

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD



**Connectors for electronic equipment – Product requirements –
Part 3-124: Detail specification for 10 way, shielded, free and fixed connectors
for I/O and Gigabit transmission capability for industrial applications**



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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONNECTORS FOR ELECTRONIC EQUIPMENT – PRODUCT REQUIREMENTS –

Part 3-124: Detail specification for 10 way, shielded, free and fixed connectors for I/O and Gigabit transmission capability for industrial applications

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IEC PAS 61076-3-124 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 PAS is based on the following document:

This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document

Draft PAS	Report on voting
48B/2508/PAS	48B/2528/RVC

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

A list of all parts of IEC 61076 series, under the general title *Connectors for electronic equipment – Product requirements*, can be found on the IEC website.

This PAS shall remain valid for an initial maximum period of 3 years starting from the publication date. The validity may be extended for a single period up to a maximum of 3 years, at the end of which it shall be published as another type of normative document, or shall be withdrawn.

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CONNECTORS FOR ELECTRONIC EQUIPMENT – PRODUCT REQUIREMENTS –

Part 3-124: Detail specification for 10 way, shielded, free and fixed connectors for I/O and Gigabit transmission capability for industrial applications

1 Scope

This part of IEC 61076 covers 10-way shielded free and fixed connectors and specifies the common dimensions, mechanical, electrical and transmission characteristics and environmental requirements as well as test specifications respectively.

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

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

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 61076-1:2006, *Connectors for electronic equipment – Product requirements – Part 1: Generic specification*

IEC 61076-3:2008, *Connectors for electronic equipment – Product requirements – Part 3: Rectangular connectors – Sectional specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581, IEC 61076-1, IEC 61076-3 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 Technical information

4.1 Systems of levels – Compatibility levels, according to IEC 61076-1

a) Intermateability

Intermateability (level 2 of IEC 61076-1:2006) standardizes only dimensions of electrical and mechanical interfaces. Intermateability ensured by application of the “Go” and “No-Go” gauge requirements in the standards that may be referenced, and adherence to the dimensional requirements within.

b) Interoperability

Interoperability of different connectors is ensured by compliance with the specified interface dimensions.

4.2 Classification into climatic categories

Table 1 shows the climatic categories.

Table 1 – Climatic category

Climatic category	Category temperature		Damp heat steady state		Days
	Lower °C	Upper °C	Temperature °C	Relative humidity %	
40/85/21	–55	+85	40	93	21

4.3 Current-carrying capacity

Conditions:

IEC 60512, test 5b

1,5 A (all pins)

Values at 20 °C

4.4 Marking

The marking of the connector and the package shall be in accordance with 2.7 of IEC 61076-1:2006.

5 Common features and typical connector pair

5.1 View showing typical fixed and free connectors

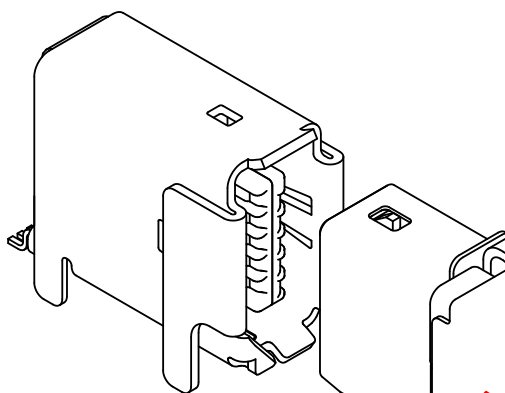


Figure 1 – View showing typical fixed and free connectors

5.2 Mating information

5.2.1 General

Coordination dimensions are dimensions without tolerances which indicate the boundary or centre-line references in order to allow for (modular) arrangement.

Dimensions are given in millimetres. Drawings are shown in third angle projection. The shape of connectors may deviate from those shapes given in the following figures as long as the specified dimensions are not influenced.

