

INTERNATIONAL STANDARD



**Connectors for electrical and electronic equipment –
Part 01: Rectangular connectors – Detail specification for 8-way, shielded, free
and fixed high density connectors for data transmission with frequencies up to
100 MHz and with current carrying capacity up to 1 A**

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CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –**Part 01: Rectangular connectors – Detail specification for 8-way, shielded, free and fixed high density connectors for data transmission with frequencies up to 100 MHz and with current carrying capacity up to 1 A**

FOREWORD

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International Standard IEC 62946-01 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/2626/FDIS	48B/2654/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, published under the general title *Connectors for electrical and 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

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INTRODUCTION

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

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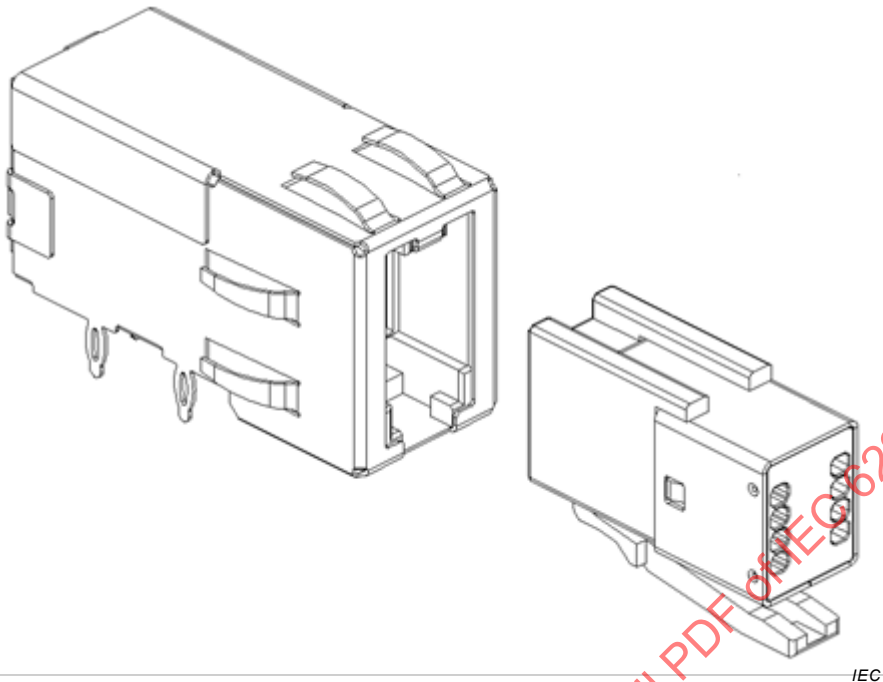
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	IEC 62946-01:2018
Subcommittee 48B: Electrical connectors	
	8-way, shielded, free and fixed high density connectors for data transmission for frequencies up to 100 MHz and with current carrying capacity up to 1 A.
	Fixed connectors are mounted on printed circuit board, the free connector is attached to wires.

CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –

Part 01: Rectangular connectors – Detail specification for 8-way, shielded, free and fixed high density connectors for data transmission with frequencies up to 100 MHz and with current carrying capacity up to 1 A

1 Scope

This part of IEC 62946 covers 8-way shielded connectors, and is intended to specify the common dimensions, mechanical, electrical and environmental characteristics and tests for the family of IEC 62946-01 connectors.

These connectors are intermateable and interoperable with other IEC 62946 series 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 – Part 581: Electromechanical components for electronic equipment*

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

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

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

IEC 60512-1-2, *Connectors for electronic equipment – Tests and measurements – Part 1-2: General examination – Test 1b: Examination of dimension and mass*

IEC 60512-2-1, *Connectors for electronic equipment – Tests and measurements – Part 2-1: Electrical continuity and contact resistance tests – Test 2a: Contact resistance – Millivolt level method*

IEC 60512-3-1, *Connectors for electronic equipment – Tests and measurements – Part 3-1: Insulation tests – Test 3a: Insulation resistance*

IEC 60512-4-1, *Connectors for electronic equipment – Tests and measurements – Part 4-1: Voltage stress tests – Test 4a: Voltage proof*

IEC 60512-5-2, *Connectors for electronic equipment – Tests and measurements – Part 5-2: Current-carrying capacity tests – Test 5b: Current-temperature derating*

IEC 60512-6-3, *Connectors for electronic equipment – Tests and measurements – Part 6-3: Dynamic stress tests – Test 6c: Shock*

IEC 60512-6-5, *Electromechanical components for electronic equipment – Basic testing procedures and measuring methods – Part 6: Dynamic stress tests – Section 5: Test 6e: Random vibration*

