

INTERNATIONAL STANDARD



**Connectors for electronic equipment –
Part 02: Detail specification for 8-way, unshielded, free and fixed high density
connectors for data transmission with frequencies up to 250 MHz and with
current carrying capacity up to 1 A**

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INTERNATIONAL
ELECTROTECHNICAL
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CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –**Part 02: Detail specification for 8-way, unshielded, free and fixed high density connectors for data transmission with frequencies up to 250 MHz and with current carrying capacity up to 1 A**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

International Standard IEC 62946-02 has been prepared by subcommittee 48B: Electrical connectors, of IEC technical committee 48: Electrical connectors and mechanical structures for electrical and electronic equipment.

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

FDIS	Report on voting
48B/2537/FDIS	48B/2546/RVD

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

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

A list of all parts in the IEC 62946 series, under the general title *Connectors for electronic equipment*, can be found on the IEC website.

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

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

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

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INTRODUCTION

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning connectors given in this specification.

The IEC takes no position concerning the evidence, validity and scope of this patent right.

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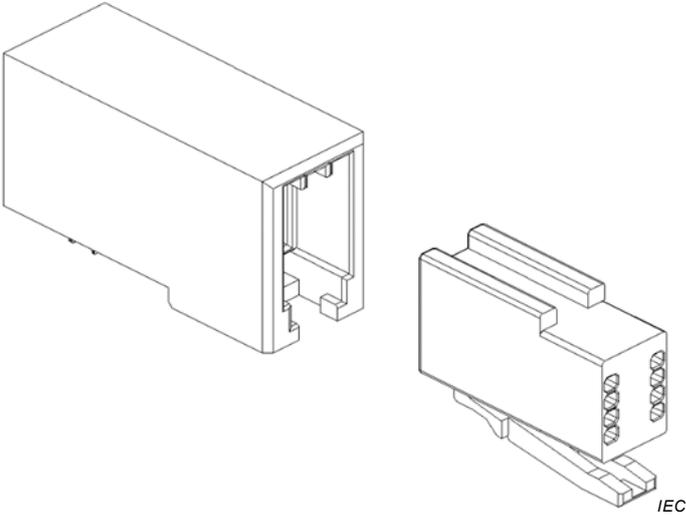
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	IEC 62946-02, Ed. 1 (date of issue)
Subcommittee 48B: Electrical connectors	
	8-way, unshielded, free and fixed high density connectors for data transmission up to 250 MHz and with current carrying capacity up to 1 A.
	Fixed connectors are mounted on printed circuit board, the free connector is attached to wires.

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CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –

Part 02: Detail specification for 8-way, unshielded, free and fixed high density connectors for data transmission with frequencies up to 250 MHz and with current carrying capacity up to 1 A

1 Scope

This part of IEC 62946 covers 8-way, unshielded free and fixed high density connectors for data transmission with frequencies up to 250 MHz and with extra low voltage current carrying capabilities up to 1 A, and is intended to specify the common dimensions, mechanical, electrical, signal integrity and environmental characteristics and tests for these connectors.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

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

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

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

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

IEC 60512-11-7, *Connectors for electronic equipment – Tests and measurements – Part 11-7: Climatic tests – Test 11g: Flowing mixed gas corrosion test*

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

IEC 61984, *Connectors – Safety requirements and tests*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581,

IEC 60512-1 and the following apply.

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

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

3.1 interoperability

interoperability of connectors to this standard from different sources is ensured by compliance with the specified interface dimensions