5.2.2 Contacts – mating conditions (see Figure 2 and Table 2)

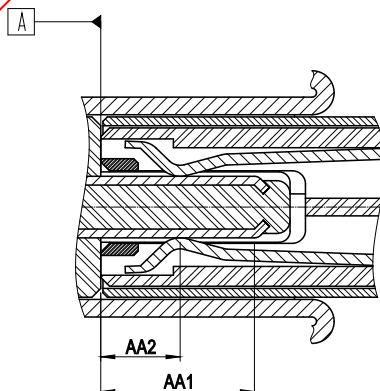


Figure 2 – Contact interface dimensions with terminated free connector

Table 2 – Dimensions for Figure 2*Dimensions in millimetres*

Letter	Minimum	Nominal	Maximum
AA1	3,35	3,5	3,65
AA2	1,6	1,8	2

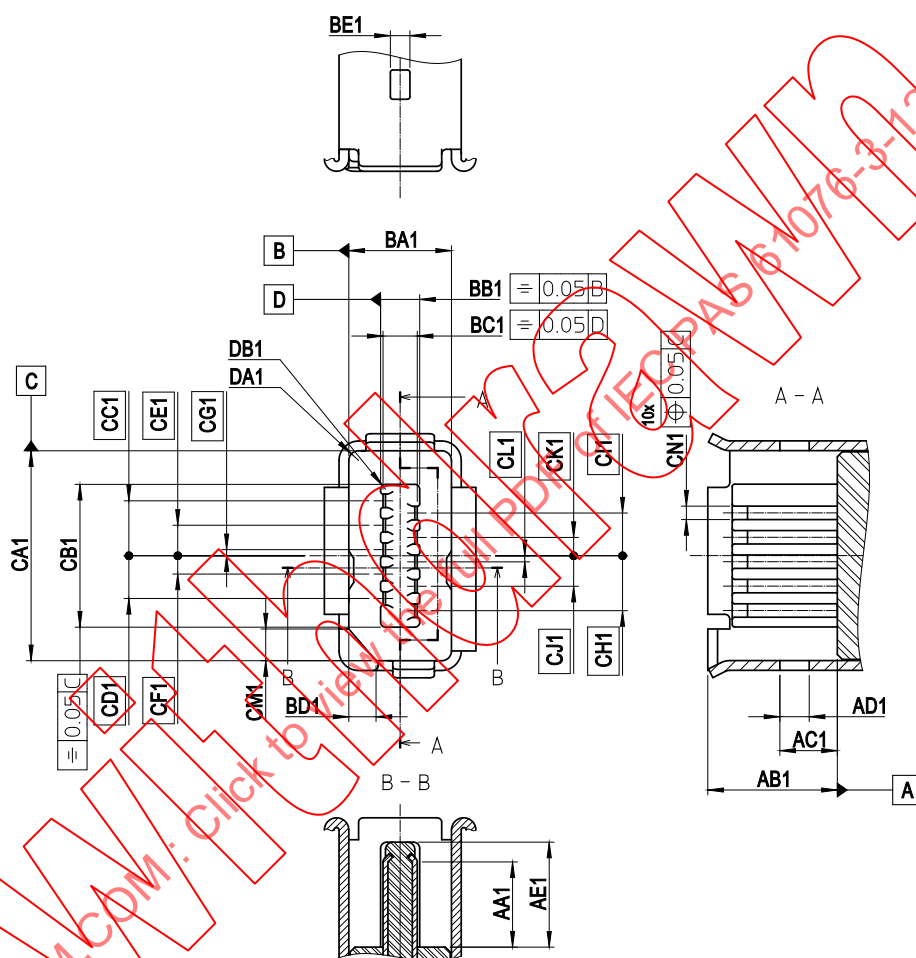
5.2.3 Fixed connector (see Figures 3 and 4 and Tables 3 and 4)**Figure 3 – Fixed connector Type A (Projection method 3)**

Table 3 – Dimensions for Figure 3

Dimensions in millimetres

Letter	Minimum	Nominal	Maximum
AA1	3,35	3,5	3,65
AB1	4,95	5,3	5,65
AC1	2,25	2,35	2,55
AD1	1,1	1,1	1,4
AE1	4,1	4,3	4,5
BA1	4,17	4,2	4,23
BB1	1,5	1,6	1,63
BC1	1,3	1,4	1,5
BD1	1	1,05	1,1
BE1	0,7	0,8	0,9
CA1	8,58	8,6	8,62
CB1	5,8	5,85	5,9
CC1		2,25	
CD1		1,75	
CE1		1,25	
CF1		0,75	
CG1		0,25	
CH1		2,25	
CI1		1,75	
CJ1		1,25	
CK1		0,75	
CL1		0,25	
CM1	1,2	1,2	1,3
CN1	0,65	0,65	0,7
DA1	R0,3	R0,4	R0,5
DB1	R0,1	R0,2	R0,3

