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Connecteurs pour équipements électroniques – Essais et mesures – Partie 27-100: Essais d'intégrité des signaux jusqu'à 500 MHz sur les connecteurs de la série CEI 60603-7 – Essais 27a à 27g



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CONNECTORS FOR ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 27-100: Signal integrity tests up to 500 MHz on 60603-7 series connectors – Tests 27a to 27g

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International Standard IEC 60512-27-100 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

FDIS	Report on voting
4B/2262/FDIS	48B/2275/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.

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

A list of all parts of IEC 60512 series, under the general title *Connectors for electrical equipment – Tests and measurements* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date 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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CONNECTORS FOR ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 27-100: Signal integrity tests up to 500 MHz on 60603-7 series connectors – Tests 27a to 27g

1 Scope and object

This part of IEC 60512 specifies the test methods for transmission performance for IEC 60603-7 series connectors up to 500 MHz. It is also suitable for testing lower frequency connectors if they meet the requirements of the detail specifications and of this standard.

The test methods provided here are:

– insertion loss, test 27a;
– return loss, test 27b;
– near-end crosstalk (NEXT) test 27c;
– far-end crosstalk (FEXT), test 27d;
– transverse conversion loss (TCL), test 27f;
– transverse conversion transfer loss (TCTL), test 27g;

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For the transfer impedance (Zt) test, see IEC 60512-26-100, test 26e.

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For the coupling attenuation, see IEC 62153-4-12.

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.

IEC 60050–581, *International Electrotechnical Vocabulary (IEV) – Part 581: Electromechanical components for electronic equipment*

IEC 60512-1, *Connectors for electronic equipment – Tests and measurements – Part 1: General*

IEC 60512-1-100, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General - Applicable publications*

IEC 60512-26-100, *Connectors for electronic equipment – Tests and measurements – Part 26-100: Measurement setup, test and reference arrangements and measurements for connectors according to IEC 60603-7 – Tests 26a to 26g*

IEC 60603-7 (all parts), *Connectors for electronic equipment*

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

IEC 61076-1, *Connectors for electronic equipment – Product requirements – Part 1: Generic specification*

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

IEC 61169-16, *Radio-frequency connectors – Part 16: Sectional specification – RF coaxial connectors with inner diameter of outer conductor 7 mm (0,276 in) with screw coupling – Characteristic impedance 50 ohms (75 ohms) (Type N)*

IEC 62153-4-12, *Metallic communication cable test methods – Part 4-12: Electromagnetic compatibility (EMC) – Coupling attenuation or screening attenuation of connecting hardware – Absorbing clamp method*

3 Terms, definitions, acronyms and symbols

NOTE It should be noted that this document, although having a close relationship with corresponding documents, which use different terminology to that used in those documents.

3.1 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 60050(581), IEC 61076-1, IEC 60512-1, IEC 60603-7 as well as the following, apply.

3.1.1 Test Free Connector (TFC)

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free connector, which is constructed such that it is a test artefact, is known as a Test Free Connector (TFC)

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3.2 Acronyms

For ease of reference, acronyms used in this standard are given below.

ACRF	Attenuation to crosstalk ratio, far-end
CM	Common mode
CMR	Common mode rejection
DM	Differential mode
DMCM	Differential mode plus common mode
DUT	Device under test
EIA	Electronic Industries Alliance
ELTCTL	Equal level transverse conversion transfer loss
FEXT	Far-end crosstalk
F/UTP	Foil (surrounding) unscreened twisted-pairs
ICEA	Insulated Cable Engineers Association
IDC	Insulation displacement connection
IPC	Insulation piercing connection
NEXT	Near-end crosstalk
OSB	Output signal balance
PSAACRF	Power sum attenuation to alien crosstalk ratio, far-end
PSACRF	Power sum attenuation to crosstalk ratio, far-end
PSANEXT	Power sum alien near-end crosstalk
PSFEXT	Power sum far-end crosstalk

PSNEXT	Power sum near-end crosstalk
RL	Return Loss
TCTL	Transverse conversion transfer loss
TFC	Test free connector
TIA	Telecommunications Industry Association
U/UTP	Unshielded twisted-pair
Zt	Transfer impedance

3.3 Symbols

A	terminal of balun
a	insertion loss; equation coefficient
B	terminal of balun
b	equation coefficient
C	terminal of balun
D	terminal of balun
f	frequency
J	fixed connector; socket
k	equation coefficient
P	free connector
R_x	resistor
S_{xy}	normalized S-parameter
T_{xy}	T-parameter
TD	time delay
Zt	transfer impedance
Ω	Ohms
%	percent
°	degree

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4 Overall test arrangement

4.1 Test instrumentation

All test instrumentation shall be qualified for use over the frequency range of 1 MHz to 500 MHz.