IEC 60512-9-1, *Connectors for electronic equipment – Tests and measurements – Part 9-1: Endurance tests – Test 9a: Mechanical operation*

IEC 60512-9-3, *Connectors for electronic equipment – Tests and measurements – Part 9-3: Endurance tests – Test 9c: Mechanical operation (engaging and separating) with electrical load*

IEC 60512-11-4, *Connectors for electronic equipment – Tests and measurements – Part 11-4: Climatic tests – Test 11d: Rapid change of temperature*

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

IEC 60512-11-9, *Connectors for electronic equipment – Tests and measurements – Part 11-9: Climatic tests – Test 11i: Dry heat*

IEC 60512-11-12, *Connectors for electronic equipment – Tests and measurements – Part 11-12: Climatic tests – Test 11m: Damp heat, cyclic*

IEC 60512-13-1, *Connectors for electronic equipment – Tests and measurements – Part 13-1: Mechanical operation tests – Test 13a: Engaging and separating forces*

IEC 60512-13-2, *Connectors for electronic equipment – Tests and measurements – Part 13-2: Mechanical operation tests – Test 13b: Insertion and withdrawal forces*

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

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 61076-1 and IEC 60512-1 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>

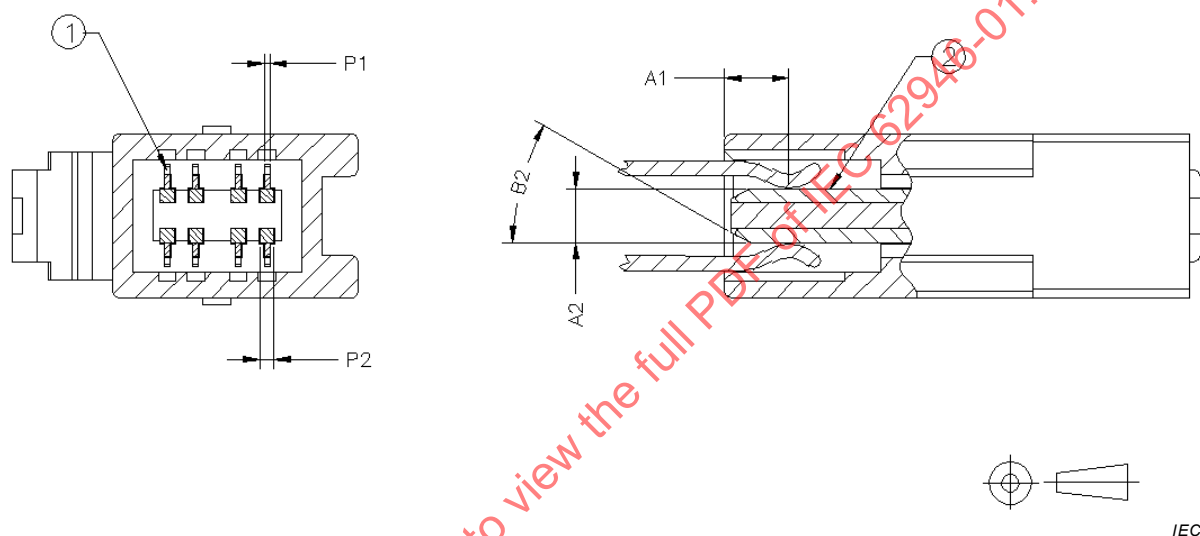
4 Mating information

4.1 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 but the dimensions specified shall not be changed.

4.2 Contacts – mating conditions

Figure 1 shows on the right a side view of a free male connector, partially sectioned in the contact area, and only the mating female contact portion of the corresponding fixed female connector. On the left it shows a cross-section of said free male connector in the same contact area, and the cross-section of the mating female contacts (key 1). It identifies only those dimensions which are relevant for the correct contact interfacing, provided in Table 1.



Key

- 1 Female contact of fixed connector. The mating information shown can only be achieved with a free connector with a cable attached.
- 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

Table 1 – Dimensions for Figure 1

(Dimensions in millimetres)

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

4.3 Fixed female connector

Figure 2 provides two front views of the fixed female connector. The first view (Figure 2a)) shows its main part (i.e. without shield), for better addressing of all relevant dimensions provided in Table 2. The second view (Figure 2b)) shows the same as Figure 2a) dressed with the shielding, in order to provide the shielding relevant dimensions also provided in Table 2.

