INTERNATIONAL STANDARD

IEC 60603-7-7

Second edition
2006-06

Connectors for electronic equipment –

Part 7-7:
Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 600 MHz

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CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 7-7: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 600 MHz

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International Standard IEC 60603-7-7 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

This second edition cancels and replaces the first edition published in 2002. This edition constitutes a technical revision.

The following changes to the first edition have been made in this second edition:

- Many minor detail changes concerning the harmonization of this document, its specifications and its test procedures with those contained in the other IEC 60603-7 series standards.
- Significant performance improvements have been made to insertion loss and return loss, now specified to 1 000 MHz, for special applications (ISO/IEC 15018).

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

FDIS	Report on voting
48B/1664/FDIS	48B/1691/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 60603 series, under the general title *Connectors for frequencies below 3 MHz for use with printed boards*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

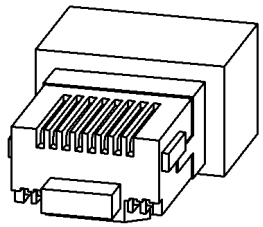
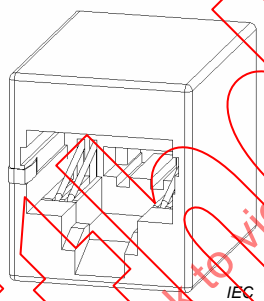
This detail specification describes connectors according to IEC 60603-7 series connectors requirements.

This detail specification describes connectors that are similar to and backward compatible with IEC 60603-7 series connectors. Backward compatibility definition and requirements are given in 2.2.

The complete requirements for the connectors described herein correspond to this detail specification and the current issues of IEC 60603-7 series, which are referenced herein accordingly.

CONNECTORS FOR ELECTRONIC EQUIPMENT –

Part 7-7: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 600 MHz

<table>
<tr><td>IEC SC 48B: LF connectors
Specification available from:
IEC Central Office or the addresses shown on the inside cover.</td><td>IEC 60603-7-7</td></tr>
<tr><td rowspan="4"> 
 
IEC 1068/06</td><td>Detail specification for two-part cable to cable connector used in:
- high speed communications applications up to 600 MHz
- 4 balanced contact pairs (8 contacts)
- compatible with IEC 60603-7 series connectors
- intended for inside-building cabling systems</td></tr>
<tr><td>Typical construction is for cable mount for use in communication cabling systems</td></tr>
<tr><td>Performance level(s): 1, 2
Assessment level(s): not applicable</td></tr>
<tr><td>Reference data: not applicable</td></tr>
<tr><td colspan="2">Information on the availability of components qualified to this detail specification is not covered.</td></tr>
</table>

1 General

1.1 Scope

This part of IEC 60603, which is part of the IEC 60603-7 series, covers 8 way connectors, up to 4 pairs, and specifies mechanical and environmental requirements, and electrical transmission requirements for frequencies up to 600 MHz. These connectors are typically used as category 7 connectors in class F cabling systems specified in IS0/IEC 11801:2002.[1]

The connectors are intermateable with IEC 60603-7-X series connectors.[2]

The connectors are interoperable with IEC 60603-7-X series connectors.[3]

The connectors are backward compatible with IEC 60603-7-X series connectors.[4]

1.2 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 60050(581), *International Electrotechnical Vocabulary (IEV) – Chapter 581: Electro-mechanical components for electronic equipment*

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

IEC 60068-2-38, *Environmental testing – Part 2: Tests – Test Z/AD: Composite temperature/ humidity cyclic test*

IEC 60169-16, *Radio-frequency connectors – Part 16: R.F. 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 60352-2, *Solderless connections – Part 2: Solderless crimped connections – General requirements, test methods and practical guidance*

IEC 60352-3, *Solderless connections – Part 3: Solderless accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-4, *Solderless connections – Part 4: Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-5, *Solderless connections – Part 5: Press-in connections – General requirements, test methods and practical guidance*

IEC 60352-6, *Solderless connections – Part 6: Insulation piercing connections – General requirements, test methods and practical guidance*

IEC 60352-7, *Solderless connections – Part 7: Spring clamp connections – General requirements, test methods and practical guidance*

IEC 60512 (all parts), *Connectors for electronic equipment – Tests and measurements*

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1 ISO/IEC 11801 contains various ‘category’ designations corresponding to various frequency ranges.

2 Intermateability definition and requirements are given in 2.2.

3 Interoperability definition and requirements are given in 2.2.

4 Backward compatibility definition and requirements are given in 2.2.

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

IEC 60603-1, *Connectors for frequencies below 3 MHz for use with printed boards – Part 1: Generic specification – General requirements and guide for the preparation of detail specifications, with assessed quality*

IEC 60603-7, *Connectors for frequencies below 3 MHz for use with printed boards – Part 7: Detail specification for connectors, 8-way, including fixed and free connectors with common mating features*

IEC 60603-7-5, *Connectors for electronic equipment – Part 7-5: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 250 MHz* [5]

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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*

ISO/IEC 11801:2002, *Information technology – Generic cabling for customer premises*

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

ITU-T G.117, *Transmission aspects of unbalance about earth*

ITU-T K.20, *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*

ITU-T K.44, *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic recommendation*

ITU-T O.9, *Measuring arrangements to assess the degree of unbalance about earth*

EN 50289-1-14, *Communication Cables – Specifications for Test Methods – Part 1-14: Electrical Test Methods – Coupling attenuation or screening attenuation of connecting hardware*

2 Technical information

This detail specification covers connectors intended for use in inside-building communication cabling systems.

2.1 Terms and definitions

For the purposes of this part of IEC 60603, the terms and definitions given in 2.1 of IEC 61076-1 and IEC 60050(581) apply. Some applicable terms are also covered in IEC 60512-1.

2.2 Information on application

These connectors are interoperable with lower frequency or “category” IEC 60603-7 series connectors.

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[5] To be published.

2.2.1 Transmission performance categories

In this detail specification, the term “category”, when used in reference to transmission performance, refers to those categories defined by ISO/IEC 11801:2002.

2.2.2 Complete connectors (pairs)

The complete connectors engage a total of 8 contacts.

The IEC 60603-7-7 connector includes the 8 contacts (1,2,3,4,5,6,7,8) of a standard IEC 60603-7 series connector. In addition, the IEC 60603-7-7 connector includes 4 alternative contacts (6’,3’,4’,5’) located on the opposite side to the original contacts of a basic IEC 60603-7 series connector.

A switch is employed within the connectors to engage transmission paths between 4 pairs of terminations and the respective 4 out of 6 pairs of contacts, which operate above or below 250 MHz, see 4.2.

Switch operation is implemented by means of moving switch actuator protrusions on the free connector (see 2.2.2.1 and 2.2.2.2).

2.2.2.1 Fixed connectors

IEC 60603-7-7 fixed connectors include a rear switch actuator and side channels.

These features accommodate the switch actuator protrusions on IEC 60603-7-7 free connectors.

The fixed connector (rear) switch actuator is operated by the free connector front switch actuator protrusion placed in the extended position.

2.2.2.2 Free connectors

IEC 60603-7-7 free connectors include front and side switch actuator protrusions.

The free connector front switch actuator protrusion, when placed in the extended position, operates the fixed connector switch actuator.

The free connector side switch actuator protrusions operate the free connector switch. The absence of fixed connector side channels (as in lower frequency or “category” IEC 60603-7-X series fixed connectors) cause the extended free connector switch actuator protrusions to move into the retracted position upon insertion.

NOTE A free connector with fixed protrusions, which is not backward compatible with IEC 60603-7 series connectors, but is intermateable and interoperable with IEC 60603-7-7 fixed connectors, is specified in IEC 61076-3-110[6].

2.2.3 Interchangeability level

These connectors are intermateable, interoperable and backward compatible with IEC 60603-7 series connectors.

Interoperability of a IEC 60603-7-7 connector with a lower frequency IEC 60603-7 series connector is assured by compliance with all transmission requirements of the lower frequency IEC 60603-7 series connector when the fixed connector is mated with a full range of “test” free connectors, or “test plugs”, as described in the lower frequency IEC 60603-7 series connector.

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[6] Under consideration.

2.2.3.1 Intermateability

Intermateability is ensured by applying the “GO” and “NO-GO” gauge requirements herein, and adherence to dimensional requirements herein.

2.2.3.2 Interoperability

Interoperability of different IEC 60603-7-7 connectors is assured by compliance with all transmission requirements when the connector is mated with the respective “test” connector as described in Annex C.

Interoperability of a IEC 60603-7-7 connector with a lower frequency IEC 60603-7 series connector is assured by compliance with all transmission requirements of the lower frequency IEC 60603-7 series connector when the fixed connector is mated with a full range of “test” free connectors, or “test plugs”, as described in the lower frequency IEC 60603-7 series connector.

2.2.3.3 Backward Compatibility

The backward compatibility requirement ensures that a plug or jack which is in compliance with this detail specification, mated with a jack or plug in compliance with any lower frequency IEC 60603-7 series connector, shall fully comply with the requirements of the lower frequency IEC 60603-7 series connector.

2.2.4 Shielding/grounding

Shielding features form an integral part of these connectors and they are specified herein.

2.2.5 Terminations

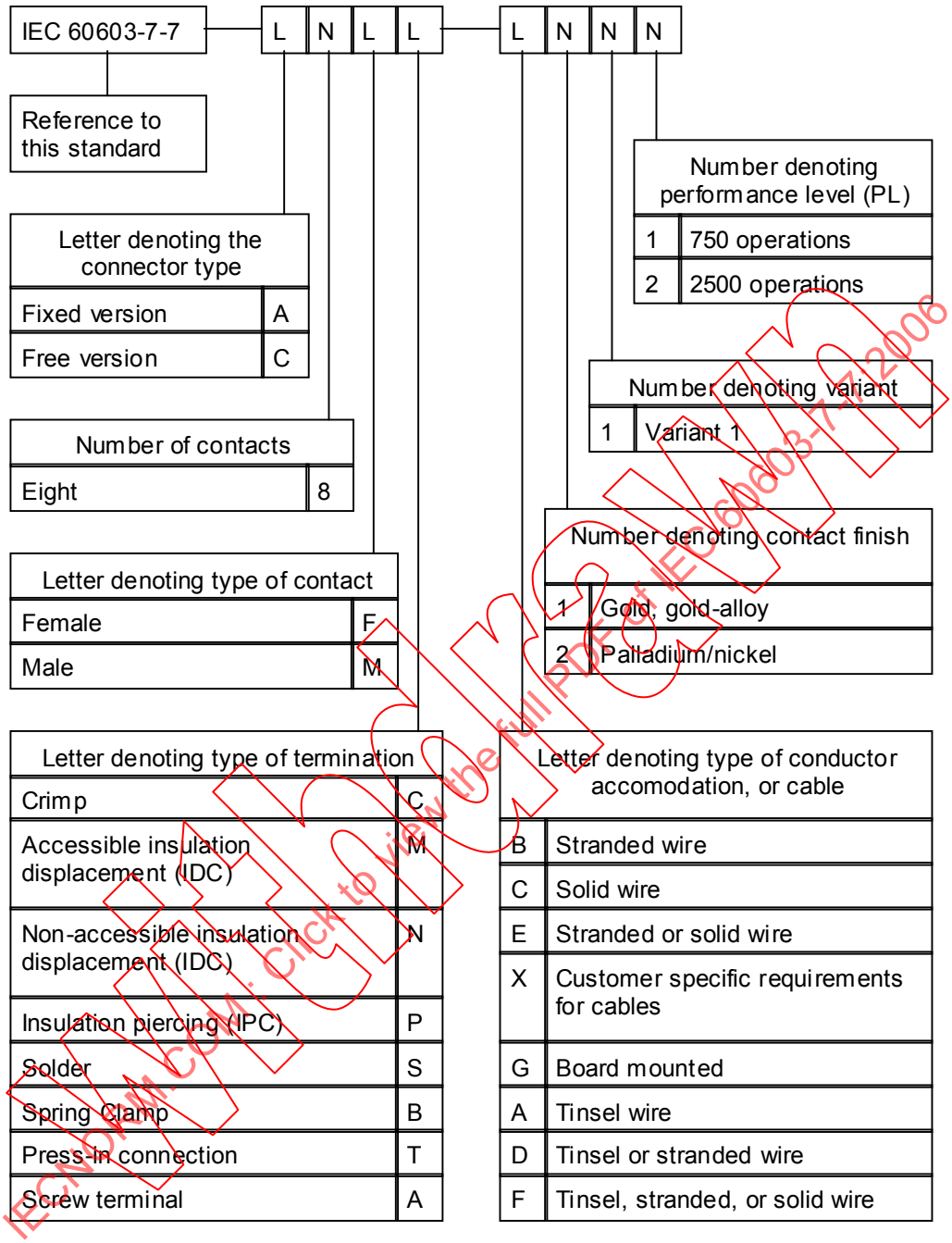
These cable connectors are terminated to the signal line and screen of the cable with specified terminations.

Fixed and free connector terminations are specified in Clause 4 and shall conform to the requirements of Clause 6.

Screen terminations shall conform to the requirements of Clause 6.

2.3 IEC type designation

Connectors, connector bodies and connectors with pre-inserted contacts according to this detail specification shall be designated by the following system:



NOTE "L" stands for letter.
"N" stands for number.

Example:
IEC 60603-7-7 A8FM-E111: Fixed shielded connector, having 8 female contacts with accessible IDC contacts, for stranded or solid wires, gold plated, meeting performance level 1.

3 Dimensional information

Common characteristics are given herein for fixed connectors and free connectors.

3.1 General

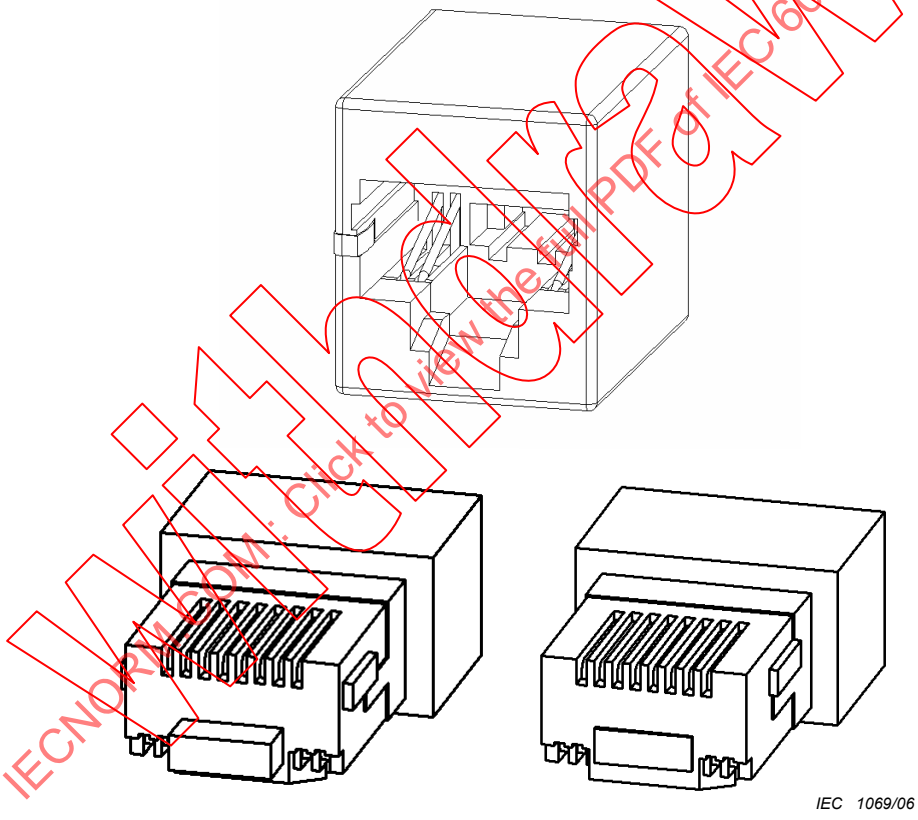
The shape of the connectors may deviate from those given in the following drawings as long as the specified dimensions are not influenced.

