

BS EN 61169-1:2013

Incorporating corrigendum February 2016



BSI Standards Publication

Radio-frequency connectors

Part 1: Generic specification — General requirements and measuring methods

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National foreword

This British Standard is the UK implementation of EN 61169-1:2013. It is identical to IEC 61169-1:2013, incorporating corrigendum February 2016. It supersedes BS EN 61169-1:1996 which is withdrawn.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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Date	Text affected
30 April 2016	Implementation of IEC corrigendum February 2016: subclause 9.4.9.2 corrected

English version

**Radio-frequency connectors -
Part 1: Generic specification -
General requirements and measuring methods
(IEC 61169-1:2013)**

Connecteurs pour fréquences
radioélectriques -
Partie 1: Spécification générique -
Exigences générales et méthodes de
mesure
(CEI 61169-1:2013)

Hochfrequenz-Steckverbinder -
Teil 1: Fachgrundspezifikation -
Allgemeine Anforderungen und
Messverfahren
(IEC 61169-1:2013)

This European Standard was approved by CENELEC on 2013-08-14. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 46F/216/CDV, future edition 2 of IEC 61169-1, prepared by SC 46F, "R.F. and microwave passive components", of IEC TC 46, "Cables, wires, waveguides, R.F. connectors, R.F. and microwave passive components and accessories" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61169-1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-05-14
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-08-14

This document supersedes EN 61169-1:1994.

EN 61169-1:2013 includes the following significant technical changes with respect to EN 61169-1:1994:

Tests methods have been updated as well as terminology.

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.

Endorsement notice

The text of the International Standard IEC 61169-1:2013 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61196 series	NOTE	Harmonised in EN 61196 series.
ISO 286-1	NOTE	Harmonised as EN ISO 286-1.
ISO 1302	NOTE	Harmonised as EN ISO 1302.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60027	Series	Letter symbols to be used in electrical technology	EN 60027	Series
IEC 60050	Series	International Electrotechnical Vocabulary	-	-
IEC 60068-1	-	Environmental testing - Part 1: General and guidance	EN 60068-1	-
IEC 60068-2-1	1990	Environmental testing - Part 2: Tests - Tests A: Cold	EN 60068-2-1 ¹⁾	1993
IEC 60068-2-2	1974	Environmental testing - Part 2: Tests - Tests B: Dry heat	EN 60068-2-2 ^{2) 3)}	1993
IEC 60068-2-6	-	Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)	EN 60068-2-6	-
IEC 60068-2-11	-	Environmental testing - Part 2: Tests - Test Ka: Salt mist	EN 60068-2-11	-
IEC 60068-2-13	-	Environmental testing - Part 2: Tests - Test M: Low air pressure	EN 60068-2-13	-
IEC 60068-2-14	2009	Environmental testing - Part 2-14: Tests - Test N: Change of temperature	EN 60068-2-14	2009
IEC 60068-2-17	-	Environmental testing - Part 2: Tests - Test Q: Sealing	EN 60068-2-17	-
IEC 60068-2-20	-	Environmental testing - Part 2-20: Tests - Test T: Test methods for solderability and resistance to soldering heat of devices with leads	EN 60068-2-20	-
IEC 60068-2-27	-	Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	EN 60068-2-27	-
IEC 60068-2-29	-	Environmental testing - Part 2: Tests - Test Eb and guidance: Bump	EN 60068-2-29	- ⁴⁾
IEC 60068-2-30	-	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	-

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¹⁾ EN 60068-2-1 is superseded by EN 60068-2-1:2007, which is based on IEC 60068-2-1:2007.

²⁾ EN 60068-2-2 includes supplement(s) A to IEC 60068-2-2.

³⁾ EN 60068-2-2 is superseded by EN 60068-2-2:2007, which is based on IEC 60068-2-2:2007.

