- d.c. resistance;

- d.c. resistance unbalance.

The requirements to be verified on each cord are described in detail in Clause 5.

Balanced cords shall meet the transmission requirements of its designated category and, with appropriate test heads, the transmission requirements of all lower categories, e.g. a category 7_A balanced cord shall meet the:

- category 7_A requirements when tested with a category 7_A test head;

- category 7 requirements when tested with a category 7 test head;

- category 6_A requirements when tested with a category 6_A test head;

- category 6 requirements when tested with a category 6 test head;

- category 5 requirements when tested with a category 5 test head.

5 Acceptance tests

5.1 Visual inspection

Visual inspection of balanced cords shall be performed by visual inspection with normal or corrected vision without any additional magnification:

- the condition, workmanship and finish are satisfactory;

- the marking, when specified in the relevant specification, is legible;

- mechanical damage is absent and there is no undesired movement or displacement of parts;

- flaking of materials or finishes is absent;

- the length as specified.

5.2 Wire map

A conductor map test is intended to verify correct pin termination at each end and to check for installation connectivity errors. For each of the conductors in the cable, and the screen(s), if any, the conductor map indicates

- continuity to the remote end;

- shorts between any two or more conductors/screen(s);

- transposed pairs;

- reversed pairs;

- split pairs;

- any other connection errors.

Correct connectivity of telecommunications outlet/connectors is defined in ISO/IEC 11801 (or equivalent), and is illustrated in Figure 2 (for four pair cables).
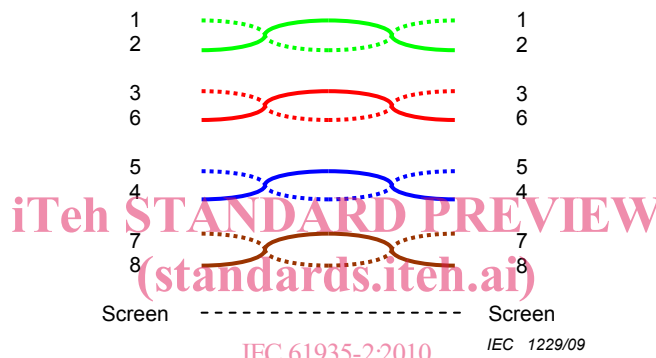
Figure 2 – Correct pairing

A reversed pair occurs when the polarity of one pair is reversed at one end of the balanced cord (also called a tip/ring reversal). See Figure 3a for an illustration of a reversed pair.

A transposed pair occurs when the two conductors in a pair are connected to the position for a different pair at the remote connection. See Figure 3b for an illustration of transposed pairs.

NOTE   Transposed pairs are sometimes referred to as crossed pairs.

Split pairs occur when pin to pin continuity is maintained but physical pairs are separated. See Figure 3c for an illustration of split pairs.
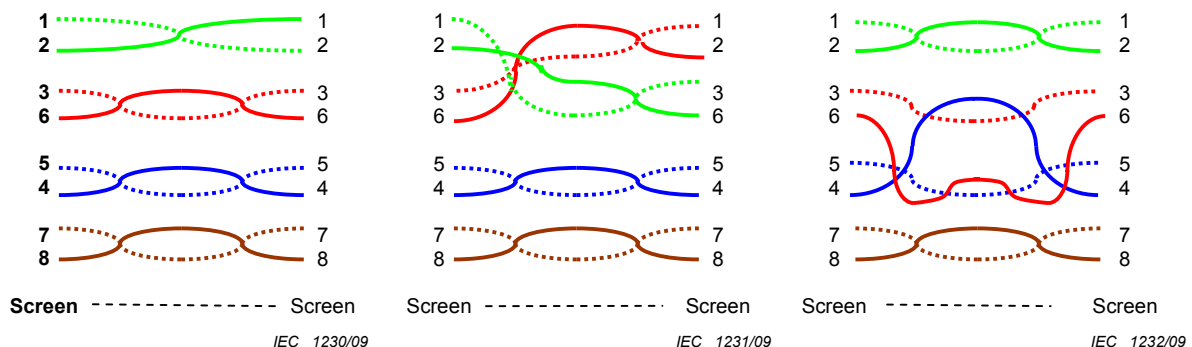

| Figure 3a – Reversed pair | Figure 3b – Transposed pairs | Figure 3c – Split pairs |

Figure 3 – Incorrect pairing

If the balanced cord wire map test is conformant, then a "pass" shall be reported.