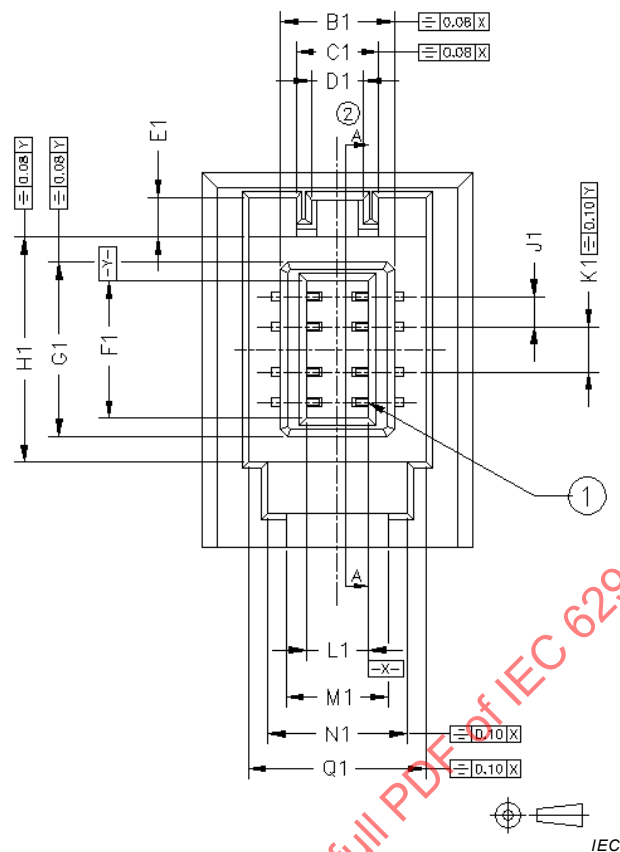


Figure 2a) View of fixed female connector without shielding

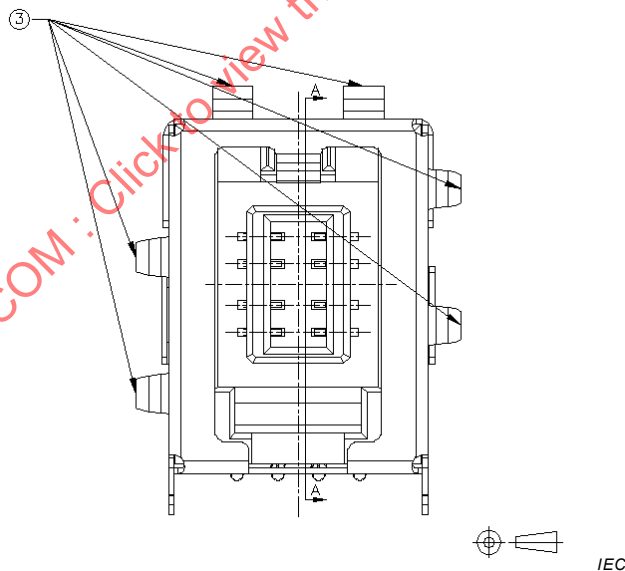


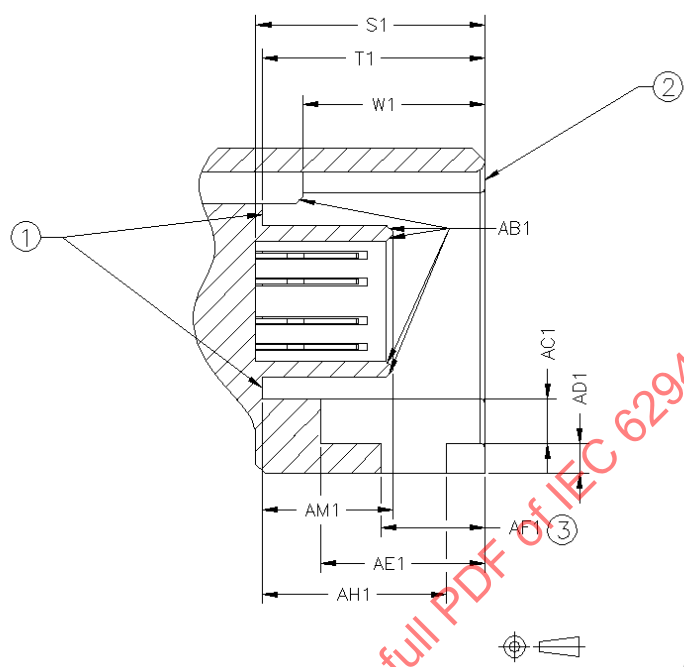
Figure 2b) View of fixed female connector with shielding

Key

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

Figure 2 – Fixed female connector, view of contact zone

Figure 4 provides two views of the fixed female connector section A-A as identified in Figure 3. The first view (Figure 4a)) shows its main part (i.e. without shield), for better addressing of all relevant dimensions provided in Table 2. The second view (Figure 4b)) shows the same as Figure 4a) dressed with the shielding, in order to provide the shielding relevant dimensions also provided in Table 2.