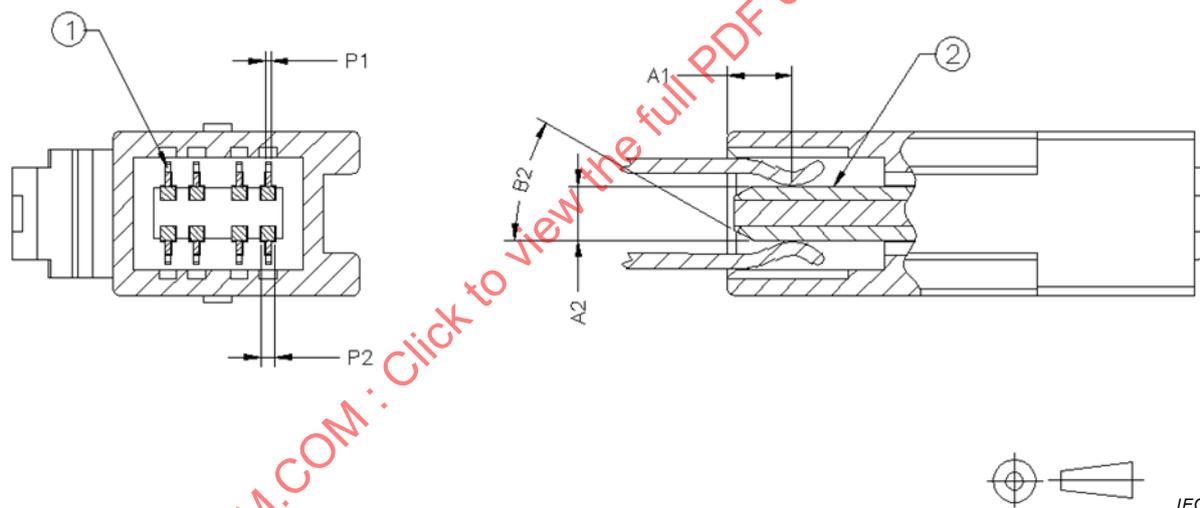
4 Common features and typical connector pair

4.1 Mating information

4.1.1 General

Dimensions are given in millimetres. Drawings are shown in third-angle projection. The shape of connectors may deviate from those given in Figures 1 to 4 and Tables 1 to 3 as long as the dimensions specified are not changed.

4.1.2 Contacts – mating conditions



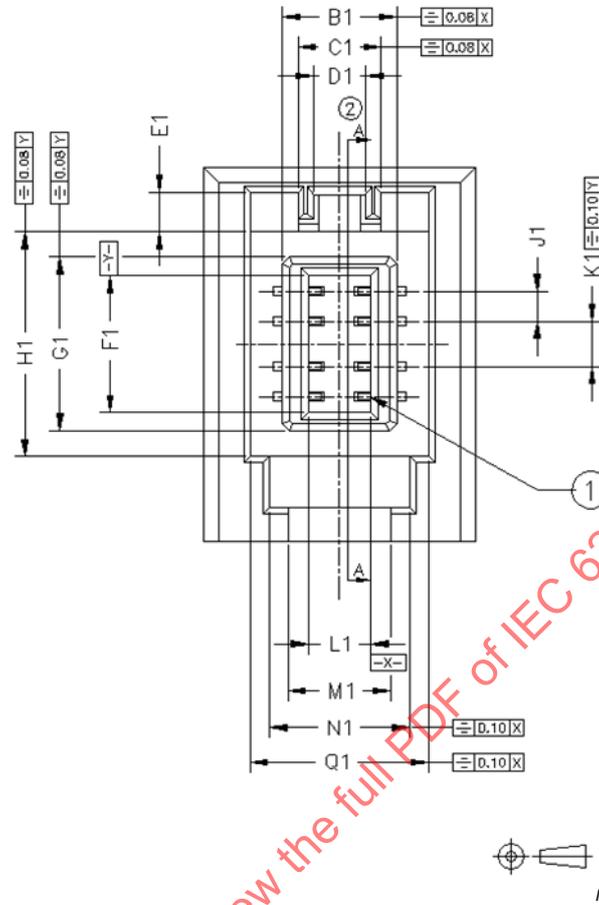
Letter	Minimum	Nominal (ref.)	Maximum
	mm	°	mm
A1	2,00		2,50
A2	1,82		1,98
B2		30°	
P1	0,19		0,21
P2	0,38		0,51

Key

- 1 Female contact of fixed connector. The mating information shown can only be achieved when a free connector is mated with a fixed connector, see the cross-section on the right, taken at the center of two opposite contacts.
- 2 Burrs shall not project above the top of the contact in this area, since it may be a contact area.