Dimensions are given in millimetres.

Drawings are shown in first angle projection unless specifically stated otherwise in the figure.

3.2 Isometric view

See Figure 1.



NOTE The free connector protrusions move together, between the extended position and the retracted position, to activate the switch within the free connector, see 2.2.

Figure 1 – Isometric view, example fixed and free connector, free connector shown with both switch positions

3.3 Common features

These connectors have common features concerning the arrangement of the contacts, mating information, and the coupling device.

These connectors have the same common features as the IEC 60603-7 series connectors.

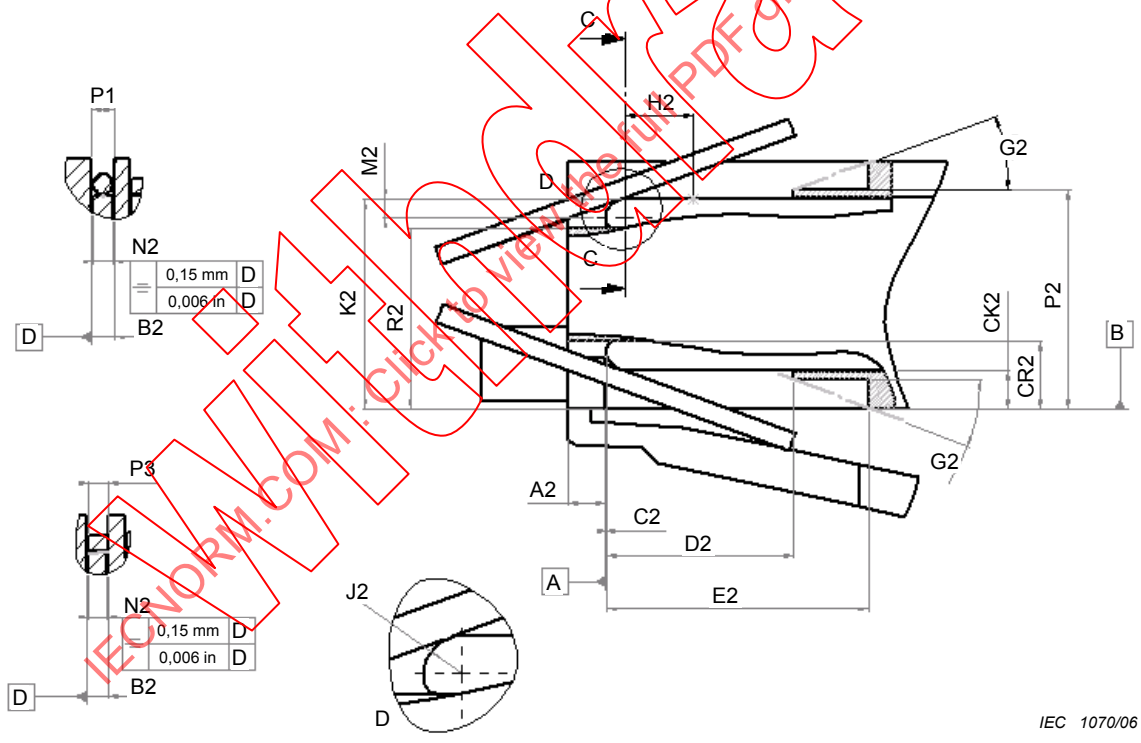
Mating alignment is controlled by a vertical and horizontal reference position and the centering of the coupling device (latch).

3.4 Engagement (mating) information

Common dimensions are given in Figure 2 and in Table 1.

Care shall be taken that contacts avoid interference with the plastic of the free connector.

The mating information shown can only be achieved with a free connector with a cable attached.



NOTE View D: preferred contact interface detail.

Figure 2 – Contact interface dimensions with terminated free connector

Table 1 – Physical interface, contacts interface

Letter	Maximum	Minimum
	mm	mm
A2	1,45	0,89
B2	0,61	0,51
C2	0,46	0,03
D2		2,79
E2		4,11
F2	6,22	
H2[c]		0,38
J2	0,64	0,38
K2	6,15	5,89
M2[d]		0,30
N2		0,28
P1[a]	0,50	0,45
P3[b]	0,50	0,36
R2	4,83	
CK2	0,60	0,50
CR2		1,70
G2 (Angle)	10°	

[a] P1: preferred fixed connector contact configuration.

[b] P3: optional fixed connector contact configuration.

[c] H2: Burrs shall not project above top of contact in this area, since it may be a contact area

[d] M2: Minimum preferred contact configuration.

3.5 Fixed connectors

Common dimensions are given in Figure 3 and Figure 4 and in Table 2.

All internal corners in the connector cavity shall have a maximum radius of 0,38 mm unless otherwise specified.

Contacts are shown at rest. Contacts shall always be contained inside guide slots. Contacts shall move freely within their guide slots.

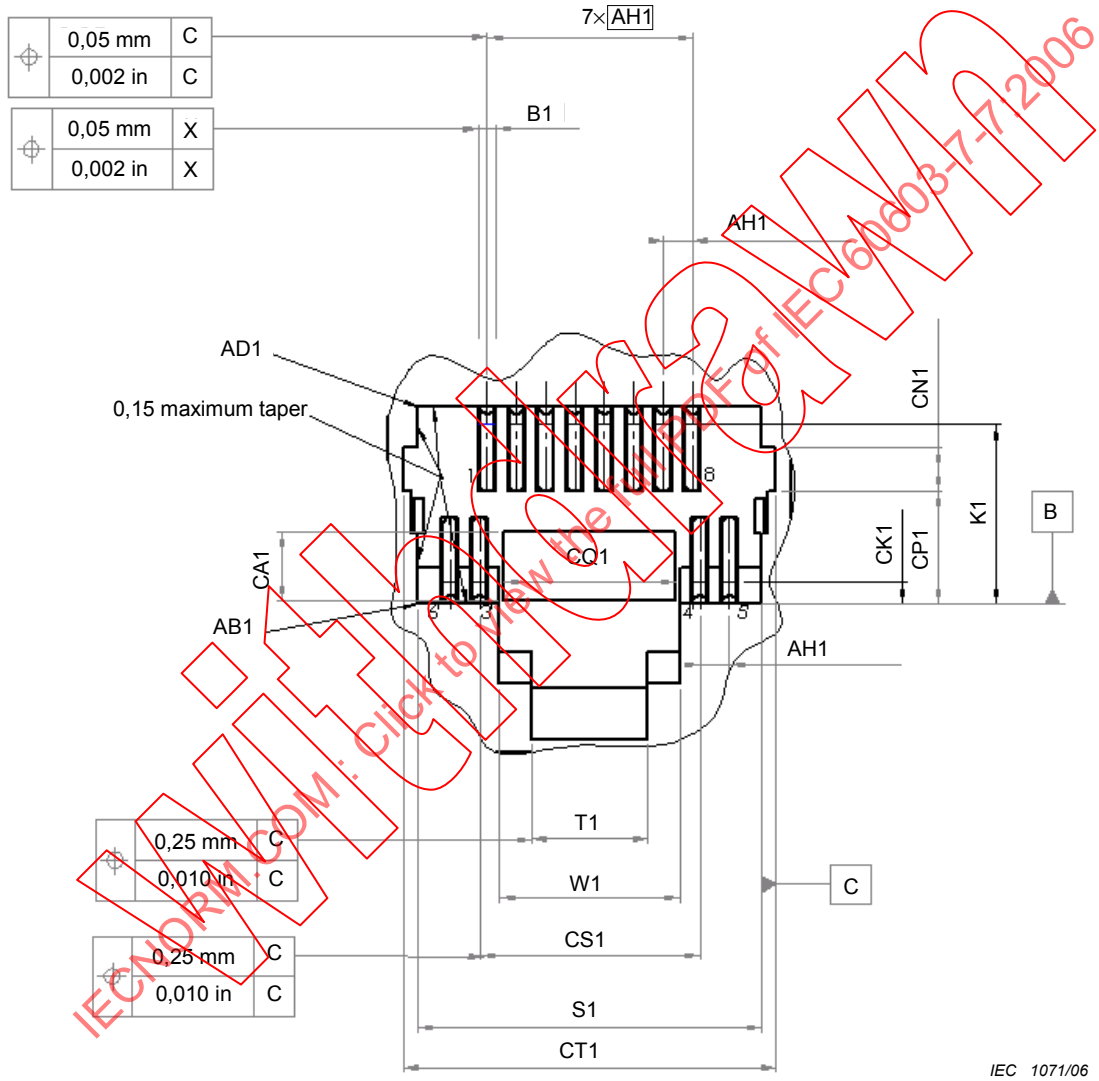


Figure 3 – Physical interface, fixed connector, front view

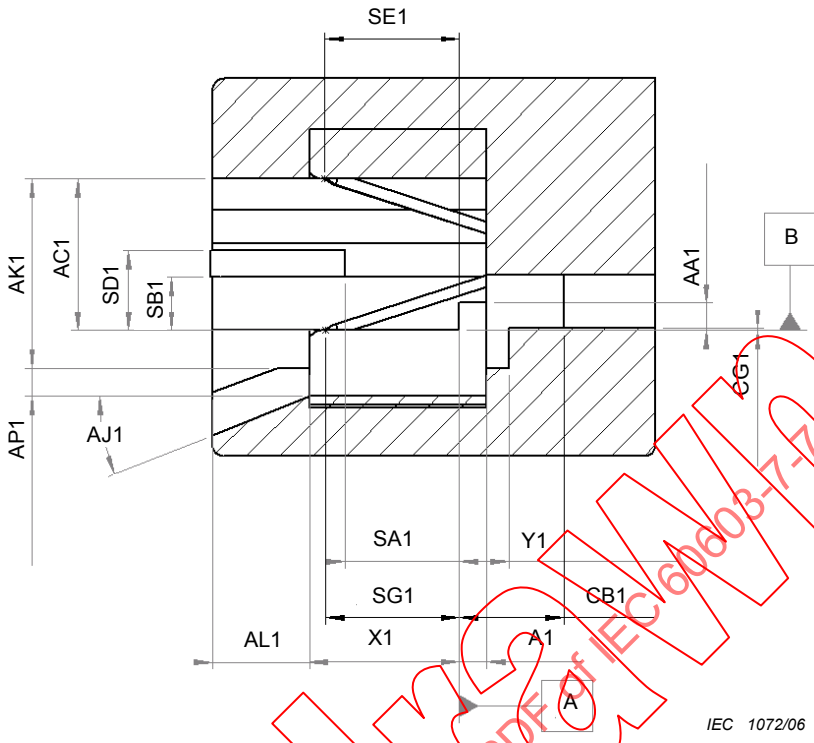


Figure 4 – Physical interface, fixed connector, side view

Table 2 – Fixed connector common dimensions

Letter	Maximum	Minimum	Nominal
	mm	mm	mm
A1		1,47	
B1	0,71		
K1[a]	5,84		
S1	12,04	11,84	11,94
T1	4,19	3,94	
W1	6,38	6,22	
X1	6,86	6,68	
Y1		2,34	
AA1[b]	1,24		
AB1	0,38		
AC1	6,96	6,76	6,86
AD1	0,13		
AH1[h]			1,02
AK1	8,66	8,38	
AL1[c]		1,40	
AP1[g]		1,27	
CA1	2,30	2,20	
CB1		3,95	
CG1	0,10		
CK1[a]		0,65	
CN1	1,40	1,30	
CP1	5,05	4,95	
CQ1	6,00	5,80	
CS1			7,66
CT1	13,0	12,9	
SA1		5,31	
SB1		2,16	
SD1	4,90		
SE1[d]	5,80		
SG1[e, f]	5,80		
Letter			
AJ1 angle			15°

[a] K1, CK1: Contact zone. Contacts shall be completely within their individual contact zone in the area indicated.

[b] AA1: Preferred male free connector stop.

[c] AL1: Front surface need not be planar or coincident with the surface below the locking device as long as insertion, latching and unlatching of free connectors is not inhibited. Projections beyond AL1 dimension shall not prevent finger access to the free connector locking (coupling) device.

[d] SE1: Maximum forward extension of contacts below surface AC1, to avoid contact with shields of free connectors. Applies in the mated state.

[e] SG1: Maximum forward extension of contacts above surface reference plane B, to avoid contact with shields of free connectors. Applies in the mated state.

[f] SG1: When this dimension is greater than 2,5 mm, and the fixed connector is mated with a lower frequency IEC 60603-7 series free connector, then “additional switch function” (see 4.2) should be utilised, The clearance requirement between signal conductors 6’,3’,4’,5’ of the fixed connector and the screen of a lower frequency IEC 60603-7 series free connector are maintained when this dimension is 2,5 mm or less while the “basic switch function” (see 4.2) is utilised. SG1 is typically 0,0 mm in the mated state with a IEC 60603-7-1,2,3,4,5 free connector.

[g] AP1: Flat surface.

[h] AH1: True position.

NOTE 1 Care should be taken that all screen contacts of the fixed connector always make contact with the screen contacts of the free connector in worst case condition to ensure reliable performance.

NOTE 2 All internal corners in the connector cavity should be 0,38 mm radius maximum unless otherwise specified.

3.6 Free connectors

Common dimensions are given in Figure 5 and in Table 3.

Full radius permitted on all contact slots.