Key

- 1 Preferred free connector stop.
- 2 This surface need not be planar or coincident with the surface below the locking device, but the insertion, latching and unlatching of free connectors shall not be inhibited.
- 3 Projections beyond AF1 dimension shall not prevent finger access to the free connector locking device.
- 4 Preferred springs height and positions. Dimensions shall be checked at tangent point of bends.
- 5 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

Table 2 – Dimensions for Figures 2 and 3*(Dimensions in millimetres)*

Letter	Minimum	Nominal (ref.)	Maximum
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		0,75	
L1	2,00		2,10
M1	3,35		3,45
Q1	5,85		5,95
S1	8,75		8,85
T1	8,50		8,60
W1	6,95		7,05
AB1		0,25 x 45°	
AC1	9,15		9,25
AD1		1,13	
AE1	6,25		6,35
AF1	3,95		4,05
AH1	7,01		7,11
AK1	0,85		0,95
AL1	0,87		0,97
AM1	4,95		5,05
AN1		7,46	
AP1		7,91	
AQ1		3,61	
AR1	1,65		1,75

4.4 Free male connector

Figure 4 provides two sets of views of the free male connector. The first set of views (Figure 4a)) shows its main part (i.e. without shield), for better addressing of all relevant dimensions provided in Table 3. The second set of views (Figure 4b)) shows the same as Figure 4a) dressed with the shielding, in order to provide the shielding relevant dimensions also provided in Table 3.

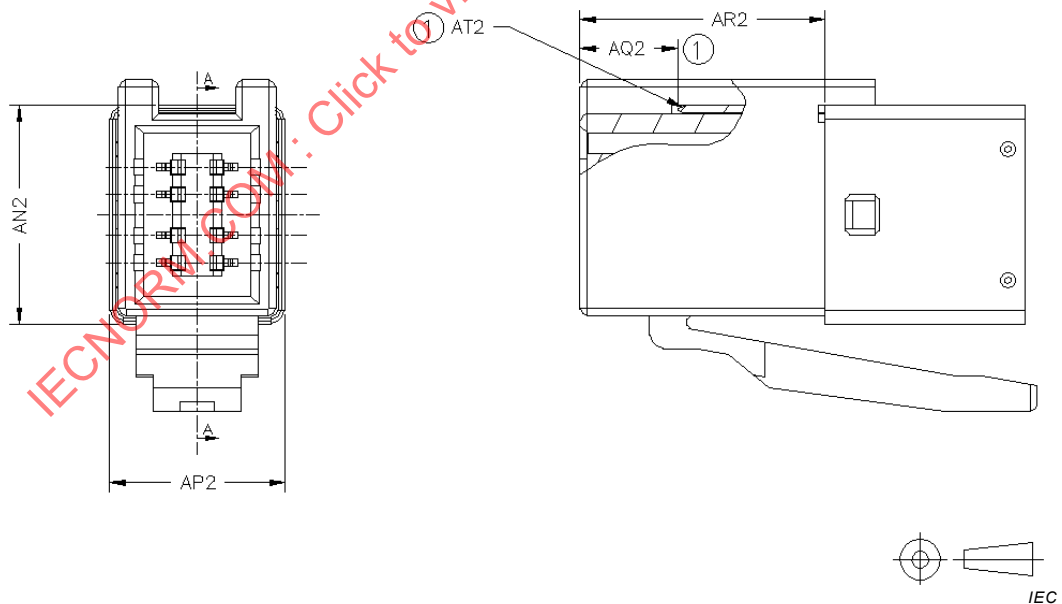
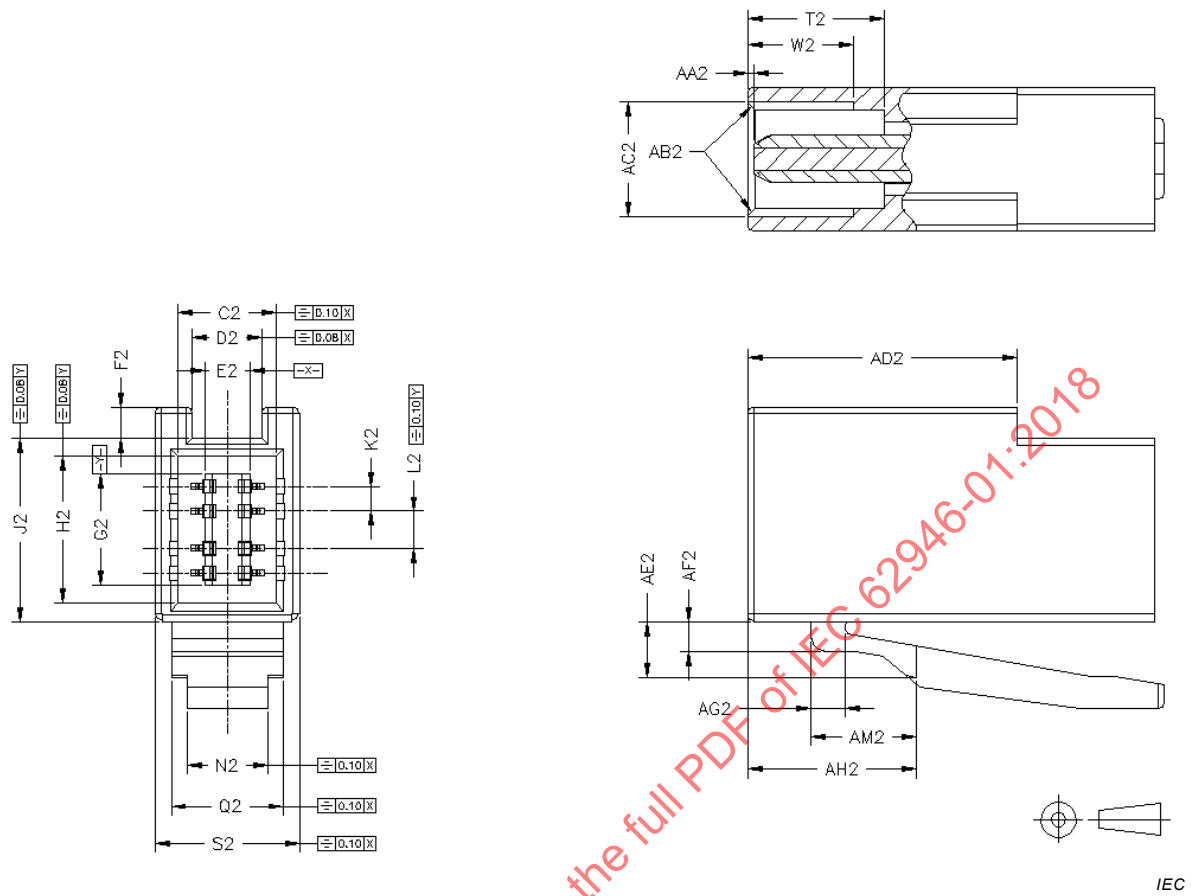