Figure 1 – Contact interface dimensions with terminated free connector

4.1.3 Fixed connector

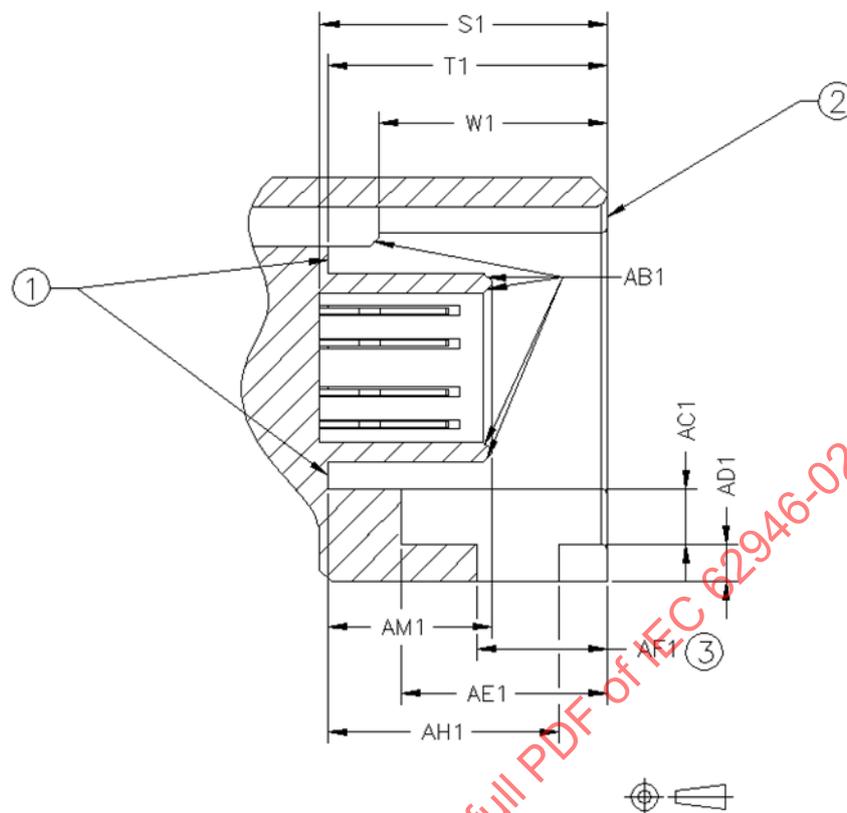


Letter	Minimum mm	Nominal (ref.) mm or °	Maximum mm
B1	3,75		3,85
C1	2,72		2,78
D1	1,72		1,78
E1	1,25		1,35
F1	4,55		4,61
G1	5,77		5,83
H1	7,45		7,50
J1		1	
K1	1,45		1,55
L1	2,00		2,10
M1	3,35		3,45
Q1	5,85		5,95

Key

- 1 Contact zone. Contacts shall be completely within their individual contact zone in the area indicated.
- 2 Section A-A: see Figure 3.

Figure 2 – View of contact zone



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Letter	Minimum mm	Nominal (ref.) mm or °	Maximum mm
S1	8,75		8,85
T1	8,50		8,60
W1	6,95		7,05
AB1		0,25 × 45°	
AC1	1,62		1,78
AD1		1,13	
AE1	6,25		6,35
AF1	3,95		4,05
AH1	7,01		7,11
AM1	4,95		5,05