These test procedures require the use of a vector network analyser. The analyser should have the capability of full 2-port calibrations. The analyser shall cover the frequency range of 1 MHz to 500 MHz at least.

When used, at least two test baluns are required in order to perform measurements with balanced symmetrical signals. The requirements for the baluns are given in 4.4.

Optionally; multi-port network analyzers for balun-less test set-up may be used.

Reference loads and cables are needed for the calibration of the set-up. Requirements for the reference loads, and cables are given in 4.6.1 and 4.6.2 respectively.

Termination loads are needed for termination of pairs, used and unused, which are not terminated by the test baluns. Requirements for the termination loads are given in 4.7.

An absorbing clamp and ferrite absorbers are needed for the coupling attenuation measurements. The requirements for these items are given in IEC 62153-4-12.

4.2 Coaxial cables and interconnect for network analysers

Lengths of coaxial cables used to connect the network analyser to the baluns shall be as short as possible. (It is recommended that they do not exceed 600 mm each.)

The baluns shall be electrically bonded to a common ground plane. For crosstalk measurements, a test fixture may be used, in order to reduce residual crosstalk (see Annex A).

Balanced interconnect and associated connecting hardware used to connect between the test equipment and the connector under test shall meet the requirements given in 4.9.2.

4.3 Measurement precautions

To ensure a high degree of reliability for transmission measurements, the following precautions are required.

a) Any measurement that is to be used in a de-embedding or re-embedding process, whether vector or matrix, shall have its phase adjusted to the free connector phase reference plane. Methods to do this are provided.

b) Consistent and stable balun and resistor loads shall be used for each pair throughout the test sequence.

c) Cable and adapter discontinuities, as introduced by physical flexing, sharp bends and restraints shall be avoided before, during and after the tests.

d) Consistent test methodology and terminations (baluns or resistors) shall be used at all stages of transmission performance qualifications.

   The relative spacing of conductors in the pairs shall be preserved throughout the tests to the greatest extent possible.

e) The balance of the cables is maintained to the greatest extent possible by consistent conductor lengths and pair twisting to the point of load.

f) The sensitivity to set-up variations for these measurements at high frequencies demands attention to details for both the measurement equipment and the procedures.

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4.4 Balun requirements

The baluns may be balun transformers or 180° hybrids with attenuators to improve matching if needed. Figure 1 shows such an arrangement.

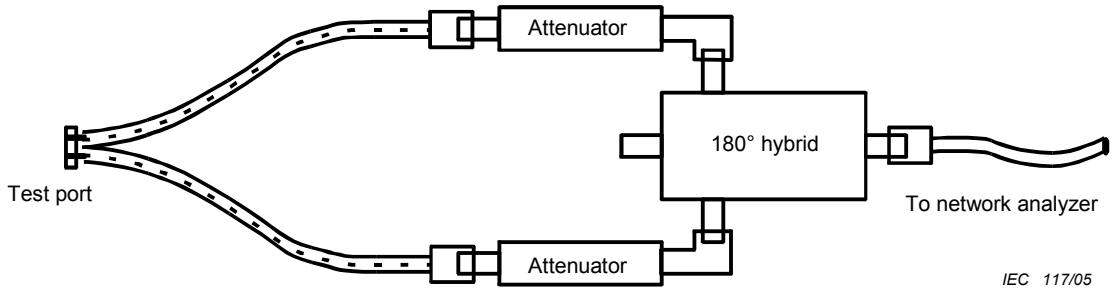

Figure 1 – Optional 180° hybrid used as a balun

The specifications for the baluns apply for the whole frequency range for which they are used. Baluns shall be RFI shielded and shall comply with the specifications listed in Table 1.

Table 1 – Test balun performance characteristics

Parameter	Frequency (MHz)	Value
Impedance, primary [a]	$1 \leq f \leq 500$	50 Ω unbalanced
Impedance, secondary	$1 \leq f \leq 500$	100 Ω balanced
Insertion loss	$1 \leq f \leq 500$	2,0 dB maximum
Return loss, bi-directional[b]	$1 \leq f < 15$ $15 \leq f \leq 500$	12 dB minimum 20 dB minimum
Return loss, CM[b]	$1 \leq f < 15$ $15 \leq f < 400$ $400 \leq f \leq 500$	15 dB minimum 20 dB minimum 15 dB minimum
Power rating	$1 \leq f \leq 500$	0,1 watt minimum
Longitudinal balance[b]	$1 \leq f < 100$ $100 \leq f \leq 500$	60 dB minimum 50 dB minimum
Output signal balance[b]	$1 \leq f \leq 500$	50 dB minimum
CM rejection[b]	$1 \leq f \leq 500$	50 dB minimum

[a] Primary impedance may differ, if necessary, to accommodate analyzer outputs other than 50 Ω.