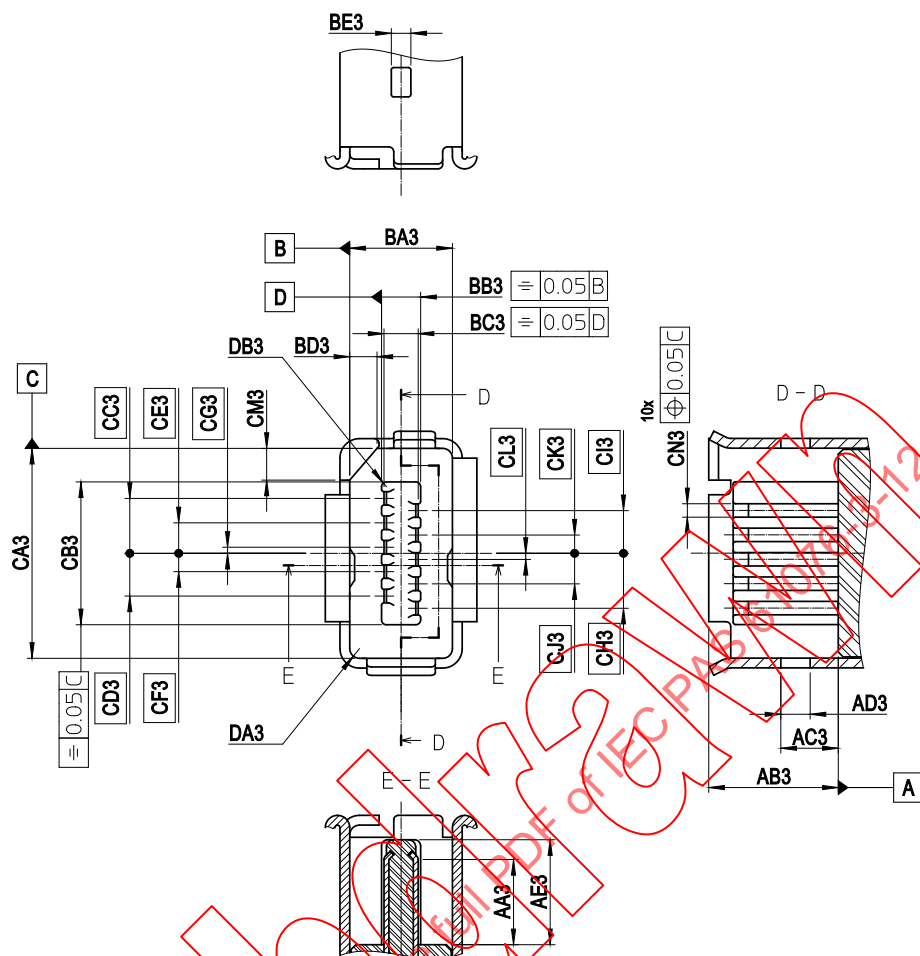


Figure 4 – Fixed connector Type B (Projection method 3)

Table 4 – Dimensions for Figure 4

Dimensions in millimetres

Letter	Minimum	Nominal	Maximum
AA3	3,35	3,5	3,65
AB3	4,95	5,3	5,65
AC3	2,25	2,35	2,55
AD3	1,1	1,1	1,4
AE3	4,1	4,3	4,5
BA3	4,17	4,2	4,23
BB3	1,5	1,6	1,63
BC3	1,3	1,4	1,5
BD3	1	1,05	1,1
BE3	0,7	0,8	0,9
CA3	8,58	8,6	8,62
CB3	5,8	5,85	5,9
CC3		2,25	
CD3		1,75	
CE3		1,25	
CF3		0,75	
CG3		0,25	
CH3		2,25	
CI3		1,75	
CJ3		1,25	
CK3		0,75	
CL3		0,25	
CM3	1,2	1,2	1,3
CN3	0,65	0,65	0,7
DA3	R0,3	R0,4	R0,5
DB3	R0,1	R0,2	R0,3