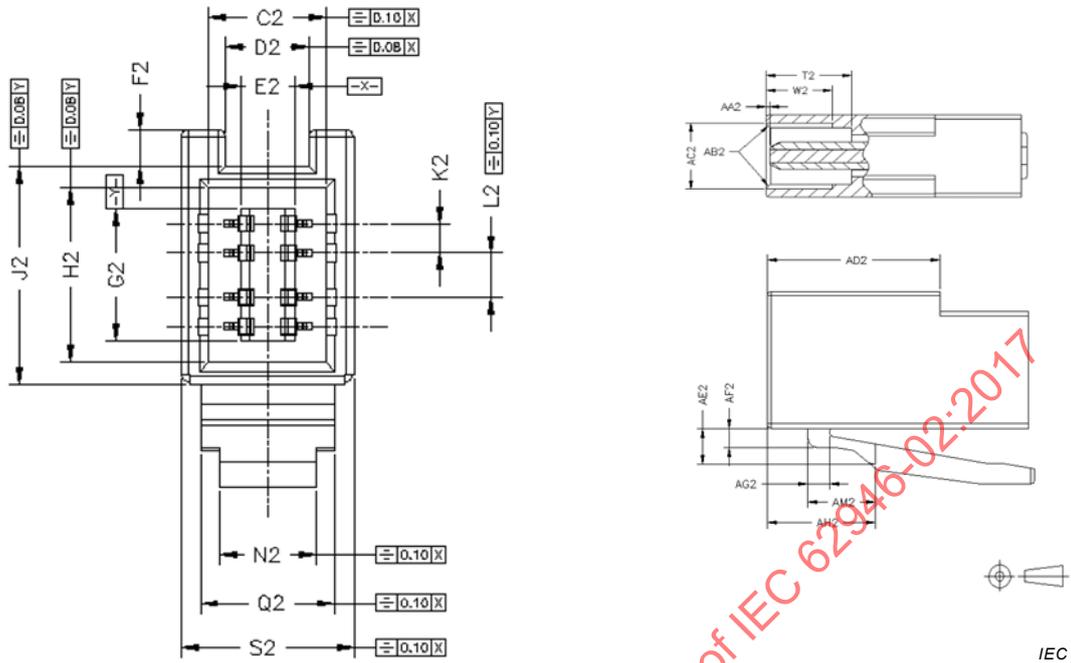
Key

- 1 Preferred free connector stop.
- 2 This surface needs 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.
- 3 Projections beyond AH1 dimension shall not prevent finger access to the free connector locking device.

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

Figure 3 – View of contact zone section A-A

4.1.4 Free connector



Letter	Minimum mm	Nominal (ref.) mm or °	Maximum mm
C2	3,92		3,98
D2	2,78		2,88
E2	1,75		1,85
F2	1,22		1,28
G2	4,45		4,51
H2	5,93		5,99
J2	7,33		7,39
K2	0,95		1,05
L2	1,45		1,55
N2	3,20		3,30
Q2	4,45		4,55
S2	5,75		5,85
T2	5,37		5,63
W2		4,25	
AA2	0,12		0,38
AB2		0,30 x 45°	
AC2		4,65	
AD2		10,85	
AE2	2,17		2,33
AF2	1,07		1,33
AG2	1,22		1,48
AM2	4,17		4,33
AH2	6,75		6,85

Figure 4 – Free connector view

5 Characteristics

5.1 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.

5.2 Pin and pair grouping assignment

For those specifications where pin and pair groupings are relevant, the pin and pair grouping assignments shall be as shown in Figure 5 unless otherwise specified.

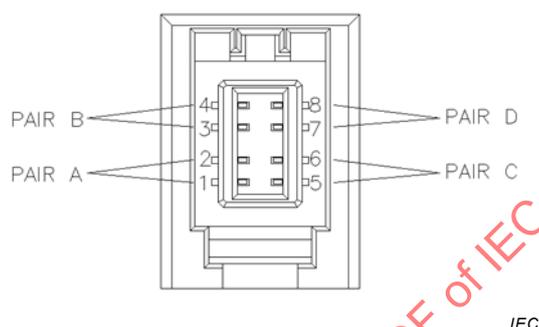


Figure 5 – Fixed connector pin and pair grouping assignment (front view of connector)

5.3 Classification into climatic category

The temperature range and severity of the damp heat, steady state test shall be at least as those given in Table 1, which are compatible in excess with ISO/IEC 11801 classification of an office environment.

Table 1 – Climatic categories – selected values

Climatic category	Lower temperature	Upper temperature	Damp heat, steady state
	°C	°C	days
40/090/21	-40	90	21

5.4 Electrical characteristics

5.4.1 General

The product is designed for data transmission up to 250 MHz and has current carrying capacity up to 1 A.

5.4.2 Creepage and clearance distances

The permissible ELV operating voltages depend on the application and also on the specified safety requirements.

Safety requirements for this connector are described in IEC 61984.

The creepage and clearance distances in Table 5 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 2 – Creepage and clearance distances

Minimum distance between contacts and chassis		Minimum distance between adjacent contacts	
Creepage mm	Clearance mm	Creepage mm	Clearance mm
1,40	0,51	0,40	0,40

5.4.3 Contact resistance

Conditions: IEC 60512-2-1, Test 2a

Mated connectors
20 mΩ maximum.

5.4.4 Voltage proof

Conditions: IEC 60512-4-1, Test 4a

Mated connectors

All variants: 250 V d.c.; one contact to all other contacts connected together and all contacts to ground plane.