[b] Measured per ITU-T (formerly CCITT) Recommendation G.117 with the network analyzer calibrated using a 50 Ω load.

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4.5 Interfacing

For ease of interfacing to test fixtures, a pin and socket interface with dimensions as shown in informative Clause A.2 is recommended.

Figure 2 depicts the proper test configurations for qualifying test baluns to the requirements of this Standard.

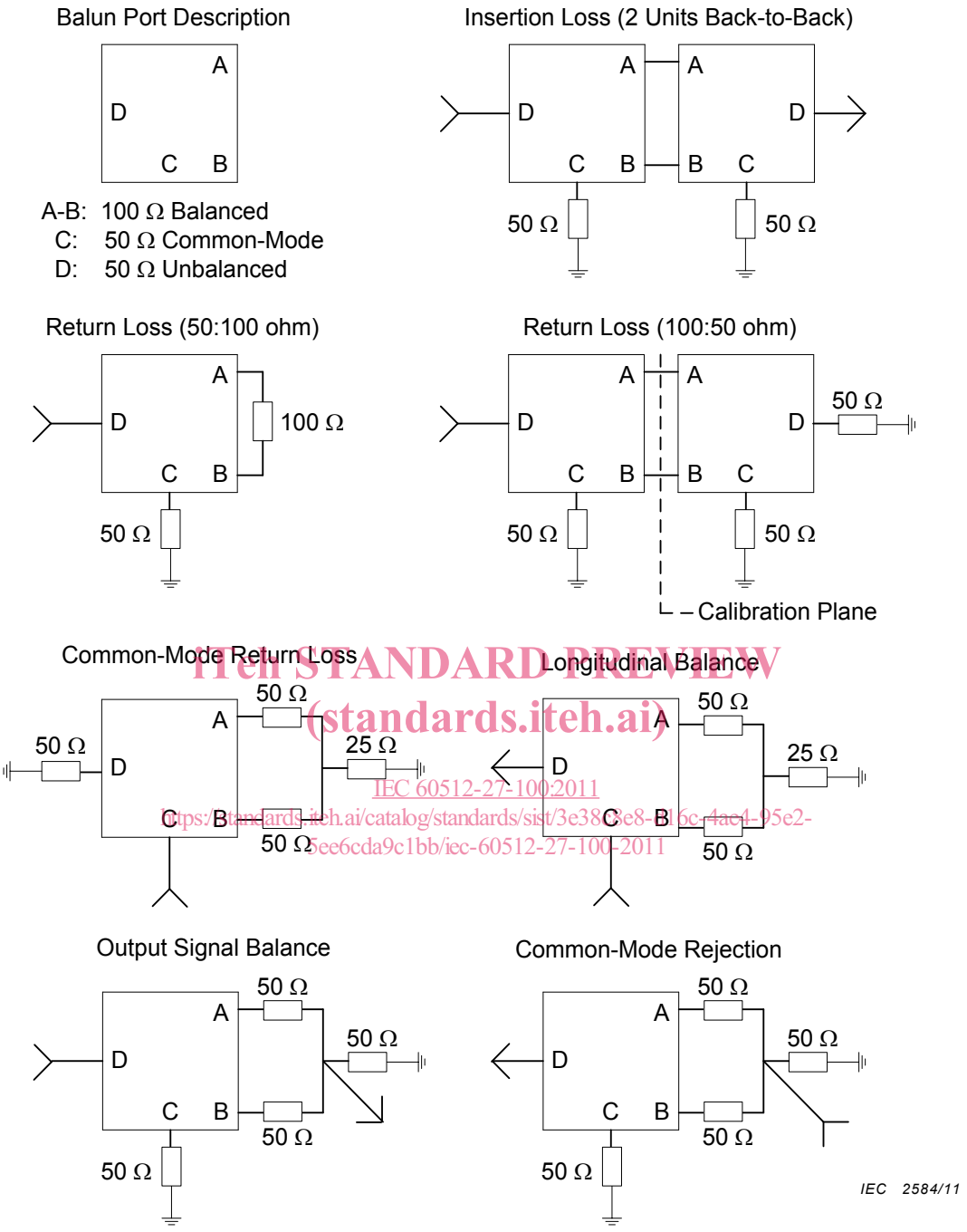

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Figure 2 – Measurement configurations for test balun qualification

4.6 Reference components for calibration

4.6.1 Reference loads for calibration

To perform a one or two-port calibration of the test equipment, a short circuit, an open circuit and a reference load are required. These devices shall be used to obtain a calibration.

The reference load shall be calibrated against a calibration reference, which shall be a 50 Ω load, traceable to an international reference standard. Two 100 Ω reference loads in parallel shall be calibrated against the calibration reference. The reference loads for calibration shall be placed in an N-type connector according to IEC 60169-16, meant for panel mounting,