5.2.4 Free connector (see Figures 5 and 6 and Tables 5 and 6)

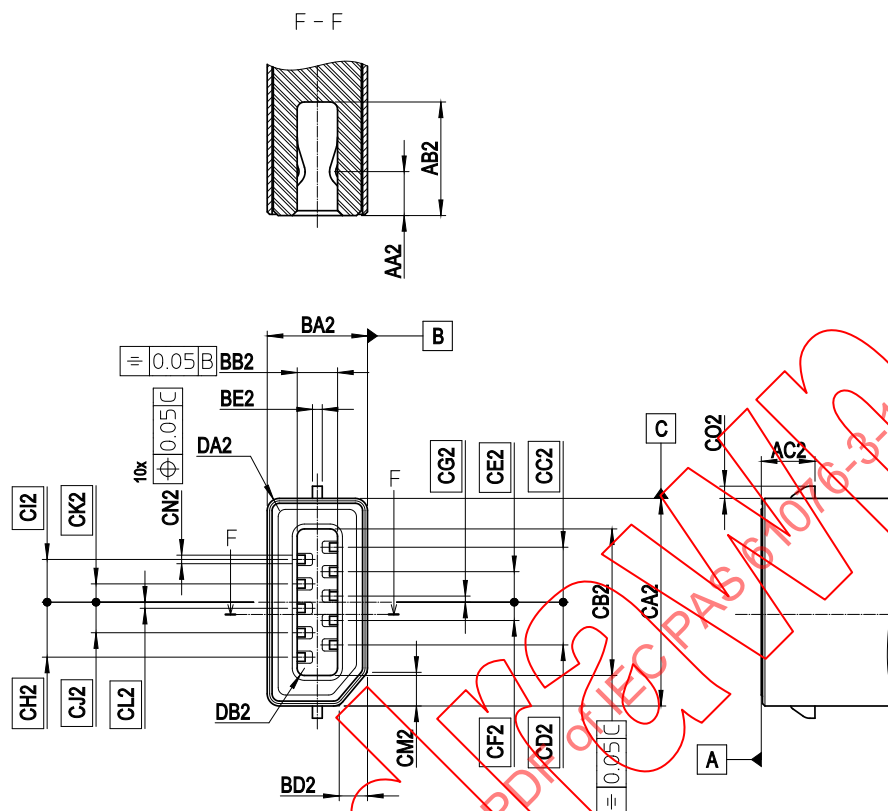


Figure 5 – Free connector Type A (Projection method 3)

Table 5 – Dimensions for Figure 5

Dimensions in millimetres

Letter	Minimum	Nominal	Maximum
AA2	1,6	1,8	2
AB2	4,6	4,65	4,8
AC2	2,05	2,2	2,25
BA2	4,03	4,1	4,17
BB2	1,63	1,63	1,83
BD2	1,1	1,2	1,3
BE2	0,35	0,4	0,45
CA2	8,47	8,5	8,53
CB2	6,15	6,2	6,4
CC2		2,25	
CD2		1,75	
CE2		1,25	
CF2		0,75	
CG2		0,25	
CH2		2,25	
CI2		1,75	
CJ2		1,25	
CK2		0,75	
CL2		0,25	
CM2	1,2	1,2	1,3
CN2	0,3	0,35	0,35
CO2	0,35	0,5	0,65
DA2	R0,5	R0,5	R0,65
DB2	R0,15	R0,3	R0,3