⁴⁾ EN 60068-2-29 is superseded by EN 60068-2-27:2009, which is based on IEC 60068-2-27:2009.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60068-2-42	-	Environmental testing - Part 2-42: Tests - Test Kc: Sulphur dioxide test for contacts and connections	EN 60068-2-42	-
IEC 60068-2-52 + corr. July	1996 1996	Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)	EN 60068-2-52	1996
IEC 60068-2-54	-	Environmental testing - Part 2-54: Tests - Test Ta: Solderability testing of electronic components by the wetting balance method	EN 60068-2-54	-
IEC 60068-2-61	1991	Environmental testing - Part 2: Test methods - Test Z/ABDM: Climatic sequence	EN 60068-2-61	1993
IEC 60068-2-78	-	Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	EN 60068-2-78	-
IEC 60457-1	-	Rigid precision coaxial lines and their associated precision connectors - Part 1: General requirements and measuring methods	HD 351.1 S1	-
IEC 60617	Data- base	Graphical symbols for diagrams	-	-
IEC 61726	-	Cable assemblies, cables, connectors and passive microwave components - Screening attenuation measurement by the reverberation chamber method	EN 61726	-
IEC 62037	Series	Passive RF and microwave devices, intermodulation level measurement	EN 62037	Series
IEC 62153	Series	Metallic communication cables test methods	EN 62153	Series
ISO 1000	- ⁵⁾	SI units and recommendations for the use of their multiples and of certain other units	-	-

⁵⁾ ISO 1000:1992 has been withdrawn.

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RADIO FREQUENCY CONNECTORS –

Part 1: Generic specification – General requirements and measuring methods

1 Scope

This part of IEC 61169, which is a generic specification, relates to radio frequency connectors for r.f. transmission lines for use in telecommunications, electronics and similar equipment.

It provides the basis for the sectional standards, which apply to individual connector types. It is intended to establish uniform concepts and procedures concerning:

- terminology;
- standard ratings and characteristics;
- testing and measuring procedures concerning electrical, mechanical and climatic properties;
- classification of connectors with regard to climatic testing procedures involving temperature and humidity.

The test methods and procedures of this standard are intended for acceptance and type approval testing.

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 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available from: <http://www.electropedia.org>)

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:1990, *Environmental testing – Part 2-1: Tests – Test A: Cold*¹

IEC 60068-2-2:1974, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*²

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11, *Environmental testing – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-13, *Environmental testing – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

¹ This publication has been withdrawn.

² This publication has been withdrawn.

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-29, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-42, *Environmental testing – Part 2-42: Tests – Test Kc: Sulphur dioxide test for contacts and connections*

IEC 60068-2-52:1996, *Environmental testing – Test Kb: Salt mist, cyclic (sodium, chloride solution)*

IEC 60068-2-54, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-61:1991, *Environmental testing – Part 2-61: Test methods – Test Z/ABDM: Climatic sequence*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60457-1, *Rigid precision coaxial lines and their associated precision connectors – Part 1: General requirements and measuring methods*

IEC 60617, *Graphical symbols for diagrams* (available from: <http://std.iec.ch/iec60617>)

IEC 62153 (all parts), *Metallic communication cables test methods*

IEC 61726, *Cable assemblies, cables, connectors and passive microwave components – Screening attenuation measurement by the reverberation chamber method*

IEC 62037 (all parts), *Passive RF and microwave devices, intermodulation level measurement*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*³

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Some of the terms defined are not used in the present document, but may be used in the different sectional specifications.

3.1 General, parts of connectors

3.1.1

contact (electrical)

state in which individual electrically conductive parts are in such close mechanical touch as to provide a low resistance path to electrical current in either direction

3.1.2

contact

conductive element in a component which mates with a corresponding element to provide an electrical path (to provide electrical contact)

³ This publication has been withdrawn.

3.1.3**male (pin) contact**

contact intended to make electrical engagement on its outer surface and which will enter a female (socket) contact

3.1.4**female (socket) contact**

contact intended to make electrical engagement on its inner surface and which will accept entry of a male (pin) contact

3.1.5**hermaphroditic contact**

contact which is intended to mate with an identical contact

3.1.6**resilient contact**

contact having elastic properties to provide a force to its mating part

3.2 Basic connector terms**3.2.1****connector**

component normally attached to a cable or mounted on a piece of apparatus (excluding an adaptor) for electrically joining separable parts of a transmission line system

3.2.2**connector pair**

two connectors having complementary mating faces and locking means, so as to be mateable and interlockable

3.2.3**series type**

terms characterizing the particular mating faces and locking means of a connector pair with regard to construction and dimension

Note 1 to entry: The term "series" is sometimes used as an approximate synonym of 'type' for designating the entirety of connector styles with identical mating face and locking means.

3.2.4**style**

particular form or shape of connector, as well as a combination of connectors of the same type

Note 1 to entry: For "adaptor", see 3.5.1 to 3.5.5: a 'within-type adaptor' may also be considered as a particular style of a given type.

Note 2 to entry: Examples are: free and fixed connectors, both straight and right angle, within-type adaptors straight and right angle.