Figure 4 – Free male connector, view of contact zone

Table 3 – Dimensions for Figure 4*(Dimensions in millimetres)*

Letter	Minimum	Nominal (ref.)	Maximum
C2	3,92		3,98
D2	2,75		2,85
E2	1,77		1,83
F2	1,22		1,28
G2	4,47		4,53
H2	5,92		5,98
J2	7,37		7,43
K2		1	
L2		0,75	
N2	3,20		3,30
Q2	4,45		4,55
S2	5,75		5,85
T2	5,37		5,63
W2	4,20		4,30
AA2	0,20		0,30
AB2		0,30 x 45°	
AC2	4,55		4,75
AD2		10,85	
AE2	2,17		2,33
AF2	1,07		1,33
AG2	1,22		1,48
AH2	6,75		6,85
AM2	4,17		4,33
AN2	7,88		8,12
AP2	6,33		6,57
AQ2	3,47		3,73
AR2		9,00	
AT2		C 0,1 x 0,3	

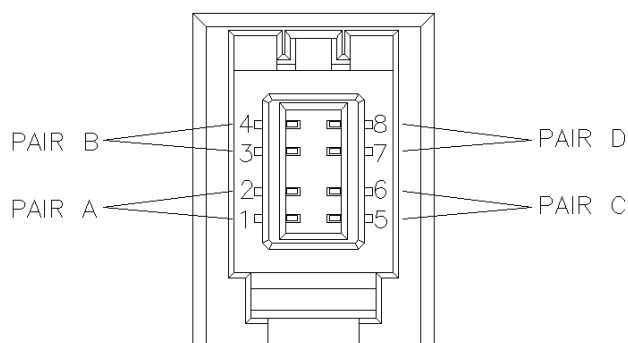
5 Characteristics

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.



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Figure 5 – Fixed female connector pin and pair grouping assignment, front view of connector (and conversely for the free male connector)

5.3 Classification into climatic category

The lowest and highest temperatures and the duration of the damp-heat steady-state test shall be selected from the preferred values stated in Subclause 2.3 of IEC 61076-1:2006. The connectors are classified into climatic categories in accordance with the general rules given in IEC 60068-1. The temperature range and severity of the damp heat, steady state test given in Table 4 are compatible with ISO/IEC 11801 classification of an office environment.