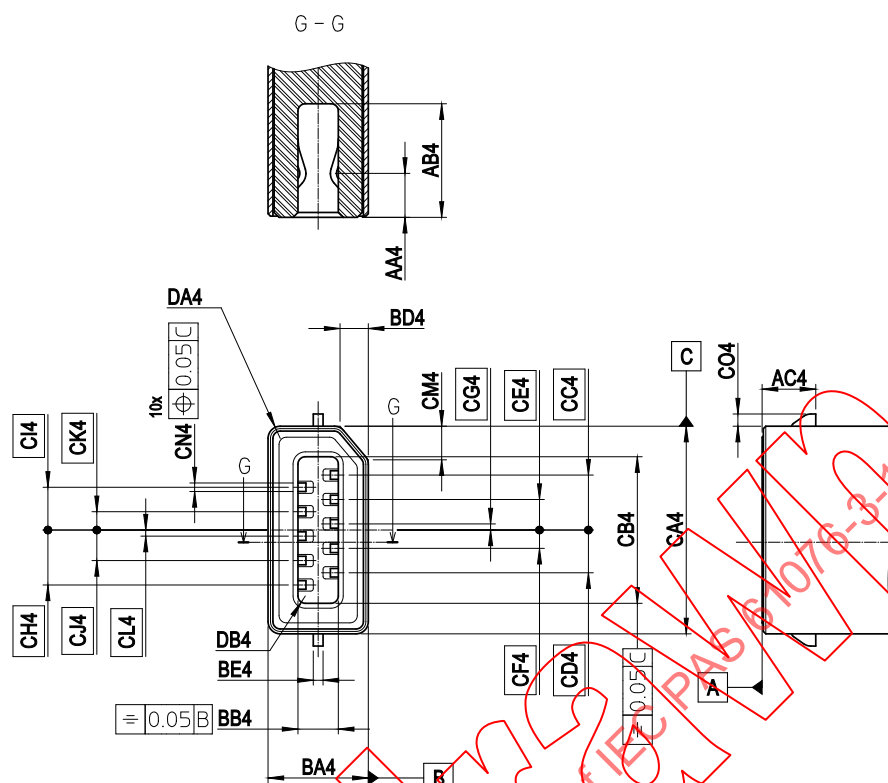


Figure 6 – Free connector Type B (Projection method 3)

Table 6 – Dimensions for Figure 6

Dimensions in millimetres

Letter	Minimum	Nominal	Maximum
AA4	1,6	1,8	2
AB4	4,6	4,65	4,8
AC4	2,05	2,2	2,25
BA4	4,03	4,1	4,17
BB4	1,63	1,63	1,83
BD4	1,1	1,2	1,3
BE4	0,35	0,4	0,45
CA4	8,47	8,5	8,53
CB4	6,15	6,2	6,4
CC4		2,25	
CD4		1,75	
CE4		1,25	
CF4		0,75	
CG4		0,25	
CH4		2,25	
CI4		1,75	
CJ4		1,25	
CK4		0,75	
CL4		0,25	
CM4	1,2	1,2	1,3
CN4	0,3	0,35	0,35
CO4	0,35	0,5	0,65
DA4	R0,5	R0,5	R0,65
DB4	R0,15	R0,3	R0,3

6 Characteristics

6.1 General

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

6.2 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 Figures 7 and 8 unless otherwise specified.

The connector Type A is defined for 10/100 Mbit/s and 1/10 Gbit/s Ethernet communication.

The connector Type B is defined for all other non Ethernet applications such as signalling, serial or other industrial bus communication systems.

Connector pin assignment:

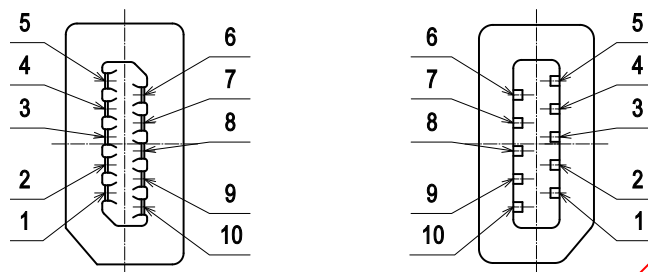


Figure 7 – Connector pin assignment for Type A, front view of connector

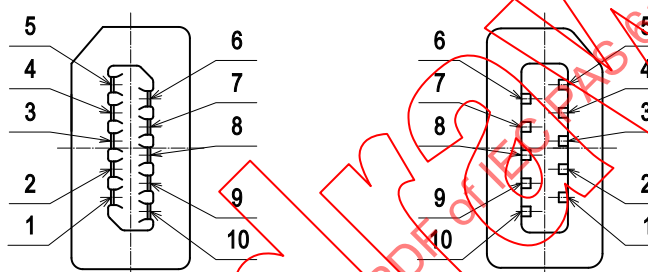


Figure 8 – Connector pin assignment for Type B, front view of connector

Board connector pin assignment for 10/100 Mbit/s Ethernet:

Pin No.	Signal
1	TX+
2	TX-
3	N.C
4	N.C
5	N.C
6	RX+
7	RX-
8	N.C
9	N.C
10	N.C

Board connector pin assignment for 1/10 Gbit/s Ethernet:

Pin No.	Signal
1	BI_DA+
2	BI_DA-
3	GND
4	BI_DC+
5	BI_DC-
6	BI_DB+
7	BI_DB-
8	GND
9	BI_DD+
10	BI_DD-

6.3 Classification into 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 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 7.