3.2.5**variant**

variation of a style, in particular details, such as cable-entry dimensions

3.2.6**grade**

qualification of a connector with regard to mechanical and electrical precision in particular with respect to a defined return loss

3.2.7**general purpose connector: Grade 2**

connector making use of the widest permitted dimensional deviations (tolerances) so as still to guarantee minimum stated performance and intermateability

Note 1 to entry: A requirement for the return loss may or may not be specified.

3.2.8**high performance connector: Grade 1**

connector for which limits of return loss are specified as a function of frequency.

Note 1 to entry: No tighter dimensional tolerances than those applicable to Grade 2 are normally specified. The manufacturer is responsible, however, for choosing tighter tolerances where necessary to ensure that the return loss requirements are met.

3.2.9**standard test connector: Grade 0**

precisely made connector of a particular type used to carry out return loss measurements on Grade 1 and Grade 2 connectors, contributing only negligible errors to the measuring result

Note 1 to entry: The standard test connector is often part of an inner-type adaptor which allows connection with a precision connector forming part of the measuring equipment.

3.2.10**precision connector**

connector that has coincident mechanical and electrical reference planes, air dielectric, and has the property of making connections with a high degree of repeatability without introducing significant reflections, loss or leakage

Note 1 to entry: It is intended for mounting on air-lines and instruments. Precision connectors can be of the hermaphroditic type, flange type or of the pin and socket type as stated in IEC 60457-1.

3.2.11**laboratory precision connector****LPC**

precision connector without dielectric support for the centre conductor

3.2.12**general precision connector****GPC**

precision connector with self-contained dielectric support capable of supporting the unsupported centre conductor of an LPC and standard air-line which it is mated

3.3 Constructional terms**3.3.1****male connector/pin connector**

connector containing a male (pin) centre contact

3.3.2**female connector/socket connector**

connector containing a female (socket) centre contact

3.3.3**plug connector**

connector featuring the active part of the coupling mechanism, i.e. the nut or bayonet ring, and which normally is a free contact

Note 1 to entry: Depending on the particular type, a plug may be a male or female connector.

3.3.4**socket**

connector complimentary to the plug

3.3.5**hermaphroditic connector**

connector which mates with an identical connector

3.3.6**free connector**

connector for attachment to a free end of a cable

Note 1 to entry: If not specified as fixed, a connector is assumed to be free.

3.3.7

fixed connector

connector with provision for attachment to a mounting surface

3.3.8

triaxial

transmission line comprising three concentric conductors having a common axis and with each conductor insulated from the other two

3.4 Sealing

3.4.1

sealed connector

connector employing a seal capable of fulfilling specified gas-, moisture- or liquid tightness requirements

3.4.2

barrier seal

seal preventing the passage of gases, moisture or liquids in an axial direction within the body shell of a connector

3.4.3

panel seal

seal preventing the passage of gases, moisture or liquids between the fixed connector or adaptor body shell and the panel via the mounting hole(s)

Note 1 to entry: The sealing member is often provided as a discrete item.

3.4.4

mating face seal

seal preventing the passage of gases, moisture or liquids into the interface space of a pair of mated connectors

3.4.5

hermetic seal

seal meeting the requirements specified on application of Test Qk of IEC 60068-2-17

3.5 Miscellaneous terms

3.5.1

adaptor

two-port device for joining two transmission lines having non-mating connectors

3.5.2

fixed adaptor

adaptor with provision for attachment to a mounting surface

Note 1 to entry: If not specified as fixed, an adaptor is assumed to be free.

3.5.3

within-type adaptor

adaptor for use between two or more connectors all of the same type

3.5.4

inter-type adaptor

adaptor for use between two or more connectors of different types

3.5.5

standard test adaptor

inter-type adaptor for test purposes, having a standard test connector at one end and a precision connector at the other end

3.5.6**standard air line**

homogenous air dielectric transmission line having the smallest possible irregularities in diameter and straightness of conductors, no self-contained supports for the inner conductor and using non-magnetic material with good conductivity

3.5.7**reference line**

air-line similar to the standard air-line but with dielectric support of the inner conductor, and with a design such that the internal return loss is kept at a minimum within the frequency range made use of for measurements

3.5.8**proof coupling torque**

maximum torque to be applied to the screw-coupling mechanism of a specific connector series for testing the mechanical strength of the coupling mechanism

3.5.9**normal coupling torque**

maximum/minimum values of torque to be applied in normal use to the coupling of screw type connectors

3.5.10**engagement and separation torque**

torque required to overcome friction, compression of springs, etc. during the engagement and separation of connectors with rotary type coupling mechanisms before or after complete engagement

Note 1 to entry: This is intended to check for undue tightness of threads, burrs on bayonet-cams, freedom of rotation of coupling rings, etc.