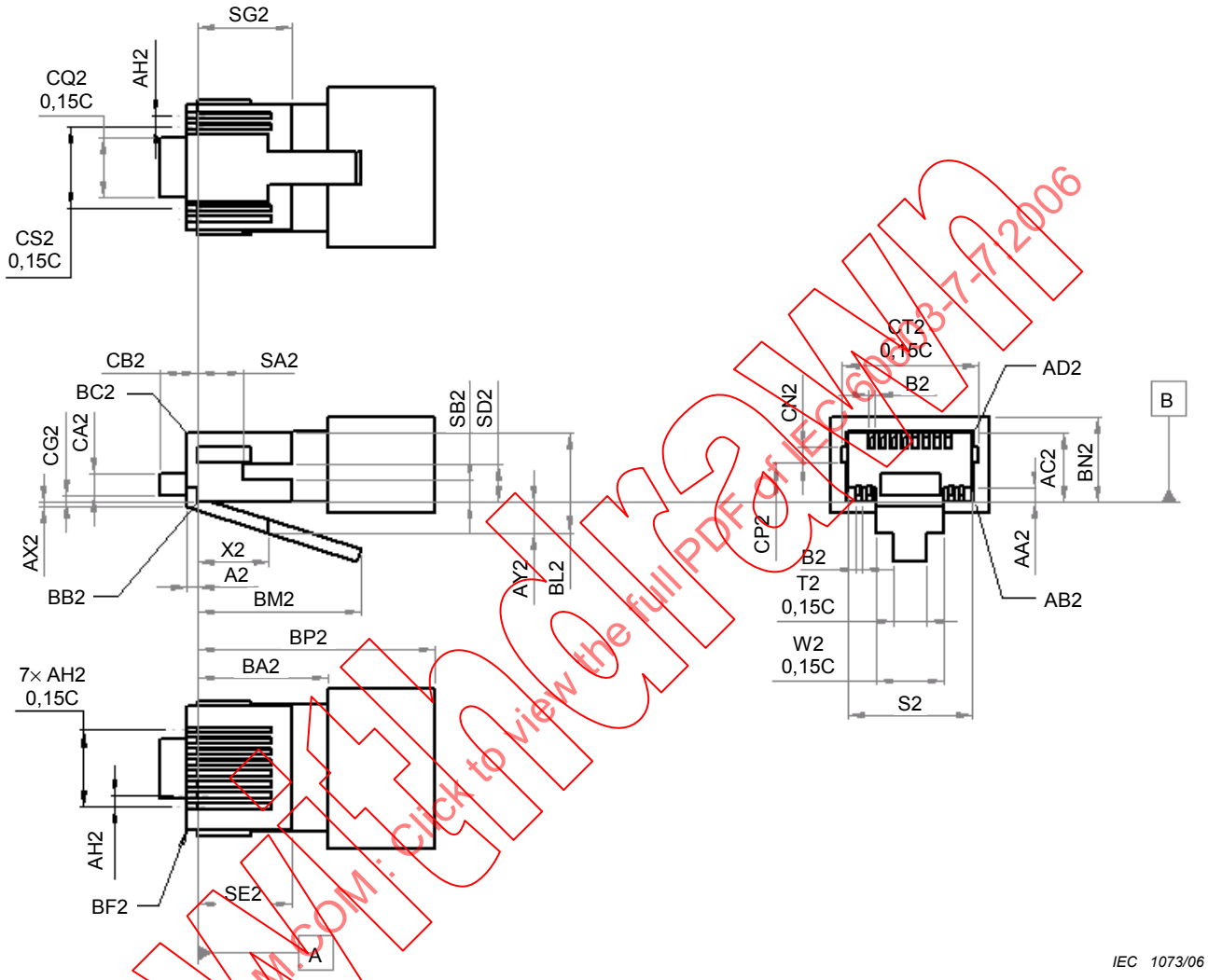


Figure 5 – Physical interface, free connector

Table 3 – Common dimensions – free connector

Letter	Maximum	Minimum	Nominal
	mm	mm	mm
A2	1,45	0,89	1,17
B2	0,61	0,51	0,56
S2	11,79	11,58	11,68
T2	3,38	3,12	
W2	6,17	6,02	
X2	6,51	6,36	
AA2		1,24	
AB2	0,64	0,38	
AC2	6,71	6,50	6,60
AD2	0,64	0,13	
AH2[a]			1,02
AX2	1,32		
AY2	2,87	2,67	
BA2		12,32	
BB2	1,14	0,38	
BC2	1,02	0,51	
BF2	0,64		
BL2[b]	8,36		
BM2	15,88	14,61	
BN2	9,24		
BP2	23,11		
CA2	2,20	2,00	
CB2	3,95	3,75	
CG2	0,22	0,12	
CN2	1,30	1,20	
CP2	5,05	4,95	
CQ2	5,70	5,50	
CS2[a]			7,66
CT2	12,85	12,75	
SA2	4,22		
SB2	2,11		
SD2		4,95	
SE2		6,85	
SG2		6,85	

[a] AH2, CS2: These dimensions apply to the locations of the contact slots.

[b] BL2: Applies with locking device depressed.

NOTE Full radius permitted on all slots.

4 Terminations

A connector may include multiple terminations between the cable termination and the separable contact interface. These may include press-in (compliant pin) connections of jack springs into PCBs, for example. All terminations shall meet the relevant termination requirements.

In the case where a type of solderless termination is used which is not covered by any IEC standard and the supplier cannot demonstrate similar level of performance or there is no applicable IEC 60352 standard to be used as a reference, the supplier shall show conformance with the full test schedule in 7.7 for all possible variations of terminations, for example each cable construction type (screen construction types, wire construction (solid, flexible)) the connector is intended to be used for.

Free connectors are intended to be terminated to cable to provide connector and cable assemblies. The connector type designation provides basic terminations concerning the type of conductor (tinsel, stranded, solid) to which the conductor may be applied, and the type of connection used (solder, insulation displacement, etc.). Specific details concerning wire gauge size, type and thickness of conductor insulation, size and shape of cordage or cable jacket, etc., are not intended to be part of this specification. Minor variations in a free connector's interior details to accommodate differing wire gauge sizes, outer jackets, etc., do not require the generation of new free connector specifications.

If the connector is able to be used with multiple cable types, the manufacturer shall assure that all terminations comply with the relevant IEC standards with each of the cable types.

4.1 Referenced termination types

If a type of solderless termination which is covered by a IEC 60352 series specification is used, the supplier shall assure its reliability by performing tests and demonstrating a level of performance, according to IEC 60352 specifications.

4.1.1 Insulation displacement terminations

Shall conform to IEC 60352-3 or IEC 60352-4.

4.1.2 Crimp terminations

Shall conform to IEC 60352-2.

4.1.3 Insulation piercing terminations

Shall conform to IEC 60352-6.

4.1.4 Compliant pin (press-in)

Shall conform to IEC 60352-5.

4.1.5 Spring clamp terminations

Shall conform to IEC 60352-7.

4.1.6 Non-referenced termination types

If a type of termination is used, which is not covered by any IEC 60352 series specification, the supplier shall assure its reliability by performing similar tests, and demonstrating a similar level of performance, to those covered by IEC 60352 series.

4.1.7 Solder terminations

Solder terminations are not covered in IEC 60352 series and are allowed.

4.2 Switch function

Minimum switch function requirements are given and are identified as “basic switch function”.

Additional switch functions are given and are identified as “additional switch function”.

Switch functions are illustrated in 6.2 and Figure 16 and Figure 17.

4.2.1 Basic switch function

The basic switch function uses a single pole switch for each alternate contact to connect the respective standard contact to either the screen or the alternate contact. The alternate contact is permanently connected to the termination.

4.2.2 Additional switch function

The additional switch function uses a double pole switch for each alternate contact to connect the respective standard contact to either the screen or the termination while the alternate contact is respectively connected to the termination or the screen. Neither the alternate contact nor the respective standard contact is permanently connected to the termination.

4.3 Accessories

Accessories are not specified.

4.4 Mounting information for fixed connectors

Fixed connector mounting information is not specified.

4.4.1 Hole pattern on printed boards

Fixed connector printed board mounting is not specified.

4.4.2 Mounting on panels

Fixed connector mounting on panels is not specified.

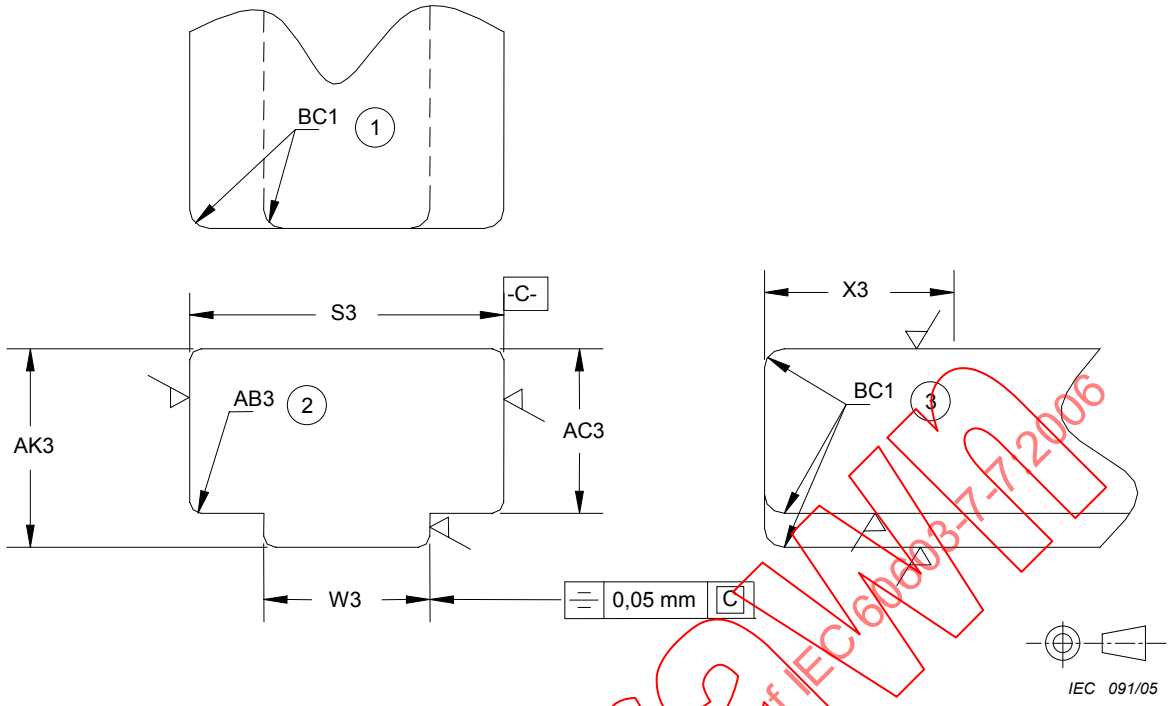
4.5 Mounting information for free connectors

Mounting information for free connectors onto cables is not specified.

5 Gauges

5.1 Fixed connectors

Gauges shall be made according to the following requirements:
Material: tool steel, hardened.
ν = Surface roughness, according to ISO 1302.
Ra = 0,25 µm maximum
A 0,01 mm wear tolerance shall be applied.
Clearance shall be provided for signal contacts and screen contacts (not shown on drawings).



NOTE 1 Four places.

NOTE 2 Six places.

NOTE 3 All around.

Figure 6 – "Go" gauge

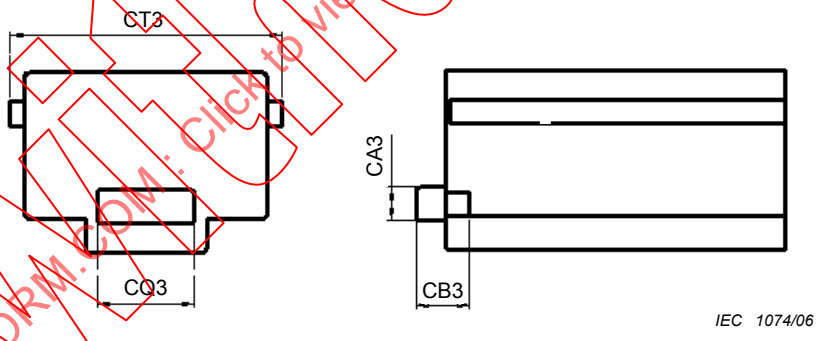
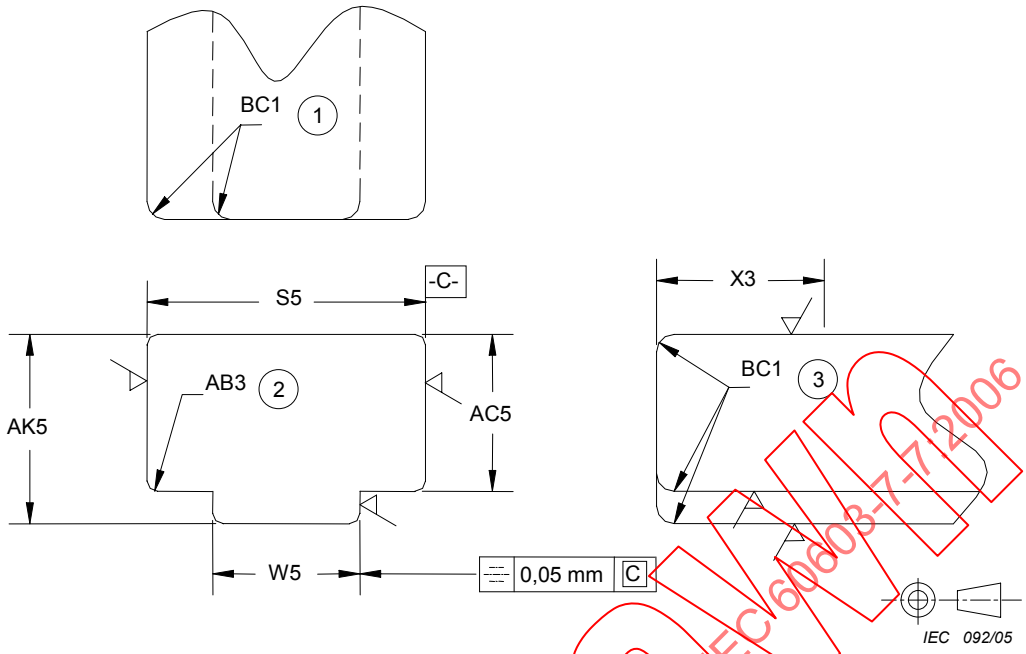


Figure 7 – Fixed connector additional go gauge

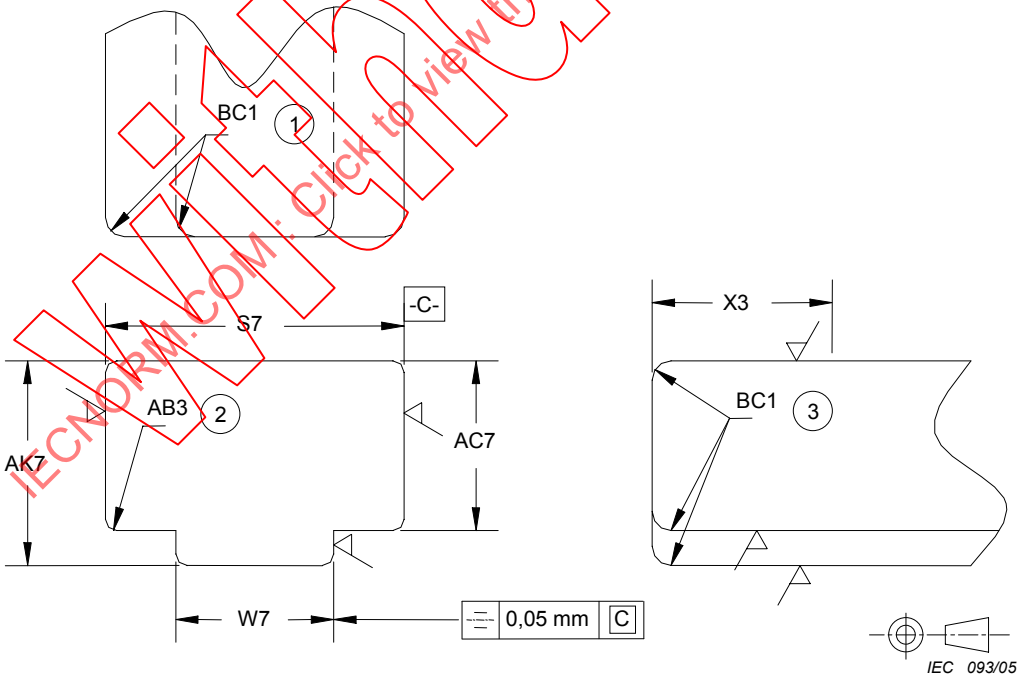


NOTE 1 Four places.

NOTE 2 Six places.

NOTE 3 All around.

Figure 8 – "No-go" gauge width



NOTE 1 Four places

NOTE 2 Six places

NOTE 3 All around.