Table 7 – Climatic category

Climatic category	Category temperature		Damp heat steady state		Days
	Lower °C	Upper °C	Temperature °C	Relative humidity %	
40/85/21	-55	+85	40	93	21

6.4 Electrical characteristics

6.4.1 Voltage proof

Conditions:

IEC 60512-4-1, Test 4a, Method A

Standard atmospheric conditions

Mated connectors

All variants:

500 V d.c.; one contact to all other contacts connected together.

500 V d.c.; all contacts connected together to shield.

6.4.2 Voltage rating

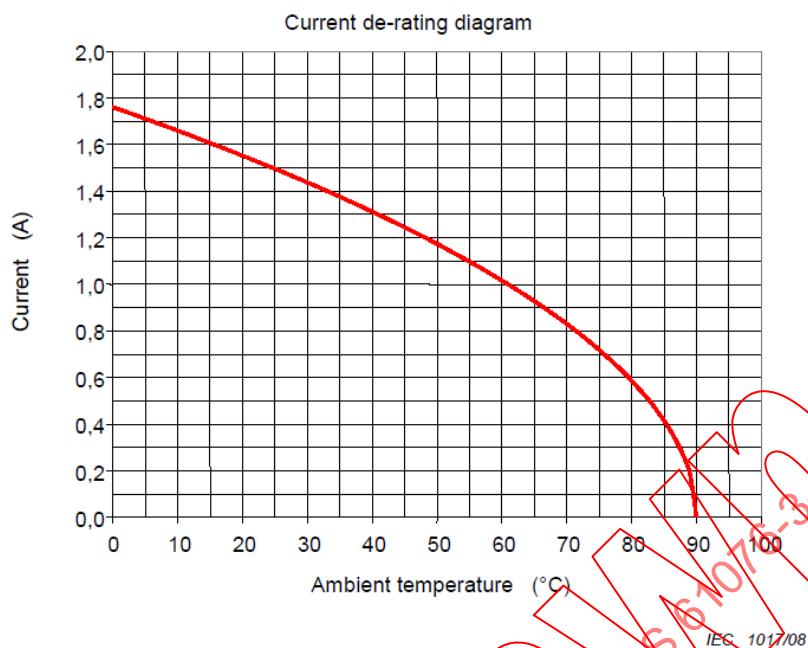
Intended for a voltage less or equal 50 V a.c. and 60 V d.c.

6.4.3 Current-carrying capacity

Conditions:

IEC 60512-5-2, Test 5b

All contacts, connected in series.



NOTE 1 The maximum permissible current for a given ambient temperature (t) is: $I_{(t)} = 1,76 \cdot \left(1 - \frac{t}{90}\right)^{0,5}$

NOTE 2 For ambient temperatures lower than 0 °C, the maximum permissible current per conductor is 1,76 A.

Figure 9 – Current de-rating diagram

6.4.4 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.

6.5 Mechanical characteristics

6.5.1 Mechanical operation

Conditions:

IEC 60512-9-1, Test 9a
 Speed: = 10 mm/s maximum
 Rest: 5 s, minimum (unmated)
 5 000 operations.

6.5.2 Insertion and withdrawal forces

Conditions:

IEC 60512-13-2, Test 13b
 Speed: maximum rate of 50 mm per minute.
 All types, insertion and withdrawal: 25 N maximum

6.6 Transmission performance

6.6.1 General

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

All transmission performance requirements apply between the reference planes specified in IEC 60512-27-100 and IEC 60512-26-100, test 26e for transfer impedance.

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.

6.6.2 Insertion loss

Conditions:

IEC 60512-27-1, test 27a

Mated connectors

All pairs: $\leq 0,02 \sqrt{f}$ dB from 1 MHz to 500 MHz.

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

6.6.3 Return loss

Conditions:

IEC 60512-27-2, test 27b

Mated connectors

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 500 MHz.

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

6.6.4 Near end cross talk

Conditions:

IEC 60512-27-3, test 27c

Mated connectors

All pair combinations: $\geq 94 - 20 \log(f)$ dB from 1 MHz to 250 MHz.