Table 4 – Climatic categories – selected values

Climatic category	Lower temperature °C	Upper temperature °C	Damp heat, steady state days
40/090/21	-40	70	-

5.4 Electrical characteristics

5.4.1 Voltage proof

Conditions shall be in accordance with IEC 60512-4-1, Test 4a, Standard atmospheric conditions.

Mated connectors.

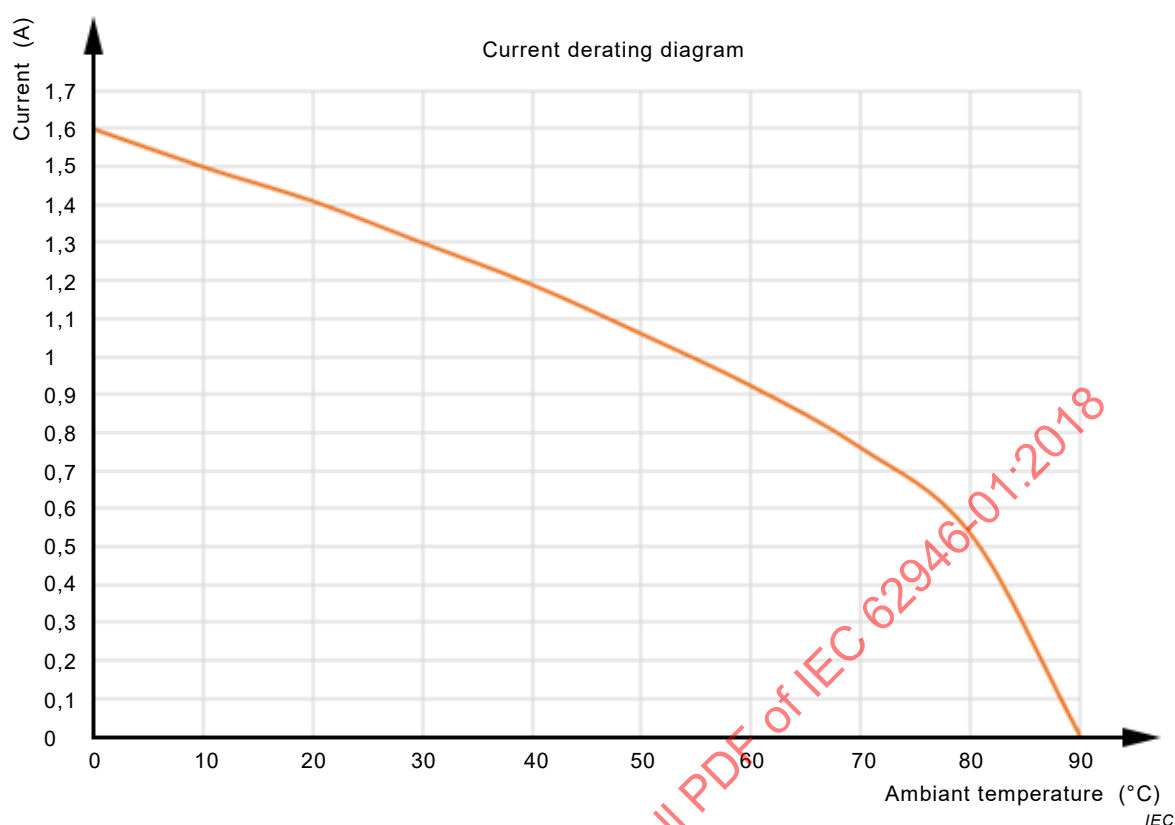
All variants: 500 V DC; one contact to all other contacts connected together.
2 250 V DC; between bridged signal contacts on plug and board side and earth shield.

5.4.2 Current-temperature derating

Conditions shall be in accordance with IEC 60512-5-2, Test 5b.

All contacts, connected in series

The current-carrying capacity of connectors in accordance with the requirements of Subclause 2.5 of IEC 61076-1:2006 shall comply with the de-rating curve given in Figure 6.



- 1 The maximum permissible current for a given ambient temperature (t) shall be:

$$I(t) = 1.6 \left(1 - \frac{t}{90} \right)^{0.5}$$

- 2 For ambient temperatures lower than 0 °C, the maximum permissible current shall be 1,6 A.

Figure 6 – Connector de-rating curve

5.4.3 Initial insulation resistance

Conditions shall be in accordance with IEC 60512-3-1, Test 3a.

Method A.

Mated connectors.

Test voltage: 500 V d.c.

All types: 500 MΩ minimum.

5.5 Transmission characteristics

5.5.1 General

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

All transmission performance requirements shall 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.