Figure 9 – "No-go" gauge height

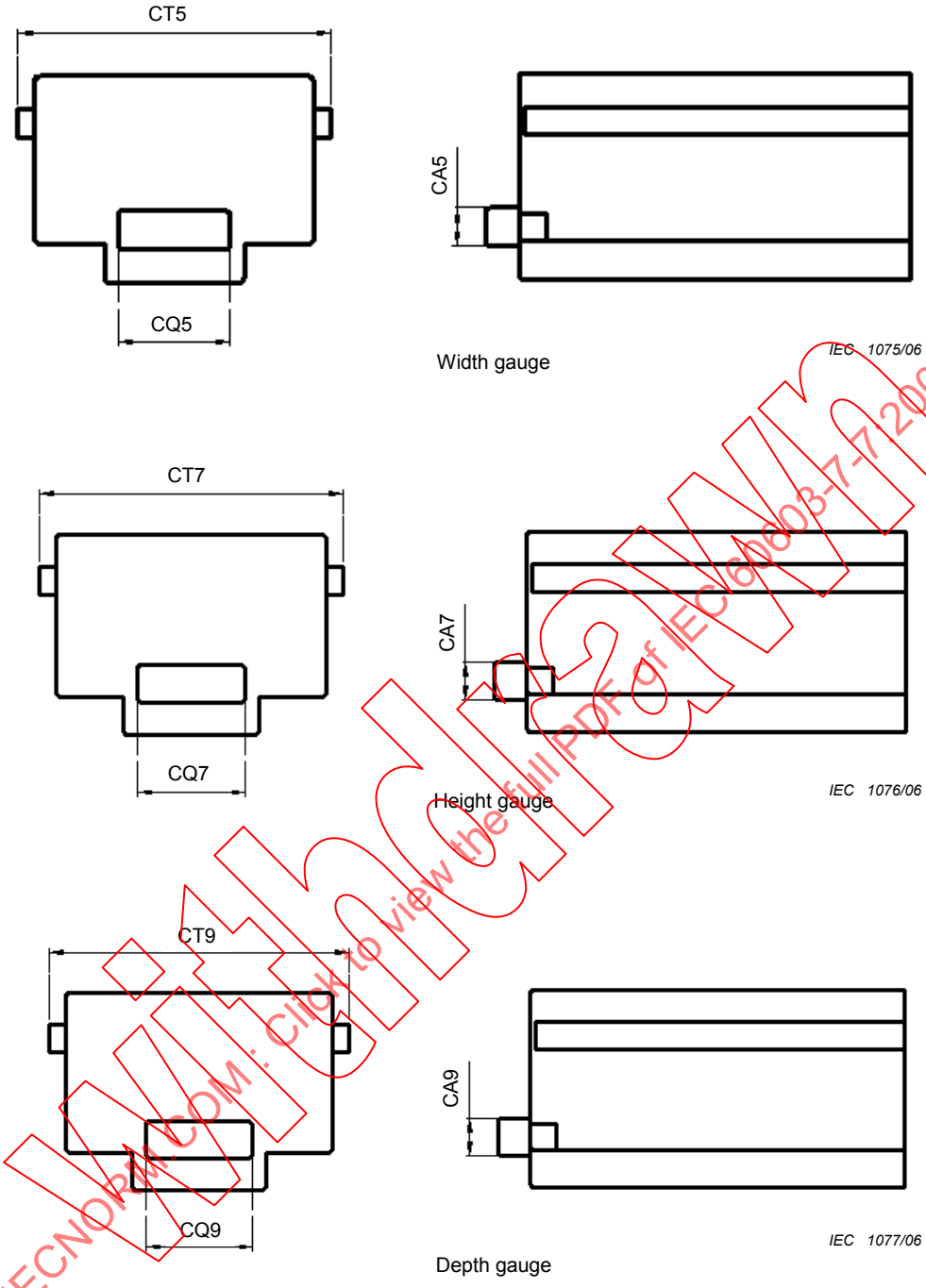


Figure 10 – Fixed connector additional no-go gauges

Table 4 – Fixed connector gauge dimensions

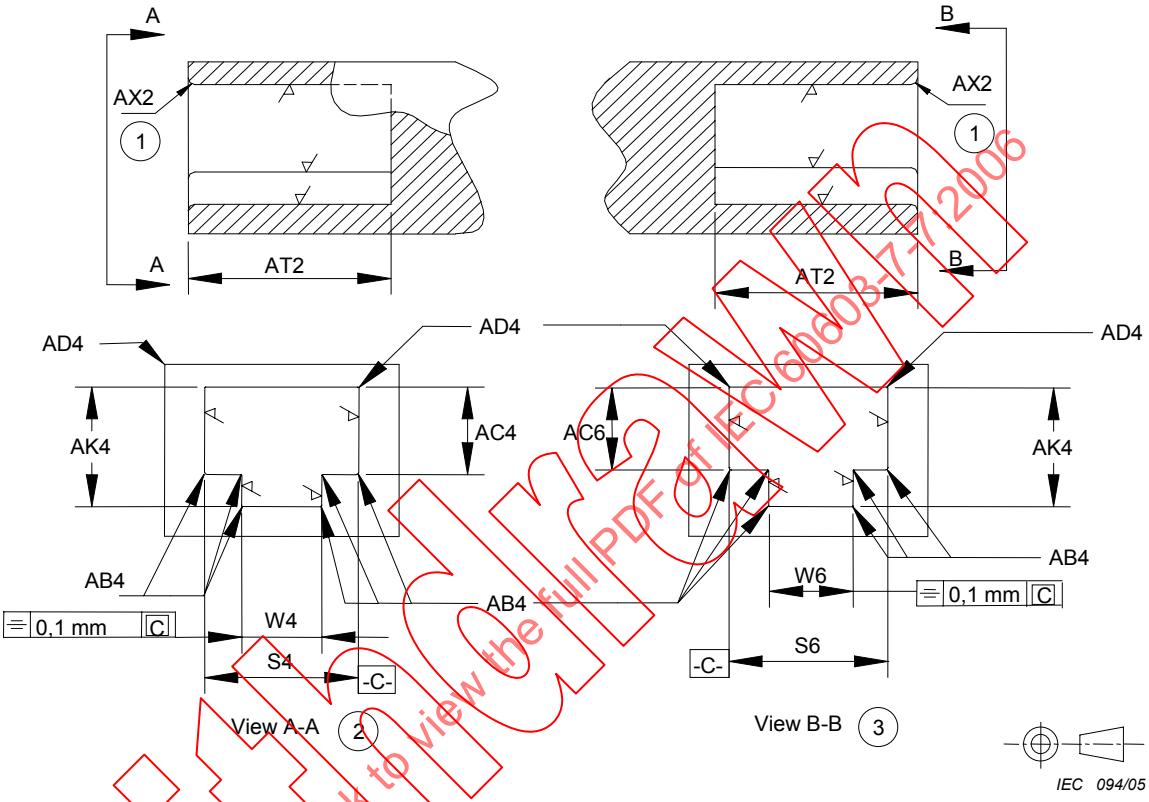
Letter	Maximum	Minimum	Nominal (ref)
	mm	mm	mm
S3	11,796	11,786	
S5	12,050	12,040	
S7	11,68	11,58	
X3		10,16	
AB3	0,51	0,389	0,450
AC3	6,716	6,706	
AC5	6,45	6,35	
AC7	6,970	6,96	
BC1	0,89	0,64	0,76
W3	6,12	6,109	
W5	6,38	6,365	
W7	5,97	5,89	
AK3	8,357	8,346	
AK5	8,13	8,05	
AK7	8,672	8,66	

Table 5 – Fixed connector, additional, gauge dimensions

Letter	Maximum	Minimum
	mm	mm
CA3	2,17	2,03
CA5	2,17	2,03
CA7	2,31	2,3
CA9	2,17	2,03
CB3	2,27	2,08
CQ3	5,7	5,55
CQ5	5,7	5,55
CQ7	5,7	5,55
CQ9	6,01	6,0
CT3	12,87	12,81
CT5	13,01	13,0
CT7	12,87	12,81
CT9	12,87	12,81

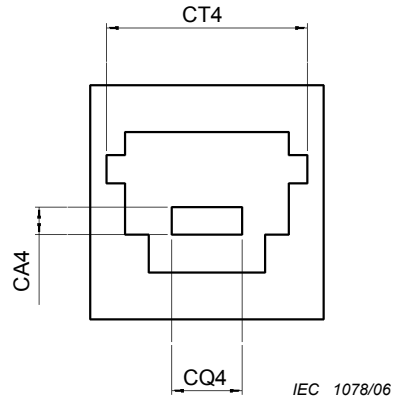
5.2 Free connectors

Gauges shall be made according to the following requirements:
Material: tool steel, hardened.
v = Surface roughness, according to ISO 1302
Ra = 0,25 µm maximum
A 0,01 mm wear tolerance shall be applied.

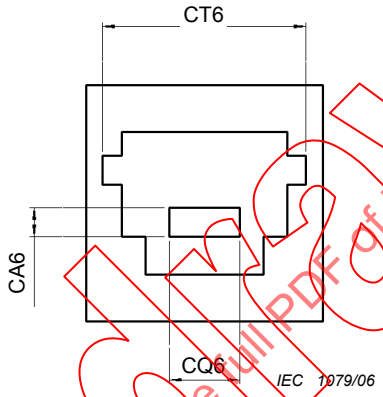


NOTE 1 All around.
NOTE 2 Width gauge.
NOTE 3 Height gauge.

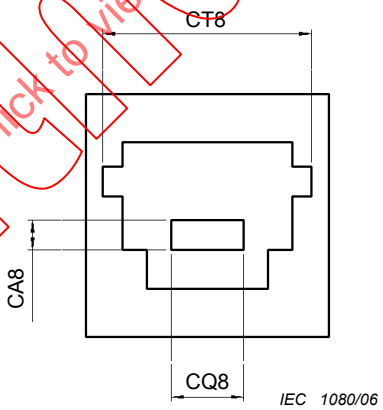
Figure 11 – "No-go" gauges



Width gauge



Width gauge

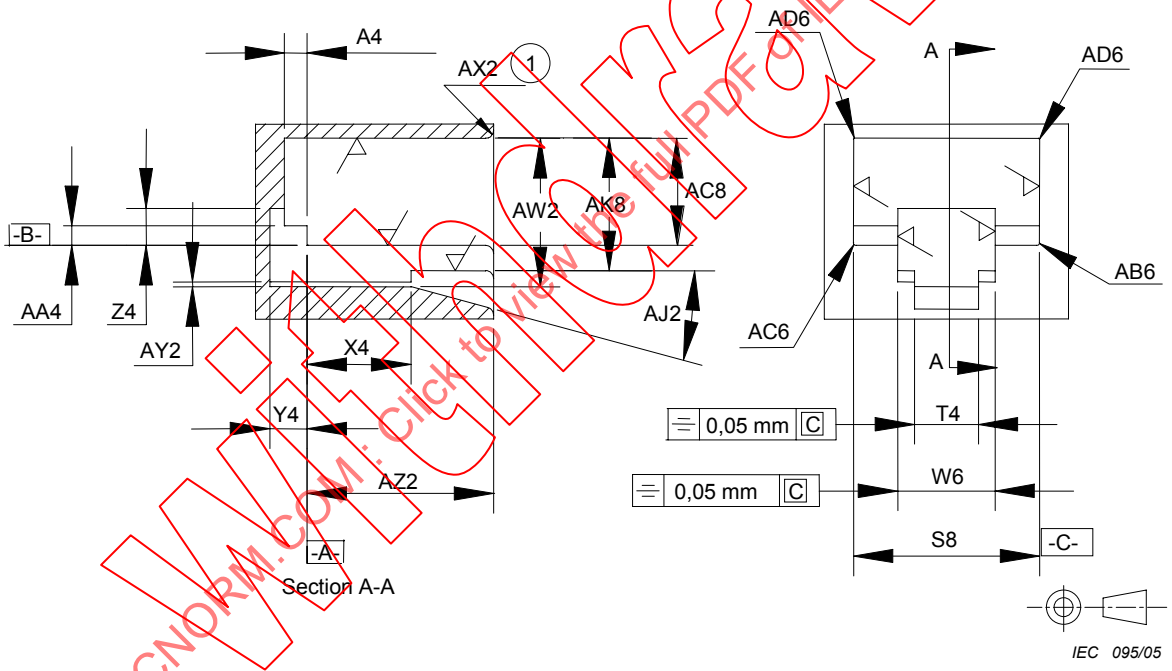


Height gauge

Figure 12 – Free connector additional no-go gauges

Table 6 – Free connector NO-GO gauge dimensions

Letter	Maximum	Minimum
	mm	mm
S4	11,593	11,582
S6	11,989	11,887
W4	6,02	6,010
W6	6,40	6,30
AB4	0,38	0,0
AC4	6,91	6,81
AC6	6,512	6,502
AD4	0,127	0,0
AK4	9,42	9,32
AT2	15,29	15,19
AX2	0,635	0,38



NOTE 1 All around.

Figure 13 – "Go" gauge

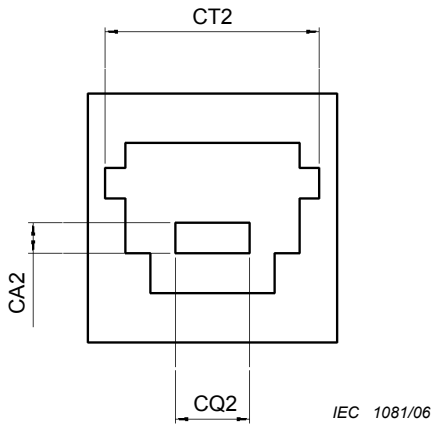


Figure 14 – Free connector additional go gauges

Table 7 – Free connector GO gauges dimensions

Letter	Maximum	Minimum
	mm	mm
A4	1,448	1,438
S8	11,847	11,836
T4	4,115	4,013
W6	6,198	6,187
X4	6,604	6,594
Y4	2,39	2,34
Z4	2,39	2,29
AA4	1,255	1,245
AB6	0,38	0,0
AC8	6,767	6,756
AD6	0,13	0,0
AK8	8,357	8,346
AW2	9,42	9,32
AX2	0,64	0,38
AY2	0,305	0,295
AZ2	11,91	11,81
AJ2	16	14

Table 8 – Free connector additional gauges dimensions

Letter	Maximum	Minimum
	mm	mm
CA2	2,22	2,21
CA4	2,22	2,21
CA6	2,22	2,21
CA8	2,0	1,99
CQ2	5,81	5,71
CQ4	5,81	5,71
CQ6	5,7	5,69
CQ8	5,81	5,71
CT2	12,96	12,86
CT4	12,85	12,84
CT6	12,96	12,86
CT8	12,96	12,86

5.3 Probes

Probe damage testing is not specified.

5.4 Contact resistance gauge

Contact resistance is only specified for mated connectors.

5.5 Test panel (for voltage proof test)

These connectors are screened. The connector shield forms the ground conductor for voltage proof testing.

6 Characteristics

All the requirements and test schedules apply to the entire mated connectors including the switch unless otherwise specified.

6.1 General

Compliance to the test schedules is intended to ensure the reliability of all performance parameters, including transmission parameters, over the range of operating climatic conditions. Stable and compliant contact resistance is a good indication of the stability of transmission performance.

The characteristics given within this specification are those that are specific to IEC 60603-7-7. The other relevant characteristics are given in the series IEC 60603-7-X. A connector complying with IEC 60603-7-7 also complies with the other lower levels of IEC 60603-7-X.