All pair combinations: $\geq 46,04 - 30 \log(f/250)$ dB from 250 MHz to 500 MHz.

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

6.6.5 Far end cross talk

Conditions:

IEC 60512-27-4, test 27d

Mated connectors

All pair combinations: $\geq 83,1 - 20 \log(f)$ dB from 1 MHz to 500 MHz.

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

6.6.6 Transverse conversion loss

Conditions:

IEC 60512-27-6, test 27f

Mated connectors

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 500 MHz.

Whenever the formula results in a value greater than 50 dB, the requirement shall revert to 50 dB.

6.6.7 Transverse conversion transfer loss

Conditions:

IEC 60512-27-7, test 27g

Mated connectors

All pairs: $\geq 68 - 20 \log(f)$ dB from 1 MHz to 500 MHz.

Whenever the formula results in a value greater than 50 dB, the requirement shall revert to 50 dB.

6.6.8 Transfer impedance

Conditions:

IEC 60512-26-5, test 26e

Mated connectors

All pairs: $\leq 0,1 \times f^{0,3} \Omega$ from 1 MHz to 10 MHz and $\leq 0,02 \times f \Omega$ from 10 MHz to 80 MHz.

6.6.9 Propagation delay

All types: $\leq 2,5$ ns

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

6.6.10 Delay skew

All types: $\leq 1,25$ ns

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

7 Test schedule

7.1 General

7.1.1 Overview

This test schedule shows the tests and the order in which they shall be carried out as well as the requirements to be met.

Unless otherwise specified, all tests shall be carried out under standard atmospheric conditions for testing as specified in IEC 60068-1, as directed by the applicable part of IEC 60512.

Unless otherwise specified, mated and locked sets of connectors shall be tested. Care shall be taken to keep a particular combination of connectors together during the complete test sequence, i.e. when unmating is necessary for a certain test, the same connector styles as before shall be mated for the subsequent tests.

In the following, a mated and locked sets of connector styles is called a specimen.

7.1.2 Arrangement for contact resistance measurement

Conditions:

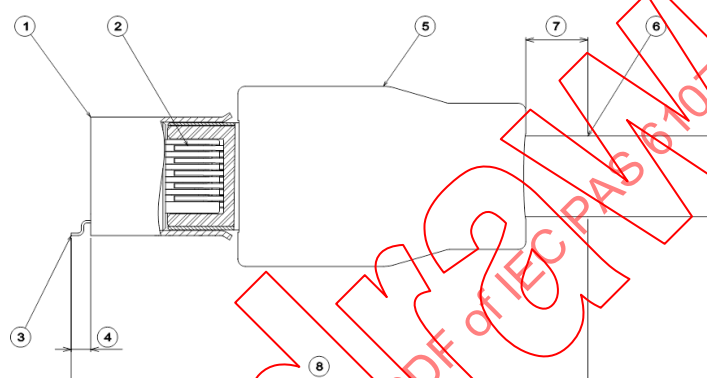
IEC 60512-2-1, Test 2a

Standard atmospheric conditions

Measuring points see Figure 10

The measurement of contact resistance shall be carried out on the number of contacts specified.

Any subsequent measurements of contact resistance shall be made on the same contacts. Figure 10 shows a contact resistance arrangement.



Key

- 1 Fixed connector
- 2 Contact point
- 3 Point A. Measure the DC resistance across each of the 10 signal pins
- 4 As short as practical (except for vibration test EP5)
- 5 Free connector
- 6 Point C
- 7 As short as practical (except for vibration test EP5)
- 8 Contact resistance measurement points

Figure 10 – Contact resistance arrangement

7.1.3 Arrangement for dynamic stress tests

Conditions:

IEC 60512-6-4, Test 6d

Frequency range: 10 Hz – 500 Hz

Amplitude: 0,35 mm

Frequency change 1 octave/min.