5.5.2 Insertion loss

Conditions shall be in accordance with IEC 60512, test 26a.

Mated connectors.

All pairs: $\geq 0,04 \times \sqrt{f}$ dB from 1 MHz to 100 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

Conditions shall be in accordance with IEC 60512, test 26b.

Mated connectors.

All pairs: $\geq 60 - 20 \log(f)$ dB from 1 MHz to 100 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

Conditions shall be in accordance with IEC 60512, test 26c.

Mated connectors.

All pair combinations: $\geq 83 - 20 \log(f)$ dB from 1 MHz to 100 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

Conditions shall be in accordance with IEC 60512, test 26d.

Mated connectors.

All pair combinations: $\geq 75,1 - 20 \log(f)$ dB from 1 MHz to 100 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

Conditions shall be in accordance with IEC 60512, test 26f.

Mated connectors.

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 100 MHz.

TCL at frequencies that correspond to calculated values of greater than 40 dB shall revert to a minimum requirement of 40 dB.

5.5.7 Transfer conversion transfer loss

Conditions shall be in accordance with IEC 60512, test 26g.

Mated connectors.

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 100 MHz.

TCTL at frequencies that correspond to calculated values of greater than 40 dB shall revert to a minimum requirement of 40 dB.

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 12,5 mm per minute.
All types, insertion and withdrawal: 20 N maximum.

6 Tests and test schedule

6.1 General

This clause states the test sequence and gives the numbers of specimens for each test sequence.

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

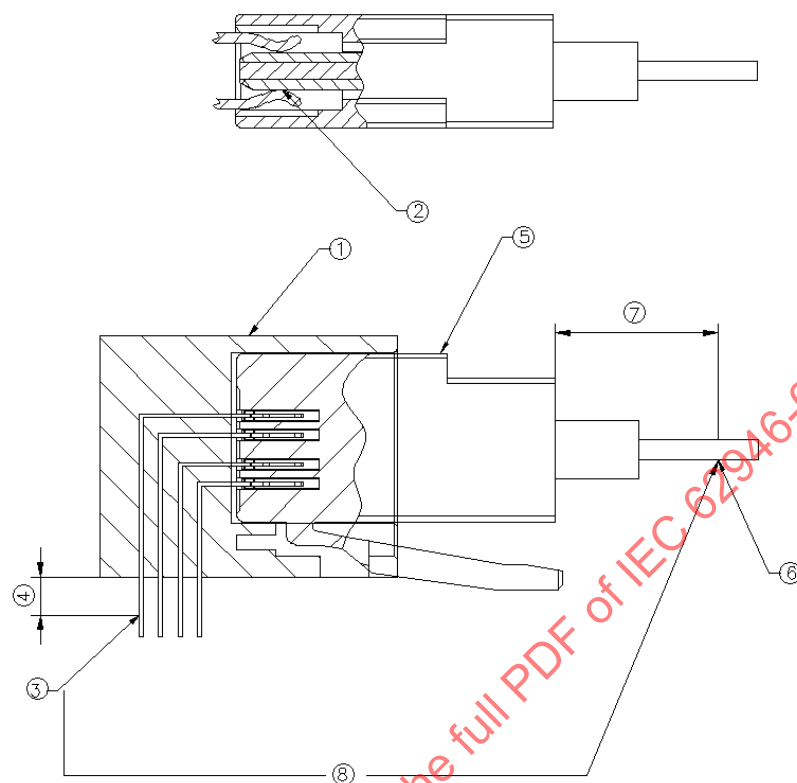
It is permissible to limit the number of variants tested to a selection representative of the whole range for which approval is required (which may be less than the range covered by the detail specification), but each feature and characteristic shall be validated against the dimensional requirements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

6.2.1 General



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Key

- 1 Fixed connector.
- 2 Point B.
- 3 Point A. The DC resistance shall be measured across each of the 8 signal pins.
- 4 The distance shall be as short as practical (except for vibration test EP5, see 6.3).
- 5 Free connector.
- 6 Point C.
- 7 The distance shall be as short as practical (except for vibration test EP5, see 6.3).
- 8 Contact resistance measurement points.