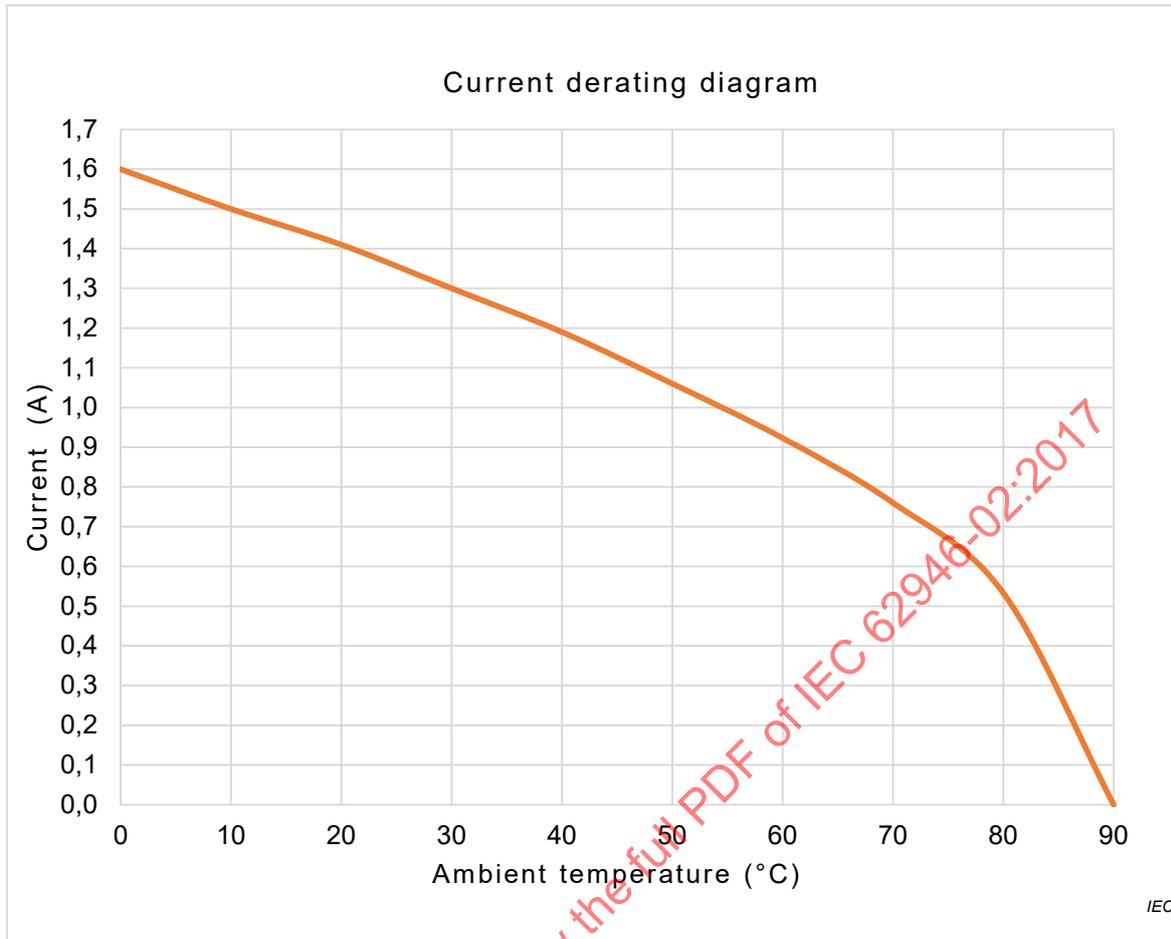
5.4.5 Current-temperature derating

Conditions: IEC 60512-5-2, Test 5b

All contacts, connected in series

The current-carrying capacity of connectors in accordance with this specification shall comply with the de-rating curve given in Figure 6.

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NOTE 1 The maximum permissible current for a given ambient temperature (t) is: $I_{(t)} = 1,6 \cdot \left(1 - \frac{t}{90}\right)^{0,5}$.

NOTE 2 For ambient temperatures lower than 0 °C, the maximum permissible current is 1,6 A.

Figure 6 – Connector de-rating curve

5.4.6 Initial insulation resistance

Conditions: IEC 60512-3-1, Test 3a

Method A

Mated connectors

Test voltage: 500 V d.c.

All types: 500 MΩ minimum initial, 250 MΩ minimum after test.

5.4.7 Input to output d.c. resistance

Conditions: IEC 60512-2-1, Test 2a

Mated connectors

Connection points: Cable termination to cable termination

All types: 200 mΩ maximum.