5.3 Propagation delay

Propagation delay is assumed to be met by design when using cables and connectors that comply with IEC 61156-6, IEC 60603-7, IEC 61076-3-104 or IEC 61076-3-110 respectively. Propagation delay shall be measured in accordance with 4.6 of IEC 61935-1.

5.4 Delay skew

Delay skew is assumed to be met by design when using cables and connectors that comply with IEC 61156-6, IEC 60603-7, IEC 61076-3-104 or IEC 61076-3-110 respectively. Delay skew shall be calculated in accordance with 4.6 of IEC 61935-1.

5.5 Insertion loss

Insertion loss is assumed to be met by design when using cables and connectors that comply with IEC 61156-6, IEC 60603-7, IEC 61076-3-104 or IEC 61076-3-110 respectively. Insertion loss shall be measured in accordance with 4.5 of IEC 61935-1.

5.6 Return loss

5.6.1 Object

The object of this test is to measure the return loss of a balanced cord.

5.6.2 Test method

Return loss is derived from the measured value of the scattering parameter, S_{11} and S_{22}, of the balanced cord.

5.6.3 Test set-up and measurement

The test set-up is described in 4.3. The test set-up consists of a network analyser, four baluns and two test heads (each containing a fixed connector). Calibration is performed according to 4.11.4.1 of IEC 61935-1.

The balanced cord shall be connected to the test equipment by connecting to appropriate (by category) test heads, as shown in Figure 1.

5.6.4 Test report

The measured results shall be reported in graphical or table format with the limits specified in the standard distinctly shown on the graphs or in the table at the same frequencies as specified in the relevant detail specification. Results for all pairs shall be reported. It shall be explicitly noted if the measured results exceed the test limits.

5.6.5 Requirements

The requirements for the return loss for each category are shown in Table 1. The assumptions that were used to develop these requirements are shown in Table 8.

Table 1 – Return loss requirements

Category	5	6	6$_A$	7	7$_A$
Frequency range (MHz)	4 to 100	4 to 250	4 to 500	4 to 600	4 to 1 000
1 to 25	$19{,}8+3{\cdot}\log(f)$ dB				
25 to 250	$38-10{\cdot}\log(f)$ dB				
250 to 500	Not applicable		$14-15{\cdot}\log(f/250)$ dB	$38-10{\cdot}\log(f)$ dB	
500 to 600	Not applicable			$38-10{\cdot}\log(f)$ dB	
600 to 1 000	Not applicable				$38-10{\cdot}\log(f)^a$ dB
NOTE The frequency f is in MHz.					
^{a} Calculated values below 10 dB revert to 10 dB.					

The requirements at key frequencies are shown in Table 2.

Table 2 – Balanced cord return loss requirements at key frequencies

Return loss requirements at key frequencies in dB					
Category	5	6	6$_A$	7	7$_A$
4 MHz	21,6	21,6	21,6	21,6	21,6
100 MHz	18,0	18,0	18,0	18,0	18,0
250 MHz	na	14,0	14,0	14,0	14,0
500 MHz	na	na	9,5	11,0	11,0
600 MHz	na	na	na	10,2	10,2
1 000 MHz	na	na	na	na	10,0
na = not applicable					

5.7   Near end crosstalk (NEXT)

5.7.1   Object

The object of this test is to measure the NEXT of a balanced cord.

5.7.2   Test method

NEXT is derived from the measured value of the scattering parameter of the balanced cord, S_{21} and S_{12} as applicable.

5.7.3   Test set-up and measurement

The test set-up is described in 4.3.

The balanced cord shall be connected to the test equipment by connecting to appropriate (by category) test heads, as shown in Figure 1. NEXT shall be measured in accordance with 4.7 of IEC 61935-1.

5.7.4   Test report

The measured results shall be reported in graphical or table format with the limits specified in the standard distinctly shown on the graphs or in the table at the same frequencies as specified in the relevant detail specification. Results for all pair combinations shall be reported. It shall be explicitly noted if the measured results exceed the test limits.