6.2 Pin and pair grouping assignment

For those specifications for which pin and pair groupings are relevant, unless otherwise specified, the pin and pair grouping assignments shall be as shown in Figure 15.

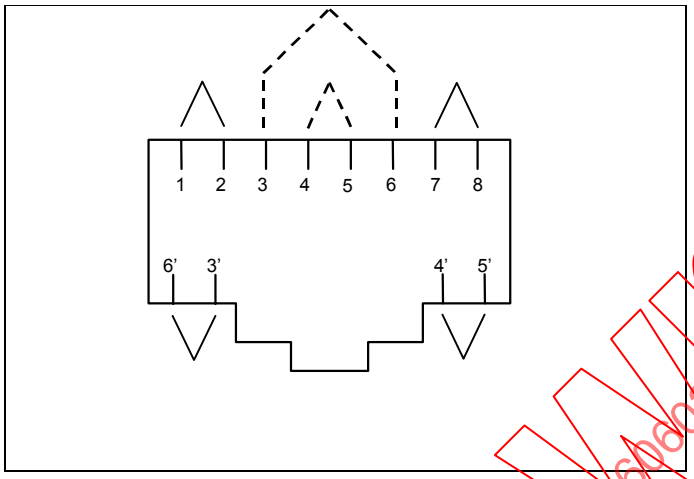


Figure 15 – Fixed connector pin and pair grouping assignment (front view of connector)

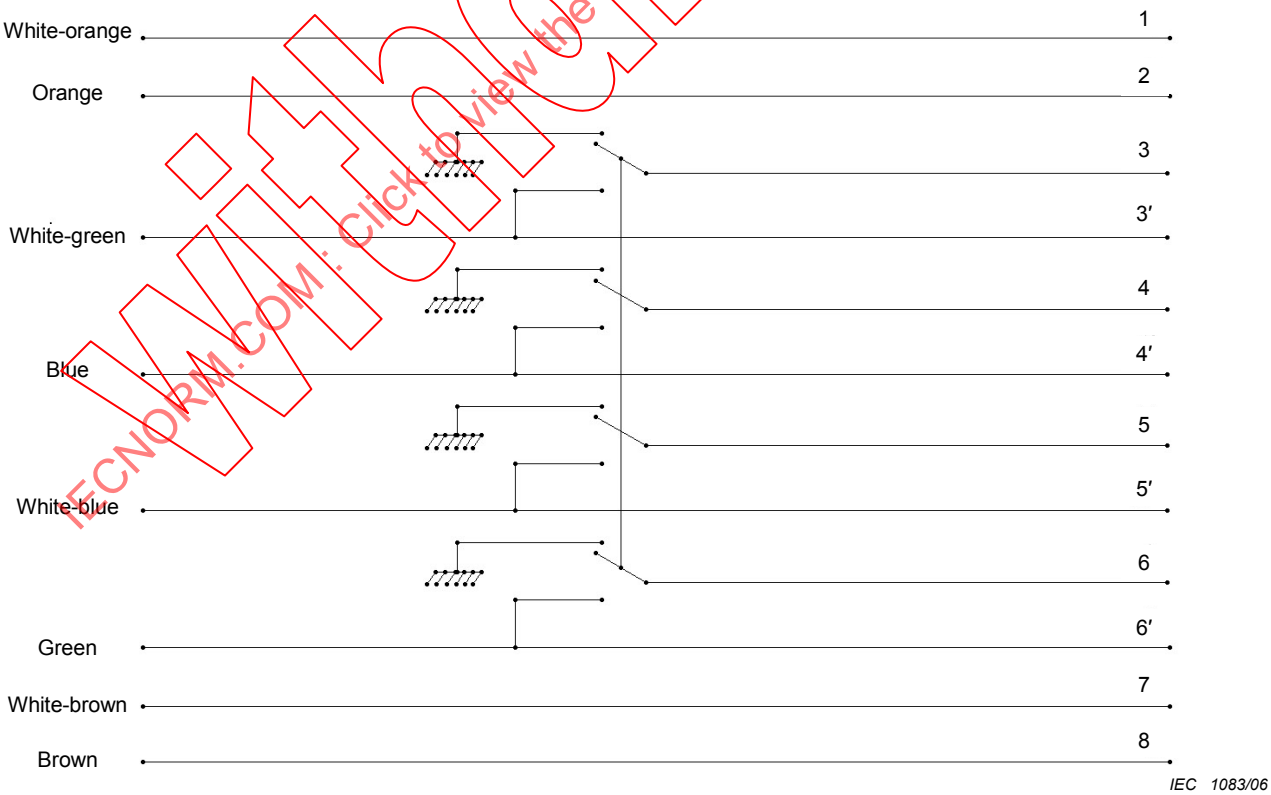


Figure 16 – Basic switch function

Figure 17 – Additional switch function

6.3 Climatic category

The lowest and highest temperatures and the duration of the damp heat, steady state test should be selected from the preferred values stated in IEC 61076-1. The connectors are classified into climatic categories in accordance with the general rules given in IEC 60068-1. The following preferred temperature range and severity of the damp heat steady state test have been selected to comply with IEC 61156 series cables (for cables used with these connectors).

Table 9 – Climatic categories – selected values

Climatic category	Temperature range °C	Damp heat steady state days
40/070/21	–40 to +70	21

6.4 Electrical characteristics

6.4.1 Creepage and clearance distance

The permissible operating voltages depend on the application and on the applicable or specified safety requirements.

Insulation co-ordination is not required for this connector; therefore, the creepage and clearance distances in IEC 60664-1 are reduced and covered by overall performance requirements.

Therefore, the creepage and clearance distances are given as operating characteristics of mated connectors.

In practice, reductions in creepage or clearance distances may occur due to the conductive pattern of the printed board or the wiring used, and shall duly be taken into account.

Table 10 – Minimum distances

Type	Minimum distance between contacts and chassis		Minimum distance between adjacent contacts	
	Creepage	Clearance	Creepage	Clearance
	mm	mm	mm	mm
A, C	1,40	0,51	0,36	0,36

6.4.2 Voltage proof

Conditions: IEC 60512, test 4a, Method A.

Standard atmospheric conditions.

Mated connectors:

1 000 V d.c. or a.c. peak, contact-to-contact,

1 500 V d.c. or a.c. peak, contact-to-test panel or contact-to-shield.

6.4.3 Current-carrying capacity

Conditions: IEC 60512, test 5b.

All contacts, connected in series.

The current carrying capacity of connectors in accordance with the requirements of IEC 61076-1 shall comply with the de-rating curve given in Figure 18.

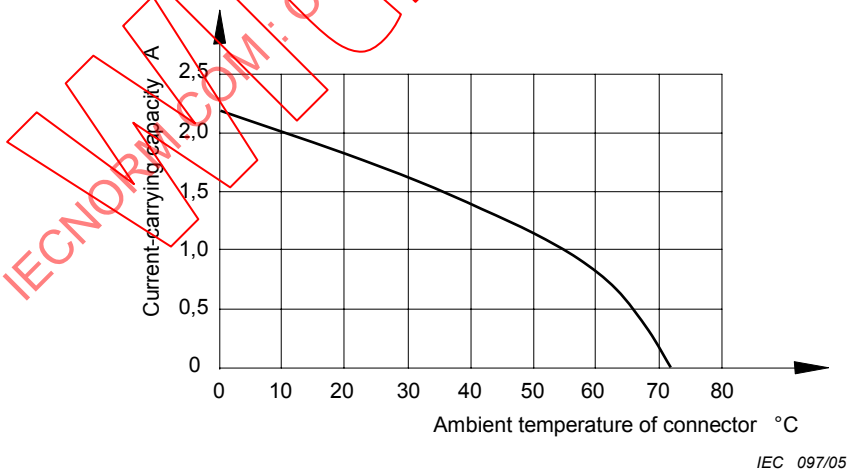


Figure 18 – Connector de-rating curve

30 °C maximum temperature rise when applying 0,75 A at 60° C.

6.4.4 Initial contact resistance

Conditions: IEC 60512, test 2a.

Mated connectors. Arranged according to 7.5.

Connection points: as specified in Figure 19.

Signal contacts: 20 mΩ maximum.

Screen contact: 20 mΩ maximum.

Switch contact: 20 mΩ maximum.

6.4.5 Input to output d.c. resistance

Conditions: IEC 60512, test 2a.

Mated connectors.

Connection points: cable termination to cable termination.

Signal contacts: 200 mΩ maximum.

Screen: 100 mΩ maximum.

6.4.6 Input to output d.c. resistance unbalance

Conditions: IEC 60512, test 2a.

Mated connectors.

Connection points: cable termination to cable termination.

Among all signal and switch conductors, maximum difference between maximum and minimum:

50 mΩ maximum.

6.4.7 Insulation resistance

Conditions: IEC 60512, test 3a, Method C.

Method A.

Mated connectors.

Test voltage: 100 V d.c..

Each contact and screen to all others: 500 MΩ minimum.

6.4.8 Transfer impedance

Conditions:

Annex I, transfer impedance test method.

Mated connectors, terminated with each cable construction intended to be allowed for these connectors.

All types:

$0{,}05(f^{0{,}3})$ Ω from 1 to 10 MHz.

$0{,}01(f)$ Ω from 10 to 80 MHz.

NOTE f is the frequency expressed in MHz.

6.5 Transmission characteristics

Category 7 performance level, respective to transmission characteristics, is determined according to specific test methods described in test group E.

Category 7 transmission performance interoperability of independent fixed or free connectors is determined by tests conducted when they are mated with precision test fixtures given in Annex C.

Transmission performance backward compatibility shall be demonstrated by testing the fixed connectors with the full range of free connectors or "test plugs" described in IEC 60603-7-5. Interoperability and backward compatibility of free connectors shall be demonstrated by testing them against the limits in IEC 60603-7-5, Annex C.

All transmission performance requirements apply between the reference planes specified in Clause D.8.

All transmission performance requirements apply for the range of frequency from 1 MHz to 600 MHz unless stated otherwise.

NOTE f is the frequency expressed in MHz.

6.5.1 Insertion loss

Conditions: Annex E, insertion loss.

Mated connectors.

All types: $\leq 0{,}02\sqrt{f}$ dB up to 1 000 MHz.

Whenever the formula results in a value less than 0,1 dB, the requirement shall revert to 0,1 dB.

6.5.2 Return loss

Conditions: Annex F, return loss.

Mated connectors.

All types: 68 – 20log(f) dB up to 1 000 MHz.

Whenever the formula results in a value greater than 30 dB, the requirement shall revert to 30 dB.

6.5.3 Propagation delay

All types: ≤2,5 ns.

NOTE Propagation delay test does not need to be performed, since it is assumed that connectors comply by design.

6.5.4 Delay skew

All types: <1,25 ns.

NOTE Delay skew test does not need to be performed, since it is assumed that connectors comply by design.

6.5.5 NEXT loss

Conditions: Annex G, NEXT loss, pair to pair.

Mated connectors, between all combinations of 2 pairs of contacts.

All types: 102,4 – 15log(*f*) dB.

Whenever the formula results in a value greater than 80 dB, the requirement shall revert to 80 dB.

6.5.6 Power sum NEXT loss (for information only)

Conditions:

Mated connectors, between each pair and all other pairs combined.

All types: 99,4 – 15log (*f*) dB.

NOTE This characteristic is achieved by compliance to pair-to-pair NEXT (6.5.5) and there is no necessity to test it.

6.5.7 FEXT loss

Conditions: Annex H, FEXT loss, pair-to-pair.

Mated connectors, between all combinations of 2 pairs of contacts.

All types: 90 – 15log(*f*) dB.

Whenever the formula results in a value greater than 75 dB, the requirement shall revert to 75 dB.

6.5.8 Power sum FEXT loss (for information only)

Conditions:

Mated connectors, between each pair and all other pairs combined.

All types: 87 – 15log(*f*) dB.

NOTE This characteristic is achieved by compliance to PP FEXT (6.5.7) and there is no necessity to test it.

6.5.9 Transverse conversion loss

Conditions: Annex J, transverse conversion loss.

Mated connectors.

All types: 68 – 20log(f) dB.

Whenever the formula results in a value greater than 40 dB, the requirement shall revert to 40 dB.

NOTE This requirement applies up to 100 MHz. Test methods for frequencies above 100 MHz are not yet fully stabilized.

6.5.10 Transverse conversion transfer loss

Conditions: Annex J, transverse conversion transfer loss.

Mated connectors.

All types: 68 – 20log(f) dB.

Whenever the formula results in a value greater than 40 dB, the requirement shall revert to 40 dB.

NOTE This requirement applies up to 100 MHz. Test methods for frequencies above 100 MHz are not yet fully stabilized.

6.5.11 Coupling attenuation

Conditions: According to EN 50289-1-14, coupling attenuation test method.

Mated connectors.

All types ≥ 85 dB, 30 MHz ≤ f ≤ 100 MHz

≥ 85 – 20 log (f/100) dB, 100 MHz < f ≤ 1 000 MHz

NOTE The coupling attenuation requirement is assumed to be fulfilled when the transfer impedance and unbalance attenuation (transverse conversion loss and transverse conversion transfer loss) requirements are met on the full bandwidth.

6.6 Mechanical characteristics

6.6.1 Mechanical operation

Conditions: IEC 60512, test 9a.

Speed: 10 mm/s maximum.

Rest: 1 s minimum (mated and unmated).

PL1: 750 operations.

PL2: 2 500 operations.

NOTE PL1 and PL2 are defined in 2.3.

6.6.2 Effectiveness of connector coupling devices

Conditions: IEC 60512, test 15f, and Annex B.

Mated connectors.

All types: 50 N for 60 s ± 5 s.

6.6.3 Insertion and withdrawal forces

Conditions: IEC 60512, test 13b, and Annex L.

Speed: 10 mm/s maximum.

All types, insertion and withdrawal: 30 N maximum.

7 Tests and test schedule

7.1 General

See IEC 61076-1.

All the requirements and test schedules apply to the entire mated connectors including the switch unless otherwise specified.

This detail specification states the test sequence (in accordance with this standard), and the number of specimens for each test sequence.

Individual variants may be submitted to type tests for approval of those particular variants.

It is permissible to limit the number of variants tested to a selection representative of the whole range for which approval is required (which may be less than the range covered by the detail specification), but each feature and characteristic shall be proved.

The connectors shall have been processed in a careful and workmanlike manner, in accordance with good current practice.

Unless otherwise specified, mated sets of connectors shall be tested. For contact resistance measurements, care shall be taken to keep a particular combination of connectors together during the complete test sequence, that is, when unmating is necessary for a certain test, the same connectors shall be mated for subsequent tests.

7.2 Test procedures and measuring methods

The test methods specified and given in the relevant standards are the preferred methods but are not necessarily the only ones that can be used. In case of dispute, however, the specified method shall be the reference method.

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1.

Where approval procedures are involved and alternative methods are employed, it is the responsibility of the manufacturer to satisfy the authority granting approval that any alternative methods which he may use gives results equivalent to those obtained by the methods specified.

7.3 Preconditioning

Before the tests are made, the connectors shall be preconditioned under standard atmospheric conditions for testing as specified in IEC 60068-1 for a period of 24 hours unless otherwise specified by the detail specification.

7.4 Wiring and mounting of specimens

7.4.1 Wiring

Wiring of these connectors shall take into account the wire diameter of the cables defined in IEC 61156 parts 2, 3, 4, 5 and 6 as applicable. Where wiring and/or shielding of test specimens is required, the detail specification shall contain information suitable to comply with the selected methods of test.

7.4.2 Mounting

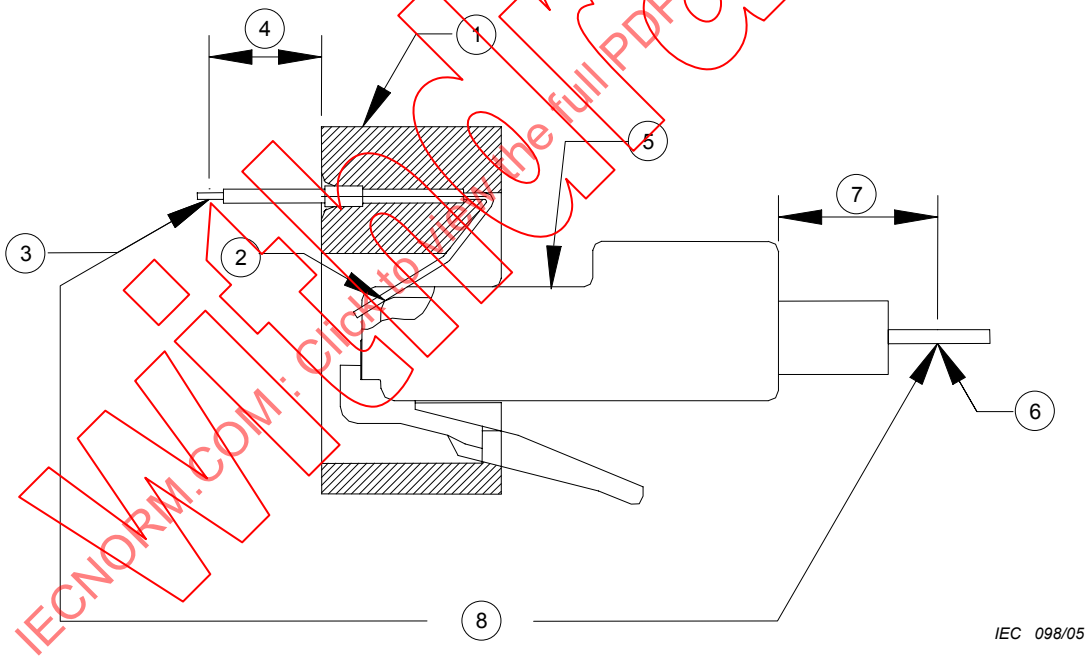
When mounting is required in a test, unless otherwise specified, the connectors shall be rigidly mounted on a metal plate or to specified accessories, whichever is applicable, using the specified connection methods, fixing devices and panel cut-outs.

7.5 Contact resistance measurement arrangement and procedure

Arrangement and procedure for contact resistance measurement are given herein.

7.5.1 Arrangement for contact resistance measurement

For the measurement of contact resistance, the points of connection shall be as shown in Figure 19.



NOTE 1 Fixed connector.
NOTE 2 Point B.
NOTE 3 Point A.
NOTE 4 As short as practical (except for vibration test CP1 see 7.3).
NOTE 5 Free connector.
NOTE 6 As short as practical (except for vibration test CP1 see 7.3).
NOTE 7 Point C.
NOTE 8 Contact resistance measurement points.

Figure 19 – Arrangement for contact resistance measurement

7.5.2 Test procedure for contact resistance measurement

a) Determine the bulk resistance of the fixed connector between points A and B of Figure 19 by calculation or by measurement. This resistance is noted R_{AB}.

b) Determine the bulk resistance of the free connector between points B and C of Figure 19 by calculation or by measurement. This resistance is noted R_{BC}.

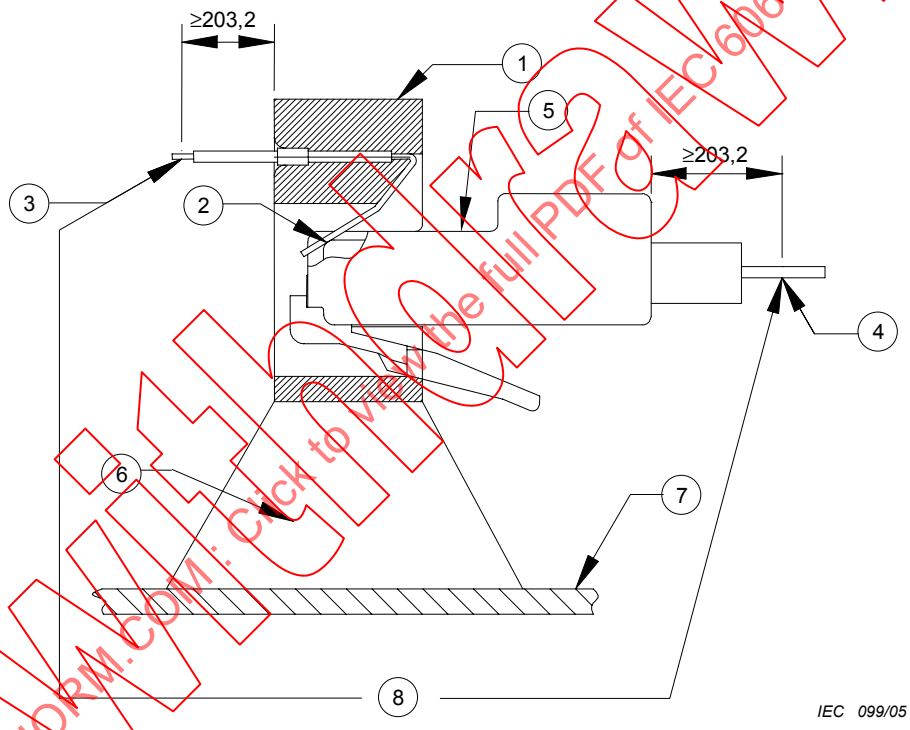
c) Measure the total mated connector resistance between points A and C, following the requirements and procedures of IEC 60512, test 2a. This resistance is noted R_{AC}.

d) Calculate the contact resistance by subtracting the sum of the bulk resistance of the fixed and free connectors from the total mated connector resistance.

Contact resistance = $R_{AC} - (R_{ABI} + R_{BCI})$

where I indicates initial value.

7.6 Arrangement for dynamic stress tests (test phase CP1)



NOTE 1 Fixed connector vibration feature.

NOTE 2 Point B.

NOTE 3 Point A. Secure to the non-vibrating member.

NOTE 4 Point C. Secure to the non-vibrating member.

NOTE 5 Free connector.

NOTE 6 Fixed connector rigidly fixed to the mounting plate.

NOTE 7 Mounting plate.

NOTE 8 Contact resistance measurement point.

Figure 20 – Arrangement for dynamic stress tests

7.7 Test schedules

The test parameters required shall not be less than those listed in Clause 6.

7.7.1 Basic (minimum) test schedule

Not applicable.

7.7.2 Full test schedule

The following tests specify the characteristics to be checked and the requirements to be fulfilled.

For a complete test sequence, a minimum of 52 + N specimens are needed. This equals 5 groups of 10, 1 group of 2 and N groups of 1. The 5 groups of 10 shall be for test group A, B, C, D, and F. The group of 2 shall be for the transmission performance testing, group E. The N groups of 1 shall be for the screen performance testing, group F. The N stands for each cable screen construction type the connectors are intended to be used for.

Where not otherwise stated, contact resistance tests, including screen contacts, apply only to the interface between plug and jack (see 7.5).

7.7.2.1 Test group P – preliminary tests

All specimens shall be subjected to the following tests. All the test group specimens shall be subjected to the preliminary group P tests in the following sequence.

The specimens shall then be divided into the appropriate number of groups. All connectors in each group shall undergo the following tests as described in the sequence given, with required alteration of the sequence of tests or adding of new tests to verify additional connector characteristics.

Table 11 – Test group P

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 test no.	Severity or condition of test	Title	IEC 60512 test no.	Requirements
P 1	General examination	1		Visual examination	1a	There shall be no defects that would impair normal operation
				Examination of dimensions and mass	1b	The dimensions shall comply with those specified in the detail specification
P 2	Polarization not applicable					
P 3	Contact resistance		Measurement points as in Figure 19 All signal contacts/specimens	Millivolt level method or contact resistance – specified test current method	2a	Contact resistance = 20 mΩ maximum
P 4			Test voltage 100 V ± 15 V d.c. Method C Mated connectors	Insulation resistance	3a	500 MΩ minimum
P 5			Contact/contact Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All contacts to screen Method A Mated connectors			1 500 V d.c. or a.c. peak

7.7.2.2 Test group AP

Table 12 – Test group AP

Test phase	Test			Measurement to be performed		
	Title	Test	Severity or condition of test	Title	IEC 60512 Test no.	Requirements
AP 1	Insertion and withdrawal forces	IEC 60512, 13b	Connector locking device depressed			Insertion force 20 N maximum Withdrawal force 20 N maximum
AP 2	Effectiveness of connector coupling device	IEC 60512, 15f	Rate of load application 44,5 N/s maximum			50 N for 60 s ± 5 s
AP 3	Rapid change of temperature	IEC 60512, 11d	–40 °C to 70 °C Mated connectors 25 cycles ι = 30 min Recovery time 2 h			
AP 4			Test voltage 100 V ± 15 V d.c. Method C Mated connectors	Insulation resistance	3a	500 MΩ minimum
AP 5			Measurement points as in Figure 19 All contacts/specimens	Contact resistance	2a	20 mΩ maximum change from initial
AP 6			Contact/contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All contacts to screen: Method A Mated connectors			1 500 V d.c. or a.c. peak
AP 7			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation
AP 8	Cyclic damp heat	IEC 60068-2-38	21 cycles low temperature 25 °C High temperature 65 °C cold subcycle –10 °C Humidity 93 % Half of the samples in mated state Half of the samples in unmated state			
AP 9			Measurement points as in Figure 19 All contacts/specimens	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts 100 mΩ maximum input to output resistance for screen
AP 10	Insertion and withdrawal forces	IEC 60512, 13b	Connector locking device depressed			Insertion force 30 N maximum Withdrawal force 30 N maximum
AP 11	Effectiveness of connector coupling device	IEC 60512, 15f	Rate of load application 44,5 N/s maximum			50 N for 60 s ± 5 s
AP 12			Unmated connectors	Visual examination	1a	There shall be not defects that would impair normal operation
AP 13	Solderability		As applicable			
AP 14	Resistance to soldering heat		As applicable			

Test phase	Test			Measurement to be performed		
	Title	Test	Severity or condition of test	Title	IEC 60512 Test no.	Requirements
AP 15 See Note			Contact/contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All contacts to screen: Method A Mated connectors			1 500 V d.c. or a.c. peak
NOTE Do not perform step AP 15 if solderability and resistance to soldering heat is not performed.						

7.7.2.3 Test group BP

Table 13 – Test group BP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 test no.	Severity or condition of test	Title	IEC 60512 test no.	Requirements
BP 1	Locking device mechanical operations		2 N operations – see mechanical operations			See Annex B
BP 2	Mechanical operations	9a	N/2 operations – see mechanical operations Speed 10 mm/s Rest 1 s (when mated and unmated) Locking device inoperative			PL 1(N) = 750 PL 2(N) = 2 500
BP 3	Flowing mixed gas corrosion	11g	4 days Half of the samples in mated state Half of the samples in unmated state		11g	
BP 4			Measurement points as in Figure 19 All contacts/specimens	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts 100 mΩ maximum input to output resistance for screen
BP 5	Mechanical operations	9a	N/2 operations – see mechanical operations Speed 10 mm/s Rest 1 s (when mated and unmated) Locking device inoperative			
BP 6			Measurement points as in Figure 19 All contacts/specimen	Contact resistance	2a	20 mΩ maximum change from initial for signal contacts 100 mΩ maximum input to output resistance for screen
BP 7			100 V ± 15 V d.c. Method C Mated connectors	Insulation resistance	3a	500 MΩ minimum
BP 8			Contact/contact: Method A Mated connectors	Voltage proof	4a	1 000 V d.c. or a.c. peak
			All contacts to screen: Method A Mated connectors			1 500 V d.c. or a.c. peak
BP 9				Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.4 Test group CP

Table 14 – Test group CP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 test no.	Severity or condition of test	Title	IEC 60512 test no.	Requirements
CP 1	Vibration	6d	F = 10-500 Hz Ampl. = 0,35 mm Accel. = 50 m/s 10 sweeps / axis Measurement points as in Figure 20	Contact disturbance	2e	10 µs maximum
CP 2			Measurement points as in Figure 19 All signal contacts and screen / specimens	Contact resistance	2a	No disturbance of plug and jack between vibration test and measurement 20 mΩ maximum change from initial for signal contacts 100 mW maximum input to output resistance for screen
CP 3			Test voltage 100 V d.c. Method C Mated connectors	Insulation resistance	3a	500 MΩ minimum
CP 4			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.5 Test group DP

Table 15 – Test group DP

Test phase	Test			Measurement to be performed		
	Title	Test	Severity or condition of test	Title	Test	Requirements
DP 1	Electrical load and temperature	IEC 60512, 9b	5 connectors 500 h 70 °C Recovery period 2 h			0,5 A 5 connectors No current: 5 connectors
DP 2			Test voltage: 100 V d.c. Method C Mated connectors	Insulation resistance	IEC 60512, 3a	500 MΩ minimum
DP 3			Contact/contact: Method A Mated connectors	Voltage proof	IEC 60512, 4a	1 000 V d.c. or a.c. peak
			All contacts to screen: Method A Mated connectors			1 500 V d.c. or a.c. peak
DP 4			Unmated connectors	Visual examination	IEC 60512, 1a	There shall be no defects that would impair normal operation
DP 5			Measurement points as in Figure 19 All signal contacts and screen / specimens	Contact resistance	IEC 60512, 2a	20 mΩ maximum change from initial for signal contacts. 100 mΩ maximum input to output resistance for screen.
DP 6	Mechanical gauging	Annex L	Both, free and fixed connector		Annex L	Passing go/no go test
DP 7	Gauging continuity	Annex A	All signal contacts and screen / specimens	Contact disturbance	IEC 60512, 2e	10 µs maximum

7.7.2.6 Test group EP

Table 16 – Test group EP

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 test no.	Severity or condition of test	Title	Test	Requirements
EP1				Insertion loss	IEC 60512, test 25b and Annex E	Per 6.5.1
EP 2			All pairs, both directions, (pair to pair)	NEXT loss	IEC 60512, test 25a and Annex G	Per 6.5.5
EP 3			All pairs, both directions	Return loss	IEC 60512, test 25e and Annex F	Per 6.5.2
EP 4			All pairs, both directions, (pair to pair)	FEXT loss	IEC 60512, test 25a and Annex H	Per 6.5.7
EP 5				Transverse conversion loss	Annex J	Per 6.5.9
EP 6				Transverse conversion transfer loss	Annex J	Per 6.5.10
EP 7	Input to output resistance		Measurement points as defined in 6.4.5 All signal contacts, switch contacts and screen / specimens	Millivolt level method	IEC 60512, test 2a	Signal contact resistance = 200 mΩ maximum Screen resistance = 100 mΩ maximum
EP 8	Resistance unbalance		Measurement points as defined in 6.4.6 All signal contacts and switch contacts / specimens	Millivolt level method	IEC 60512, test 2a	Unbalance resistance = 50 mΩ maximum
NOTE All measurements to be performed on mated connectors.						