5.4.8 Input to output d.c. resistance unbalance

Conditions: IEC 60512-2-1, Test 2a

Mated connectors

Connection points: Cable termination to cable termination

Among all signal conductors, maximum difference between maximum and minimum

All types: 50 mΩ maximum.

5.4.9 Transfer impedance

Not applicable.

5.5 Transmission characteristics

5.5.1 General

Compliance to this document, in respect to transmission characteristics, is determined according to specific test methods described in test group GP.

All transmission performance requirements apply between the reference planes specified in IEC 60512-26-100.

All transmission results shall be reported as worst case overall result for the corresponding pair or pair combination after testing all samples.

NOTE In the following subclauses f is the frequency, expressed in MHz.

5.5.2 Insertion loss (IL)

Conditions: IEC 60512-26-100, Test 26a

Mated connectors

All pairs: $\geq 0,02x\sqrt{f}$ dB from 1 MHz to 250 MHz.

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

5.5.3 Return loss (RL)

Conditions: IEC 60512-26-100, Test 26b

Mated connectors

All pairs: $\geq 64-20 \log(f)$ dB from 1 MHz to 250 MHz .

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

5.5.4 Near end cross talk (NEXT)

Conditions: IEC 60512-26-100, Test 26c

Mated connectors

All pair combinations: $\geq 94-20 \log(f)$ dB up to 250 MHz .

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

5.5.5 Far end cross talk (FEXT)

Conditions: IEC 60512-26-100, Test 26d

Mated connectors

All pair combinations: $\geq 83,1-20 \log(f)$ dB from 1 MHz to 250 MHz .

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

5.5.6 Transverse conversion loss (TCL)

Conditions: IEC 60512-26-100, Test 26f

Mated connectors

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 250 MHz .

Transfer conversion loss at frequencies that correspond to calculated values of greater than 50 dB shall revert to a minimum requirement of 50 dB.

5.5.7 Transverse conversion transfer loss (TCTL)

Conditions: IEC 60512-26-100, Test 26g

Mated connectors

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 250 MHz.

Transfer conversion transfer loss at frequencies that correspond to calculated values of greater than 50 dB shall revert to a minimum requirement of 50 dB.

5.5.8 Propagation delay

All pairs: $\geq 2,5$ ns.

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

5.5.9 Delay skew

All pair combinations: $\geq 1,25$ ns.

NOTE This characteristic is calculated from the individual propagation delay measurements and, as with propagation delay (5.5.8), it is assumed that connectors comply by design.

5.6 Mechanical characteristics

5.6.1 Mechanical operation

Conditions: IEC 60512-9-1, Test 9a

Speed: 10 mm/s maximum

Rest: 1 s minimum (mated and unmated)

250 operations.

5.6.2 Insertion and withdrawal forces

Conditions: IEC 60512-13-2, Test 13b

Speed: maximum rate of 12,7 mm per minute

All types, insertion and withdrawal: 20 N maximum.

6 Tests and test schedule

6.1 General

This document states the test sequence (in accordance with this document) and the number of specimens for each test sequence.

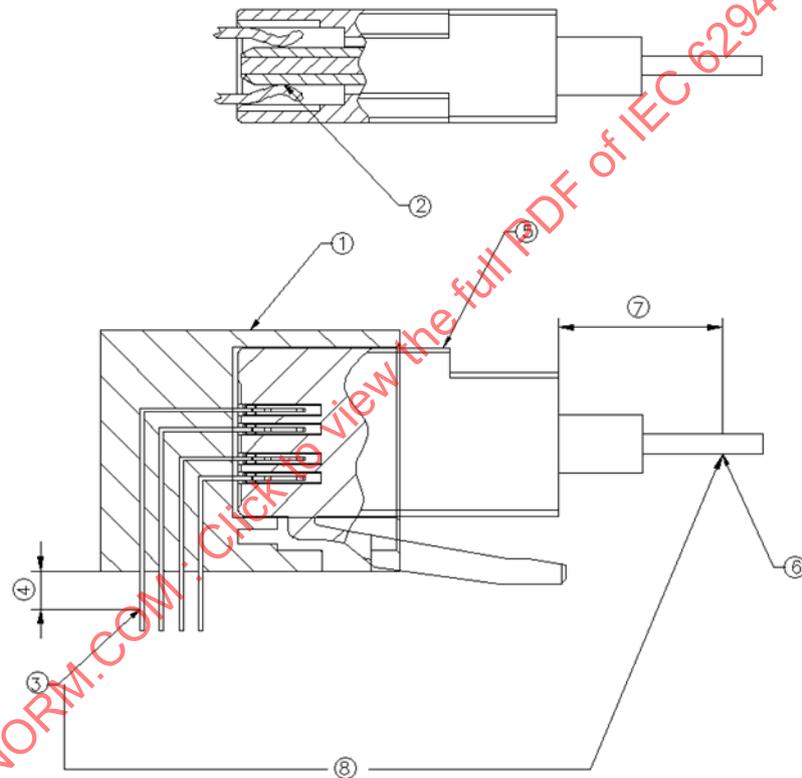
Individual variants may be submitted to type tests for approval of those particular variants.