Number of sweeps per axis: 10

Axes: 3 – x, y, z

Acceleration: 50 m/s²

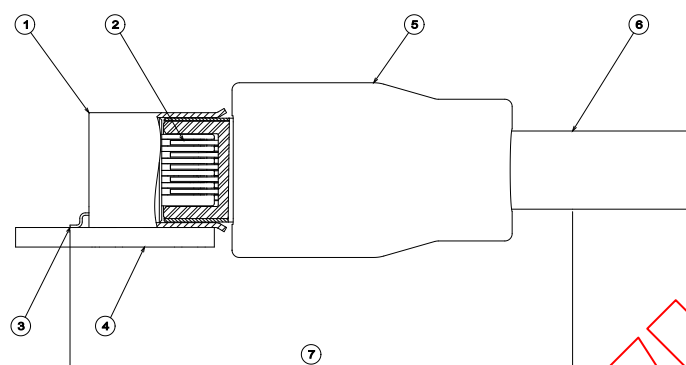
Standard atmospheric conditions

Connectors in mated and locked position.

The fixed and free connector shall be rigidly installed in a suitable fixture as specified in Figure 11.

Cable with maximum wire size or overmolded cable.

Figure 11 shows a dynamic stress test arrangement.



Key

- 1 Fixed connector vibration feature
- 2 Contact point
- 3 Point A: secure to the vibrating member. Measure the DC resistance across each of the 8 signal pins
- 4 Mounting plate
- 5 Free connector
- 6 Point C: secure to the non-vibrating member
- 7 Contact resistance measurement point

Figure 11 – Arrangement for vibration test

7.2 Test schedules

7.2.1 Basic (minimum) test schedule

Not applicable.

7.2.2 Full test schedule

7.2.2.1 General

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

For a complete test sequence, 18 specimens are needed (Test groups AP, BP, DP and EP shall each consist of 3 specimens. Test group CP consist of 6 specimens).

Contact resistance tests apply only to the interface.

7.2.2.2 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 8.

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.

Table 8 – 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.	Requirement
P1	General examination	1	Unmated connectors	Visual examination	1a	There shall be no defect that would impair normal operation
				Dimensional examination	1b	The dimensions shall comply with those specified in the relevant figure of Clause 5.
P2	Polarizing method	13e	Not applicable			
P3	Contact resistance		All contacts / specimens.	Low level contact resistance	2a	30 mΩ max. shielding resistance 100 mΩ max.
P4			500 V d.c. 1 min hold.	Insulation resistance	3a	500 MΩ minimum.
P5			Contact/contact: Method A mated connectors	Voltage proof	4a	500 V d.c. peak

7.2.2.3 Test group AP – Climatic

Table 9 shows the test group AP.

Table 9 – 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.	Requirement
AP1	Insertion and withdrawal forces		Measure the force necessary to insert / withdraw the specimens at a max. rate of 50 mm per minute (latching mechanism inactivated)	Insertion and withdrawal forces	13b	25 N max. for insertion and for withdrawal.
AP2	Rapid change of temperature	11d	Subject mated specimens to 10 cycles between - 55 °C and 85 °C with 30 min dwell at temp. extremes and 1 minute transition between temperatures			Meet visual requirements, show no physical damage.
AP3			Contact/contact	Voltage proof	4a	Subject specimens to 500 V d.c. between adjacent contacts
AP4			500 V d.c., 1 min hold	Insulation resistance	3a	500 mΩ minimum
AP5			All contacts/ specimens	Contact resistance	2°	80 mΩ max. shielding resistance 100 mΩ max.
AP6	Dry heat	11i	Subject mated specimens to a temperature of 85 °C during 21 days			Meet visual requirements, show no physical damage.
AP7	Humidity / temperature cycling		low temperature 25 °C; high temperature 65 °C; cold subcycle -10 °C; humidity 93 %		IEC 60068 -2-38, Test Z/AD	Meet visual requirements, show no physical damage.
AP8	Cold	11j	Subject mated samples to a temperature of -55 °C for 10 days			Meet visual requirements, show no physical damage.
AP9	Contact resistance		All contacts/ specimens	Low level contact resistance	2a	80 mΩ max. shielding resistance 100 mΩ max.
AP10			Contact/contact	Voltage proof	4a	Subject specimens to 500 V d.c. between adjacent contacts
AP11			500 V d.c., 1 min hold	Insulation resistance	3a	500 MΩ minimum.
AP12	Insertion and withdrawal force		Measure the force necessary to insert / withdraw the specimens at a max. rate of 50 mm per minute (latching mechanism inactivated)		13b	25 N max. for insertion and for withdrawal
AP13	General examination			Visual examination		There shall be no defects that would impair normal operation