Figure 7 – Arrangement for contact resistance measurement

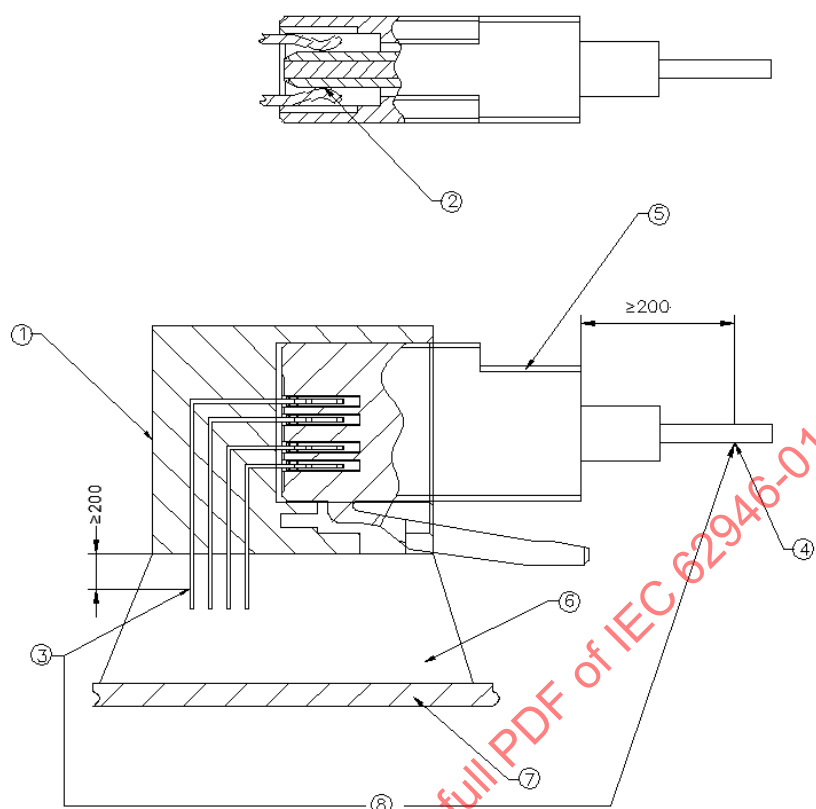
6.2.2 Contact resistance calculation method

- a) Determine the bulk resistance of the fixed connector between points A and B of Figure 7 by calculation or by measurement. This resistance shall be noted and recorded as R_{AB} .
- b) Determine the bulk resistance of the free connector between points B and C of Figure 7 by calculation or by measurement. This resistance shall be noted and recorded as R_{BC} .
- c) Measure the total mated connector resistance between points A and C, following the requirements and procedures of IEC 60512-2-1, Test 2a. This resistance shall be noted and recorded as 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.

$$\text{Contact resistance} = R_{AC} - (R_{ABi} + R_{BCi})$$

where I indicates initial value.

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



IEC

Key

- 1 Fixed connector vibration feature.
- 2 Contact point.
- 3 Point A shall be secured to the non-vibrating member, the DC resistance shall be measured across each of the 8 signal pins.
- 4 Point C shall be secured to the non-vibrating member.
- 5 Free connector.
- 6 Fixed connector shall be rigidly fixed to the mounting plate.
- 7 Mounting plate.
- 8 Contact resistance shall be measured at these points.

Figure 8 – Arrangement for vibration test

6.4 Test procedures and measuring methods

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 General

The test parameters required shall not be less than those listed in Clause 5.

6.6.2 Basic (minimum) test schedule

Not applicable.

6.6.3 Full test schedule

6.6.3.1 General

The following tests specify the characteristics which shall be checked and the requirements which shall 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. Test group FP consist of 4 specimens).

6.6.3.2 Test group P – preliminary

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; see Table 9.

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. See Tables 5 to 12.

Table 5 – 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
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 DC, 2 min hold	Insulation resistance	3a	500 MΩ minimum
P4			Subject all contacts to test panel Subject specimens to 2 250 V DC between bridged signal contacts on plug and board side and ground shield	Voltage proof	4a	No breakdown or flashover

6.6.3.3 Test group AP – Mechanical endurance**Table 6 – Test group AP**

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	1a	The dimensions shall comply with those specified in Clause 4
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 85 °C during 7 days			Shall meet visual requirements and 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			Shall meet visual requirements and 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 12,5 mm per minute			20 N maximum
AP10	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum

6.6.3.4 Test group BP – Climatic

Table 7 – 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
BP1	General examination			Visual examination	1a	There shall be no defects that would impair normal operation
				Examination of dimensions and mass	1a	The dimensions shall comply with those specified in Clause 4
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 minute transition between temperatures			Shall meet visual requirements and 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			Shall meet visual requirements and show no physical damage
BP6	Contact resistance		All contacts/specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum

6.6.3.5 Test group CP – Corrosion**Table 8 – 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
CP1	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 Clause 4
CP2	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	20 mΩ maximum
CP3	Mixed flowing gas corrosion	11g	Subject mated specimens to an environment according to Method 4 of IEC 60512-11-7 for 14 days (unmated for 7 days, then mated for 7 days)			Shall meet visual requirements and show no physical damage
CP4	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	ΔR 20 mΩ maximum