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 validated against the dimensional requirements and test sequences specified in this document.

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; so that, when un-mating is necessary for a certain test, the same connectors shall be mated for subsequent tests.

6.2 Arrangement for contact resistance measurement



IEC

Key

- 1 Fixed connector.
- 2 Point B.
- 3 Point A. Measure the DC resistance across each of the 8 signal pins.
- 4 As short as practical (except for vibration test EP5, see 6.6.2.7).
- 5 Free connector.
- 6 Point C.
- 7 As short as practical (except for vibration test EP5, see 6.6.2.7).
- 8 Contact resistance measurement points.

Figure 7 – Arrangement for contact resistance measurement

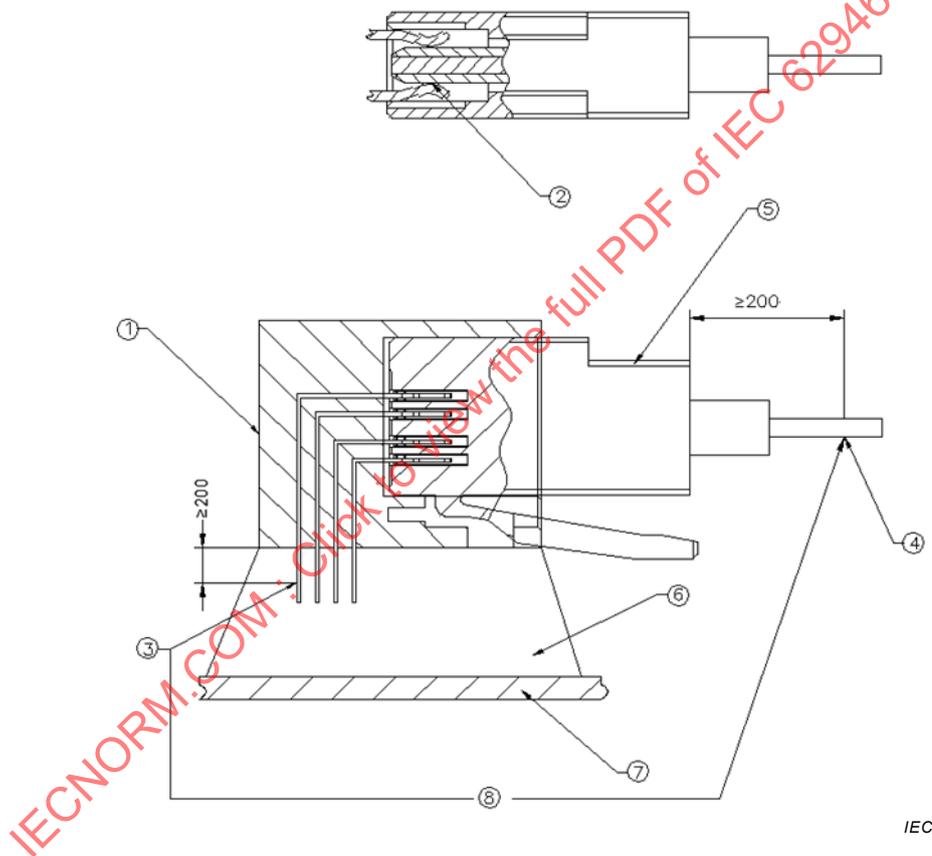
The test procedure is as follows.