7.7.2.7 Test group FP

Table 17 – Test group FP

Test phase	Test			Measurement to be performed		
	Title	Test	Severity or condition of test	Title	IEC 60512 Test No.	Requirements
FP 1	Surge test	ITU-T K.20	Mated connectors, Table 2a /2b, Basic test level Tests 2.1.1a, 2.1.1b, 2.1.3, 2.2.1a and 2.3.1a			Test 2.1 and 2.2: Acceptance criteria A per ITU-T K.44, Clause 9, Test 2.3: Acceptance criteria B per ITU-T K.44, Clause 9;
FP 2			100 V ± 15 V d.c. Method C Mated connectors	Insulation resistance	3a	500 MΩ minimum
FP 3			Unmated connectors	Visual examination	1a	There shall be no defects that would impair normal operation

7.7.2.8 Test group GP

Table 18 – Test group GP

Test phase	Test			Measurement to be performed		
	Title	Test	Severity or condition of test	Title	Test	Requirements
GP 1	High temperature	IEC 60512, 9b	500 h 70 °C Recovery period 2 h			
GP 2	Cyclic damp heat	IEC 60068-2-38	21 cycles. Low temp 25 °C High temp 65 °C Cold subcycle –10 °C Humidity 93 % Half of the samples in mated state Half of the samples in unmated state			
GP 3			Additional tests are for further study			
GP 4				Transfer impedance	Annex I	Per 6.4.8
GP 5				Coupling attenuation	EN 50289-1-14	Per 6.5.11

Annex A
(normative)

Gauging continuity procedure

A.1 Object

The object of this test is to check whether in the worst case conditions for the free connector the electrical continuity is guaranteed for signal contacts and screen.

A.2 Preparation of the specimens

A gauge according to Figure A.1 should be applied to test the fixed connector specimen.

A.3 Test method

Apply to the test specimen and to the gauge a circuit according to IEC 60512, test 2e. For each individual contact of the fixed connector and the screen, the test shall be repeated.

For the test of the signal contacts, the gauge shall be fully inserted and then be moved upwards until it stops against the plastic wall of the fixed connector (see Figure A.2).

For the test of the screen contact, the gauge shall be fully inserted and then be moved to both sides of the connector until it stops against the plastic wall of the fixed connector. This movement shall be repeated 3 times.

During this movement, a forwards force of 20 N minimum shall be applied as indicated by the arrow in Figure A.2.

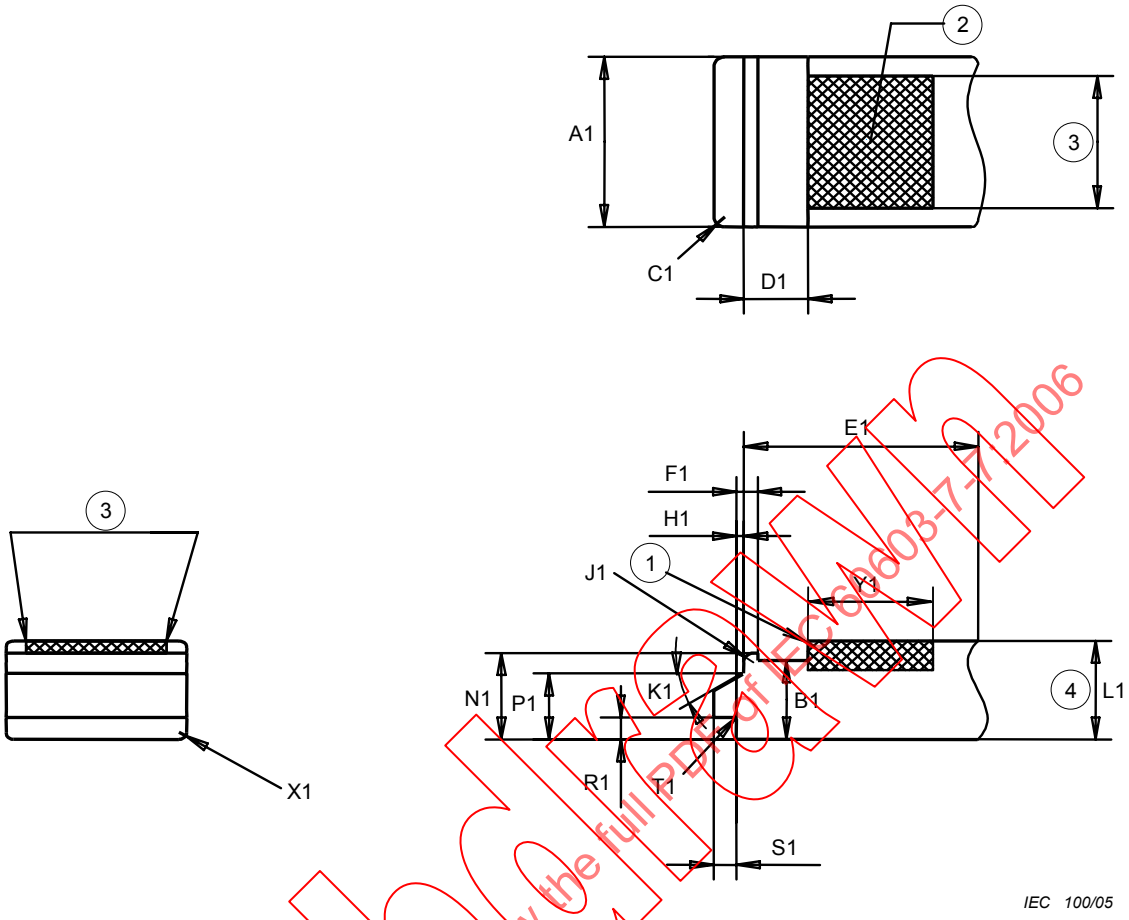
A.4 Final measurements

The fixed connector specimen will meet the requirements, if no discontinuity > 10 µs is monitored for each individual contact and the screen during movement and in end position.

A.5 Description of continuity gauge

The gauge shall be made according to the following specification:

Material: tool steel, hardened with suitable plating finish.
Surface roughness: according to ISO 1302, Ra: 0,25 µm maximum.



NOTE 1 Sharp edge.

NOTE 2 Insulation part.

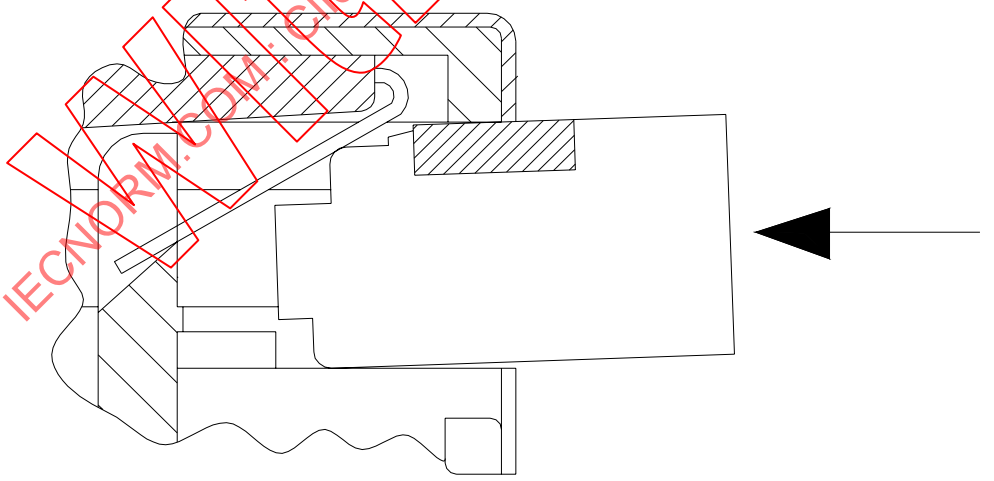
NOTE 3 Edge of insulation part may not extend beyond radius of steel part.

NOTE 4 Dimension to edge of insulation part.

Figure A.1 – Gauge

Table A.1 – Continuity gauge dimensions

Letter	Maximum	Minimum
	mm	mm
A1	11,59	11,57
B1	4,90	
C1	0,8	0,6
D1	4,12	4,10
E1		15,0
F1	0,89	0,79
H1	0,47	0,45
J1	0,69	0,59
L1	6,72	6,70
N1	5,90	5,88
P1	4,7	4,3
R1	1,6	1,4
S1	1,46	1,44
T1	0,1	
X1	0,6	0,4
Y1		5,0
K1	30	24



IEC 1085/06

Figure A.2 – Gauge insertion

Annex B
(normative)

Locking device mechanical operation – Test procedure and requirements

B.1 Object

The object of this mechanical endurance test is to assess the operational limits of the locking device on free connectors.

B.2 Preparation of the specimens

The specimen shall be prepared and mounted so that the locking device is readily accessible for application of the test. No other movement of the free connector shall be allowed.

B.3 Test method

The specimen shall be subjected to mechanical operational endurance tests of the number of cycles, as specified in test BP2 of Table 13.

The speed of the operation of the applied force to the locking device shall not exceed 20 cycles per minute.

The specimen shall be operated in the normal manner, and the locking device shall be depressed until it contacts the body of the free connector.

Mechanical aids which simulate normal operations may be used, provided that they do not introduce abnormal stresses.

B.4 Final measurements

After the specified number of operations, the specimens shall show no visual indication of fatigue or stress cracking of the locking device.

Annex C
(normative)

High frequency (category 7) transmission interoperability testing

C.1 Object

Mated pairs of connectors are required to meet the transmission performance specifications of this annex. To evaluate the performance of individual connectors, a means is provided to connect the interface side of the connector directly to the port of the network analyser equipment. The termination side of the connector is connected to the other port of the network analyser equipment.

C.2 Test equipment

The equipment used shall be as described in Annex D.

C.3 Free connector precision test fixture construction

Interoperability testing of free connectors is conducted by terminating the free connector interface to a precision test fixture.

There is no crosstalk compensation implementation within the test fixture.

A fixed board mount type connector is used with a board to make connections to the network analyser, see Figure C.1. Only the 4 pairs (8 contacts) of the connector used for high frequency transmission are terminated to leads on the board for connection to the network analyser interface. The other 2 pairs (4 contacts) of the connector are terminated to the measurement ground plane.

50 Ω strip line leads are used to facilitate either 100 Ω differential mode stimulus and detection using baluns or coupled transmission mode stimulus and detection using direct connections to network analyser equipment. Strip lines terminate each connector lead to female SMA terminations.

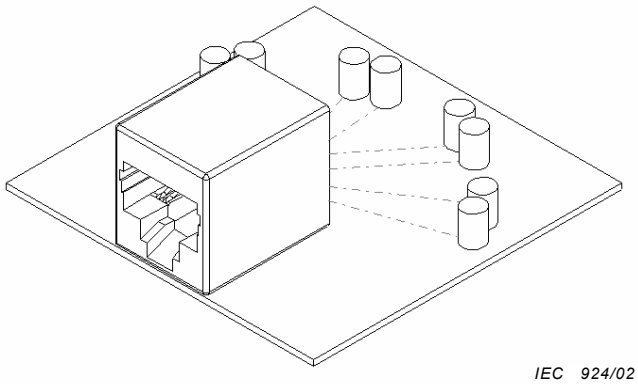


Figure C.1 – Free connector precision test fixture

C.4 Fixed connector precision test fixture construction

Interoperability testing of fixed connectors is conducted by terminating the fixed connector interface to a precision test fixture.

A free connector (variant 02) is used with a board to make connections to the network analyser, see Figure C.2. Only the 4 pairs (8 contacts) of the connector used for high frequency transmission are terminated to leads on the board for connection to the network analyser interface. The other 2 pairs (4 contacts) of the connector are terminated to the measurement ground plane.

50 Ω strip line leads are used to facilitate either 100 Ω differential mode stimulus and detection using baluns or coupled transmission mode stimulus and detection using direct connections to network analyser equipment. Strip lines terminate each connector lead to female SMA terminations.

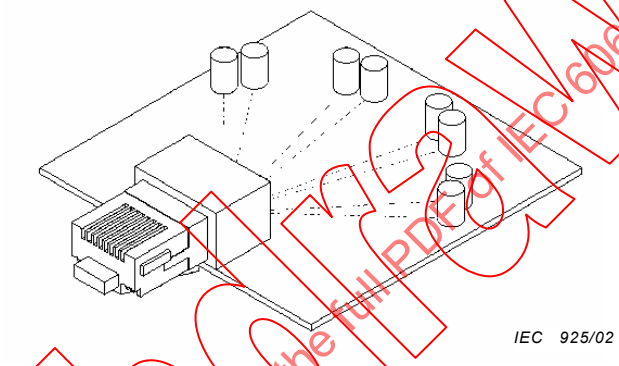


Figure C.2 – Fixed connector precision test fixture

C.5 Alternate fixed or free connector test fixture

The fixture consists of a fixed or free connector with a cover over the termination area that completely isolates the pairs. The cover portion may vary from manufacturer to manufacturer. The “cover” shall be used to shield the terminations on the far side of the connector under test.

C.6 Test fixture requirements

The performance of the precision test fixture, fixed and free, are verified together to have return loss, NEXT and FEXT performance that are a minimum of 6 dB superior to the standard category 7 requirements.

C.7 Test procedure

With the connector mated to the appropriate test fixture, measure the NEXT and FEXT performance for each pair combination as outlined in Annexes G and H respectively.

Annex D
(normative)

General requirements for the measurement set-up

D.1 Test instrumentation

These electrical test procedures require the use of a vector network analyser. The analyser should be capable of full two port calibrations. The analyser shall cover the frequency range of 1 MHz to 1 GHz at least.

At least 2 test baluns are required in order to perform measurements with balanced symmetrical signals. The requirements for the baluns are given in g) of Clause D.3.

Reference loads and cables are needed for the calibration of the set-up. Requirements for the reference components are given in D.5.1 and D.5.2 respectively.

Termination loads are needed for the termination of pairs, used and unused, which are not terminated by the test baluns. Requirements for the termination loads are given in Clause D.6.

A test adapter (triaxial test set) is needed for the transfer impedance measurements. References to requirements for this set-up are given in Annex I.

An absorbing clamp and ferrite absorbers are needed for the coupling attenuation measurements. The requirements for these items are given in EN 50289-1-14, coupling attenuation test method.

D.2 Coaxial cables and test leads for network analysers

Coaxial cable assemblies between network analyser and baluns should be as short as possible. (It is recommended that they do not exceed 60 cm 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 G).

Balanced test leads and associated connecting hardware to connect between the test equipment and the connector under test shall be taken from components that meet or exceed the requirements for the relevant category. Balanced test leads shall be limited to a maximum of 7 cm between each balun and the reference plane of the connector under test. Pairs shall remain twisted from the baluns to where connections are made. The impedance of the test leads from the DUT to the baluns shall be managed, both differential and common modes, as far as possible.

D.3 Measurement precautions

To assure a high degree of reliability for transmission measurements, the following precautions are required:

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

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

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

d) 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 detail for both the measurement equipment and the procedures.

g) All common mode terminations and the housing of the baluns shall be terminated to one common ground plane.

D.4 Balun requirements

The baluns may be balun transformers or 180° hybrids with attenuators to improve matching if needed (see Figure D.1).

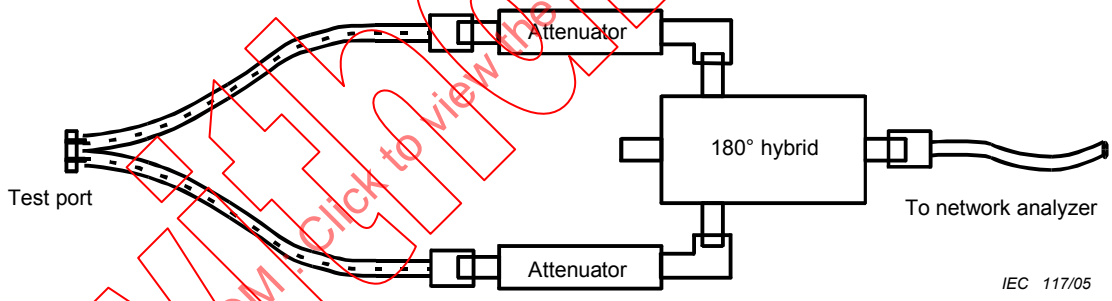


Figure D.1 – 180° hybrid used as a balun

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 D.1.

Table D.1 – Test balun performance characteristics

Parameter	Requirement at test frequencies up to 250 MHz	Requirement at test frequencies above 250 MHz
Impedance, primary	Matched to applied network analyser	
Impedance, secondary	100 Ω	
Insertion loss	10 dB maximum	
Return loss secondary	14 dB minimum	
Return loss – common mode with common mode termination[1]	10 dB minimum	
Return loss – common mode without common mode termination[1]	1 dB maximum	Not applicable
Longitudinal balance[2]	50 dB	Not applicable
Common mode rejection[3]	50 dB	40 dB
Output signal balance[3]	50 dB	40 dB
Power rating	0,1 W	

[1] Measured by connecting the balanced output terminals together and measuring the return loss. The nominal primary impedance shall terminate the primary input terminal.

[2] Applicable for baluns which are used for balance measurements. Measured from primary input terminal to common mode terminal when secondary balanced terminal is terminated with 100 Ω.

[3] Measured according to ITU-T G.117 and ITU-T O.9.

D.5 Reference components for calibration

D.5.1 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 at the reference plane.

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 a N type connector according to IEC 60169-16, meant for panel mounting, which is machined flat on the back side (see Figure D.2). The loads shall be fixed to the flat side of the connector, distributed evenly around the centre conductor. A network analyser shall be calibrated, one port full calibration, with the calibration reference. Thereafter, the return loss of the reference loads for calibration shall be measured. The verified return loss shall be >46 dB at frequencies up to 100 MHz and >40 dB at frequencies above 100 MHz and up to the limit for which the measurements are to be carried out.

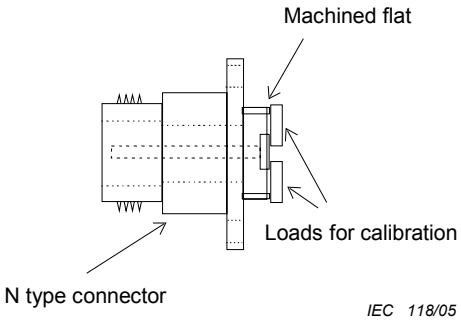


Figure D.2 – Calibration of reference loads

D.5.2 Reference cables for calibration

As a minimum, the reference cable that is used to perform calibration of the test set-up shall satisfy the requirement of the same category according to IEC 61156-5 as the category of the connector. The reference cable shall be a length of horizontal cable for which the sheath is preserved. One of the pairs of the reference cable is used for the calibrations. The total length of reference cable shall be according to the length of the measurement cables as outlined in the calibration procedures for the various tests. Both ends of the reference cable shall be well prepared, so that the twisting is maintained up to the test ports

D.6 Termination loads for termination of conductor pairs

During measurement, conductor pairs of the measurement cables for the connector under test shall be terminated according to the specified test set-up with impedance matching loads. For pairs under test, this is provided by the test instrumentation at one or both ends. For pairs not under test or not connected to test instrumentation, resistor loads or terminated baluns shall be applied. For differential mode only terminations, only resistor loads are allowed[7].

The nominal differential mode impedance of the termination shall be 100 Ω. The nominal common mode impedance shall be 50 Ω ± 25 Ω.

NOTE The exact value of the common mode impedance is not critical for most measurements. Normally, a value of 75 Ω is used for unscreened connectors, while a value of 25 Ω is used for screened connectors.

Resistor loads shall use resistors specified for ±1 % accuracy in d.c. and have a return loss greater than 40 – 10 log(f) where f is the frequency in MHz[8]. For pairs connected to a balun, common mode load is implemented by applying a load at the common mode terminal (centre tap) of the balun. The impedance of the load is equal to the common mode impedance. For a balun without a common mode terminal (centre tap is not accessible), the requirement for common mode return loss shall be complied with by inserting a balanced attenuator between the balun and the connector pair. Guidance on how this is done is shown Annex K. For pairs connected to resistor loads, common mode load is implemented by the Y configuration shown in Figure D.3.

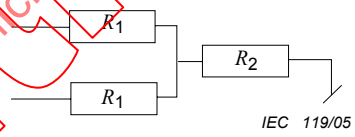


Figure D.3 – Resistor load

where

$$R_1 = \frac{R_{dif}}{2}$$

and

$$R_2 = R_{com} - \frac{R_{dif}}{4}$$

where

R_{dif} is the differential mode impedance (Ω);

R_{com} is the common mode impedance (Ω).

---

7 Unpredictable stray capacitances in baluns cause resonances at high frequencies, if they are used as terminations, when the common mode terminal is open.

8 Return loss of terminations are measured with a network analyzer connected to one balun, which is calibrated (full one port calibration) using the reference loads (D.5.1).

The two resistors R_1 shall be matched to within 0,5 %. The termination shall be implemented at a small printed circuit board with surface mount resistors. The layout for the resistors R_1 shall be symmetrical.

The common mode termination points for all pairs shall be connected to the ground plane.

D.7 Termination of screens

For screened connectors, screened measurement cables shall be used. Individually screened twisted pairs (STP) are recommended.

The screen of the connector shall be terminated to the screens of the measurement cables. The screen or screens of these cables shall be fixed to the ground plane as close as possible to the measurement baluns.

If a pyramid test setup is used, the screen of each pair shall be in contact with the grooves of the pyramid (Figure D.4) and guided as close as possible to the baluns on the mounting plate.

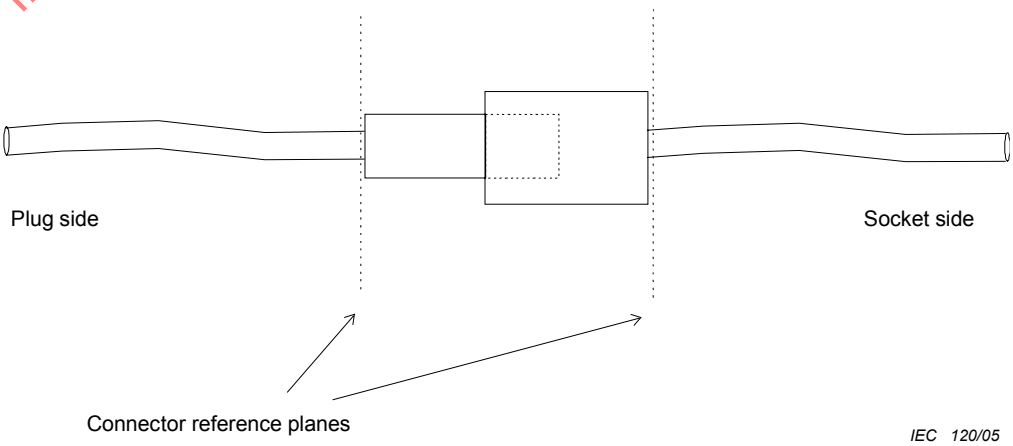
IEC 1086/06

Figure D.4 – Screened pyramid

Care shall be taken to maintain a tight fit of the individual pair foil, if present, around the twisted pairs.

D.8 Test specimen and reference planes

The test specimen is a mated pair of relevant connectors. The electrical reference plane for the test specimen is the point at which the cable sheath enters the connector (the back end of the connector), or the point, at which the internal geometry of the cable is no longer maintained, whichever is farther from the connector (see Figure D.5). This definition applies to both ends of the test specimen.



IEC 120/05

Figure D.5 – Definition of reference planes

Annex E
(normative)

Insertion loss[9]

E.1 Object

The object of this test is to measure the insertion loss, which is defined as the additional attenuation that is provided by a pair of mated connectors inserted in a communication cable.

E.2 Test method

Insertion loss is evaluated by measuring the scattering parameters, S_{21}, of all the conductor pairs.

E.3 Test set up

The test set-up consists of a network analyser and two baluns as defined in Annex D.

It is not necessary to terminate the unused pairs.

E.4 Procedure

E.4.1 Calibration

A full 2-port calibration shall be performed at the reference plane. This is performed by applying a reference cable of 14 cm maximum length between the terminals of the baluns and performing the transmission calibration measurement. A reference cable of 7 cm maximum length is then connected to the terminals of the two baluns (see Figure E.1). The total length of these cables shall be equal to the length of the reference cable used for transmission calibrations. At the end of these reference cables, the reflection calibrations are performed by applying open, short and load terminations.

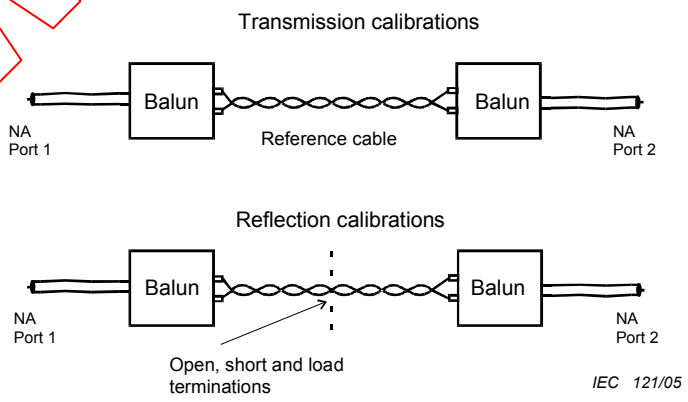


Figure E.1 – Calibration

9 Often referred to as attenuation.

E.4.2 Measurement

The test specimen shall be terminated with measurement cables at both ends. The length of the measurement cables shall be equal to the length of the reference cables used for reflection calibrations. The measurement cables shall be the cable types for which the connector is intended. A S_{21} measurement shall be performed.

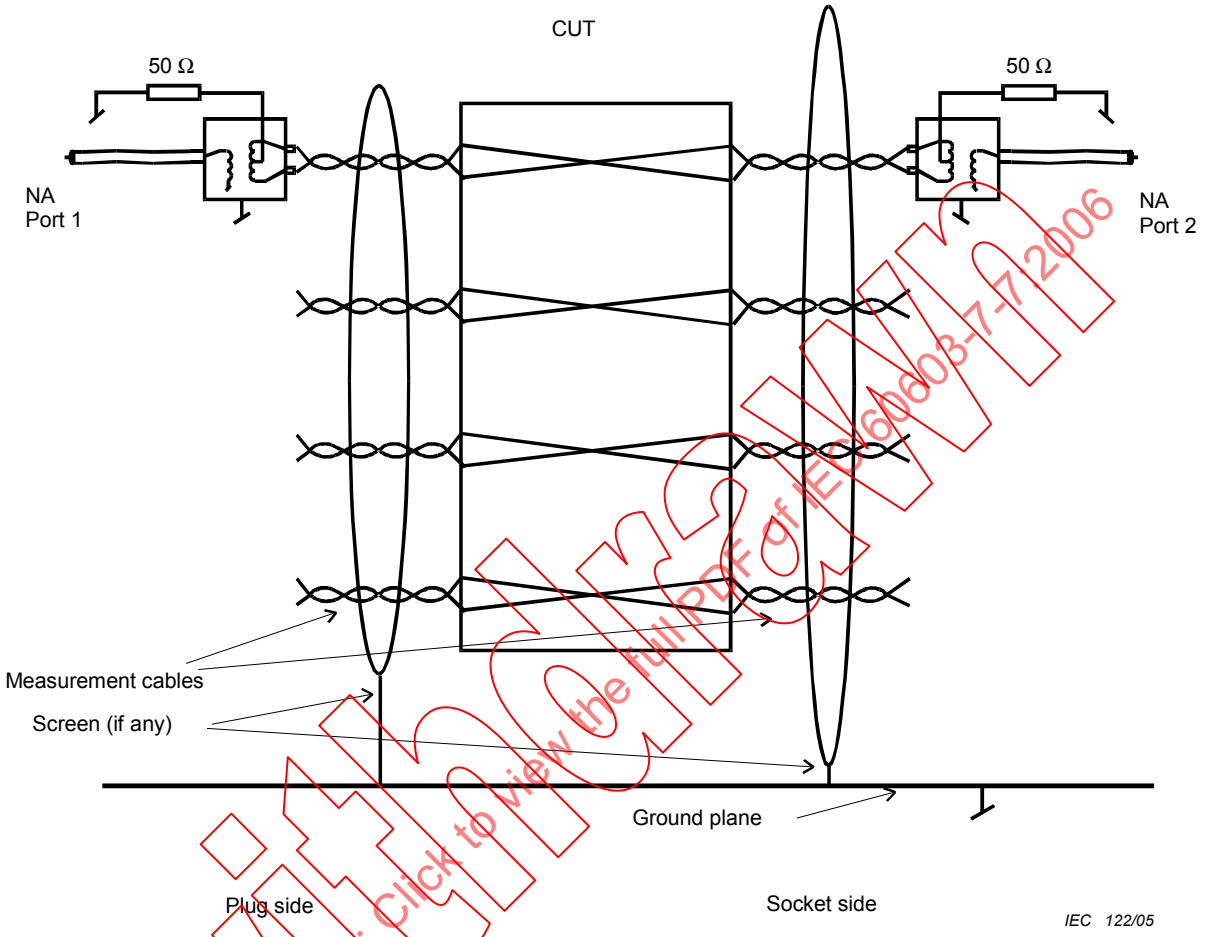


Figure E.2 – Measuring set-up

E.5 Test report

The measured results shall be reported in graphical or table format with the specification limits 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.

E.6 Accuracy

The accuracy shall be within ±0,05 dB.

Annex F
(normative)

Return loss

F.1 Object

The object of this test is to measure the Return Loss (RL) of a mated connector pair at the two reference planes.

F.2 Test method

Return loss is measured by measuring the scattering parameters, S_{11} and S_{22} of all the conductor pairs.

NOTE As a connector is a low loss device, the return loss of the two sides are nearly equal.

F.3 Test set-up

The test set-up is as described in Annex E.

A resistor network as per D.6 may be substituted for the balun at the far end.

F.4 Procedure

F.4.1 Calibration

Calibration shall be performed as described in Annex E.

F.4.2 Measurement

The test specimen shall be terminated with measurement cables at both ends. The length of measurement cables shall be equal to the length of the reference cables used for reflection calibrations. The measurement cables shall be the cable types for which the connector is intended. S_{11} and S_{22} measurements shall be carried out for each of the pairs.

F.5 Test report

The measured results shall be reported in graphical or table format with the specification limits 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.

F.6 Accuracy

The return loss of the load for calibration is verified to be greater than 46 dB up to 100 MHz and greater than 40 dB at higher frequencies. The uncertainty of the connection between the connector under test and the baluns are expected to deteriorate the return loss of the set-up (the directional bridge implemented by the test set-up) by 6 dB. The accuracy of the return loss measurements is then equivalent with measurements performed by a directional bridge, with a directivity of 40 dB and 34 dB. The accuracy (uncertainty band) is given in Table F.1.