3.5.11**push-on**

connectors with interfaces that engage/disengage in an axial direction

3.6 General electrotechnical terms**3.6.1****nominal value**

typical value used to designate or identify a component, device or equipment

Note 1 to entry: It follows from the definition that a nominal value is not subject to tolerances.

Note 2 to entry: Typical and nominal are interchangeable.

3.6.2**limiting value**

in a specification, the greatest and/or smallest admissible value of one of the quantities

3.6.3**rated value**

operational values that are provided in the detailed specification

4 Units, symbols and dimensions**4.1 Units and symbols**

Units, graphical symbols, letter symbols and terminology shall whenever possible, be taken from the following IEC publications:

60027: Letter symbols to be used in electrical technology.

60050: International Electrotechnical Vocabulary (IEV).

60617: Graphical symbols for diagrams.

Other publication:

ISO 1000: SI units and recommendations for the use of their multiples and of certain other units.

4.2 Dimensions

4.2.1 Details to be provided in relevant specifications

Each relevant specification shall provide the following.

- Sufficient dimensional information on the mating faces of connectors should be provided to ensure intermateability and compliance with performance requirements.
- Information on the connector envelope maximum dimensions shall be provided to enable the user to accommodate the connectors in their equipment.
- The relevant specification is not intended to restrict details of construction which do not affect interchangeability or performance, nor are they to be used as manufacturing drawings.

4.2.2 Dimensional units to be used in specifications

The dimensions and tolerances shall be given in metric units.

During conversion of dimensions given in inches into millimetres, they shall, in principle, be rounded to the nearest 0,001 mm or 0,000 05 in. Where, however, mechanical and electrical considerations permit, the rounding shall usually be to the nearest 0,01 mm or 0,000 5 in.

5 Standards ratings and characteristics

The ratings and characteristics applicable to each connector type and style shall be stated in the relevant specification. They should normally cover:

- a short description of the connector construction stating in particular the inner diameter of the outer conductor and, if applicable, the preferable cable types to be used with the connector;
- the return loss as a function of frequency for the different grades (if applicable) together with the conditions for which it is valid;
- the working voltage at different altitudes (pressures);
- the climatic categories;
- any other rating or characteristic applicable.

6 Classifications into climatic categories

The classification of connectors with regard to climatic conditions is based on IEC 60068-1 and indicated by a series of three sets of digits separated by oblique strokes corresponding respectively to tests at low temperature (minus sign not shown), high temperature and the number of days of exposure to damp heat, steady state.

The climatic severities are referenced by a cold temperature, high temperature and damp heat steady state duration. Examples of climatic category of this are shown in Table 1:

Table 1 – Preferred climatic categories (see IEC 60068-1)

Category designation	Letter	Temperature range	Damp heat steady state
40/85/21	A	–40 °C to +85 °C	21 days
55/125/21	B	–55 °C to +125 °C	21 days
55/155/56	C	–55 °C to +155 °C	56 days

7 IEC type designation

The purpose of the IEC type designation is to identify a particular connector within the scope of IEC r.f. connector standardization. It is not intended to include information in excess of this. In practice, it is usually necessary to identify a manufacturer's product because, although complying with the IEC standard, there may be features not covered by the standard.

Connectors complying with the relevant specification shall be designated by the following indications and in the order given:

- a) the number of the specification;
- b) the letters "IEC";
- c) additional identification as indicated in the relevant specification.

NOTE When an IEC type designation is used, either for the marking of the product or in a description of the product, it is the responsibility of the manufacturer to ensure that the item meets the requirements of the relevant specification.

8 Testing

Unless otherwise specified, the following conditions shall apply:

- a) tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1;
- b) before measurements are made, the connectors shall be preconditioned under standard atmospheric conditions for testing for a time sufficient to allow the entire connector to reach thermal stability;
- c) recovery conditions for the interval after a conditioning and the next measurement of test shall be in accordance with IEC 60068-1.

The test schedule is shown in 10.3 and details of conditioning in 9.4.1.

When a nominal value only is given for an applied stress and/or the duration of application, the specified value shall be taken to indicate the minimum test severity to be applied.

The test shall be carried out with connectors – as received from the supplier. In no case shall the contact parts be cleaned or otherwise prepared prior to tests, unless explicitly stated in the specification.

If it is required that a cable shall be attached to a connector, this shall be done in accordance with the connector manufacturer's instructions.

Mated sets of connectors shall be fully engaged and screw-coupled connectors shall be tightened to the normal coupling torque quoted in the relevant specification.

In the case of mounted connectors subjected to environmental conditioning, care shall be taken to ensure that the back-of-panel portion of such fixed connectors, when appropriate, is protected.

For tests involving exposure to extreme temperatures, a cable with appropriate temperature capability should be used.

9 Test methods

9.1 Mechanical inspection

9.1.1 Visual inspection

Visual inspection shall include a check on

- a) the marking: it shall be correct in accordance with 11.1 and be legible after any of the specified tests;
- b) the manufacture: it shall have been carried out in a careful and workmanlike manner;

- c) deterioration after electrical, mechanical and climatic tests: unless otherwise specified, there shall be no visible deterioration likely to affect the performance;
- d) the marking on the package: it shall be in accordance with 11.1.

9.1.2 Dimensions

9.1.2.1 General

The dimensions shall be checked and shall comply with those specified by the relevant specification.

Any suitable method may be used except that gauges shall be used when specified by the relevant specification.

9.1.2.2 Mechanical compatibility

The dimensions of the mating face shall be in accordance with the mating face drawings prescribed in the relevant specification. Use of compatibility gauges is optional. When used, specimens shall accept the gauges.

9.2 Electrical tests and measuring procedures

9.2.1 Return loss

9.2.1.1 General considerations

Return loss is useful for quantifying the level (amount) of the reflected signal due to the deviation from the nominal impedance and structural effects of the connector, which is useful when system performance is the primary interest.

The return loss of connectors shall be measured with the test specimen mated with a standard test connector. Adaptors shall be mated with standard test connectors on both sides.

The relevant specification for a particular connector shall also specify the pertinent standard test connector (connector of Grade O). Mated pairs of standard test connectors shall exhibit closest uniformity of characteristic impedance throughout the pair inclusive of the transitions to precision lines or cables.

Cable connectors shall be attached to an appropriate cable in accordance with the instructions supplied by the connector manufacturer. The cable to be used shall preferably be of the close tolerance type.

9.2.1.2 Frequency domain test

9.2.1.2.1 Test equipment

A vector network analyzer (VNA) capable of performing s-parameter measurements using calibration standards (open, short, load) is recommended.

A vector network analyser is a test system that enables the RF performance of radio frequency (RF) and microwave devices to be characterised in terms of network scattering parameters, or S parameters.

The return loss of the connector(s) under test shall be measured with the VNA over the specified frequency range of interest.

A detailed description of the error correction (calibration) procedure is given in the manual of the VNA.

Precision test connectors with small inherent reflections (see note below) shall be fitted on both ends of the test specimen to allow direct connection to the network analyzer, analyzer test leads and/or, terminating load.

NOTE Small inherent reflections $\leq 1,035:1$ VSWR.

9.2.1.2.2 Procedure

The two-connector procedure uses cable of a known value attached to the connector.

Time domain reflectometry (TDR) shall be used to check the homogeneity of the measuring set-up, to localize imperfections and to examine the accuracy of the characteristic impedance of the sections of coaxial lines used.

When available on the network analyser, gating will be performed for removing errors due to the cable.

The procedure is illustrated in Figures 2 and 3.

The interconnecting cable of the connectors shall consist either of a prescribed cable of verified performance or an adequate cable simulator.

As a check of the accuracy of the system, it is recommended to repeat the measurements with the connector assembly reversed between the standard test connectors.

The typical return loss graphical symbols are described in Figure 1:

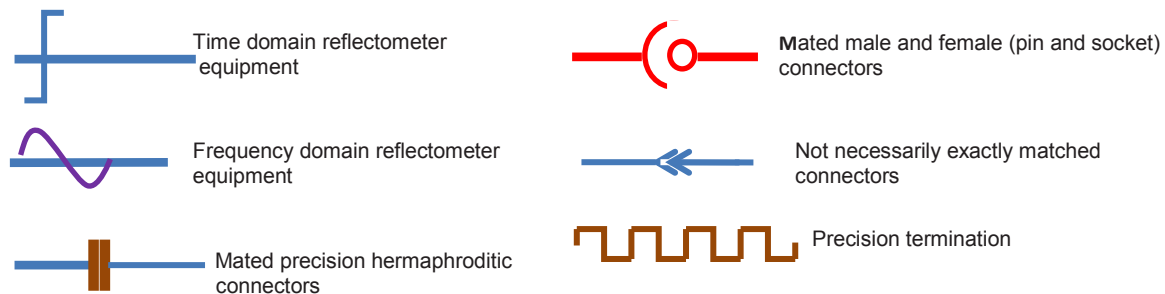


Figure 1 – graphical symbols

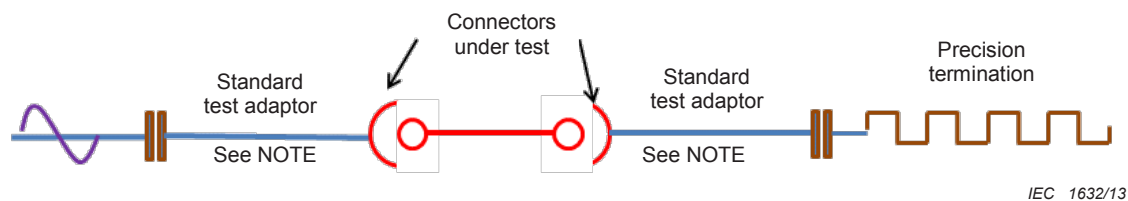
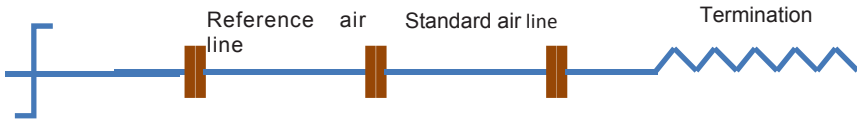
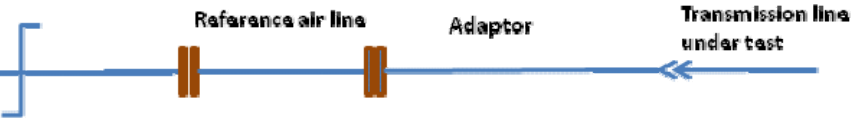
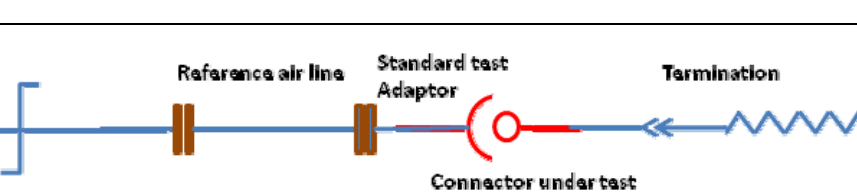
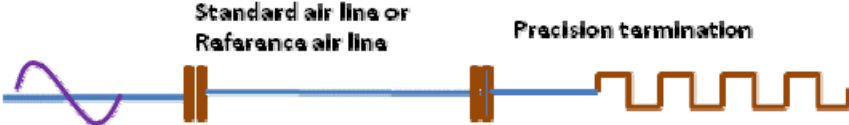
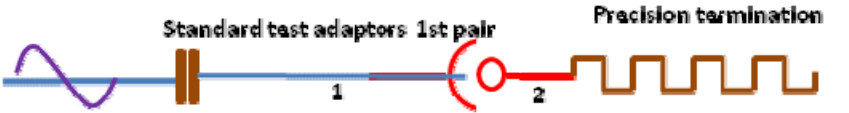


Figure 2 – General principle

NOTE Standard tests connectors are either directly used on the analyzer port, analyzer test leads and/or the precision termination or are connected through standard test adaptors.

Purpose	Test method	Notes
Selection and verification of reference line by comparison with standard air line		
Selection and verification of transmission line for use during subsequent measurements by comparison with reference line		Adaptors need be neither precision or calibrated
Verification of performances of standard test adaptors		
Routine equipment check		Verification of equipment and termination errors
Additional equipment check		Verification of overall error
Verification of performance of standard test adaptors (1,2,3 and 4)		Standard test adaptors may also be checked cross-coupled and reversed
		

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Figure 3 – Measuring set-up for two-connector procedure

9.2.1.3 Method of time domain reflectometry (TDR)

9.2.1.3.1 Theoretical considerations

Assuming the incident signal has the ideal form of a step function, the reflected $s(f) = r(t)$ is converted to the complex return loss as a function of frequency by:

$$r(\omega) = j\omega \int_0^T s(t) \times e^{-j\omega t} \times dt$$

where 0 to T is the time interval comprising the portion of $s(t)$ due to the reflection arising from the connector under test.