- Determine the resistance of the fixed connector between points A and B of Figure 7 by calculation or by measurement. This resistance is noted and recorded as R_{AB} .
- Determine the resistance of the free connector between points B and C of Figure 7 by calculation or by measurement. This resistance is noted and recorded as R_{BC} .
- 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 and recorded as R_{AC} .
- Calculate the contact resistance by subtracting the sum of the bulk resistance of the fixed and free connectors from the total mated connector resistance.

$$\text{Contact resistance} = R_{AC} - (R_{AB} + R_{BC})$$

where “I” indicates initial value.

6.3 Arrangement for vibration test (test phase EP5), see Figure 8



Key

- Fixed connector vibration feature.
- Contact point.
- Point A: secure to the non-vibrating member, measure the DC resistance across each of the 8 signal pins.
- Point B: secure to the non-vibrating member.
- Free connector.
- Fixed connector rigidly fixed to the mounting plate.
- Mounting plate.
- Contact resistance measurement points (dimensions in mm).

Figure 8 – Arrangement for vibration test

6.4 Test procedures and measuring methods

The test methods specified and given in the relevant standards are the preferred methods but not necessarily the only ones that can be used. In case of dispute, however, the specified method shall be used as 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 give results equivalent to those obtained by the methods specified in this document.

6.5 Preconditioning

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

6.6 Test schedules

6.6.1 Basic (minimum) test schedule

Not applicable.

6.6.2 Full test schedule

6.6.2.1 General

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

For a complete test sequence, 25 specimens are needed (Test groups AP, BP, CP, EP and GP shall each consist of 3 specimens. Test group DP shall consist of 6 specimens and test group FP consist of 4 specimens).

Contact resistance tests apply only to the interface (see 6.2).

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6.6.2.2 Test group P – preliminary

All the specimens of test groups AP – GP shall be subjected to the preliminary group P tests in the following sequence; see Table 3.

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 in Tables 4 to 10.

Table 3 – Test group P – Preliminary

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 test no	Severity or condition of test	Title	IEC 60512 test no	Requirements
P1	General examination			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
P2	Contact resistance		All contacts/specimens	Low level contact resistance	2a	20 mΩ maximum
P3			500 V d.c., 2 min hold	Insulation resistance	3a	500 MΩ minimum
P4	Withstanding voltage		Contact/contact		4a	Subject specimens to 250 V d.c. between adjacent contacts. No breakdown or flashover.
			All contacts to test panel		4a	Subject specimens to 500 V d.c. between bridged signal contacts on plug and board side and ground panel. 1 mA cutoff, 200 V per second ramp. No breakdown or flashover.

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6.6.2.3 Test group AP – Mechanical endurance

Table 4 – Test group AP – Mechanical endurance

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test no	Severity or condition of test	Title	IEC 60512 Test no	Requirements
AP1	General examination			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
AP2	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	20 mΩ maximum
AP3	Mating / unmating force	13a	Measure the force necessary to mate / unmate individual ports at a maximum rate of 12,7 mm per minute			20 N maximum
AP4	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum
AP5	Temperature life	11i	Subject mated specimens to a temperature of 90 °C during 7 days			Meet visual requirements, show no physical damage.
AP6	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum
AP7	Mechanical operation	9c	Mate and unmate the specimens for 50 cycles at a max. rate of 200 cycles/hour (18 s max. duty cycle, e.g. 9 s mated, 9 s unmated).			Meet visual requirements, show no physical damage
AP8	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum
AP9	Mating / unmating force	13a	Measure the force necessary to mate / unmate the specimens at a max. rate of 12,7 mm per minute			20 N maximum
AP10	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum

6.6.2.4 Test group BP – Climatic

Table 5 – Test group BP – Climatic

Test phase	Test			Measurement to be performed		
	Title	IEC 60512 Test no	Severity or condition of test	Title	IEC 60512 Test no	Requirements
BP1	General examination			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
BP2	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	20 mΩ maximum
BP3	Rapid change of temperature	11d	Subject mated specimens to 10 cycles between -40 °C and 60 °C with 30 min dwell at temp. extremes and 1 min transition between temperatures			Meet visual requirements, show no physical damage.
BP4	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum
BP5	Damp heat cyclic	11m	Subject mated specimens to 10 cycles (10 days) between 25 °C and 60 °C at 80 % to 100 % RH			Meet visual requirements, show no physical damage.
BP6	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum