

Connectors for electronic equipment –

Part 4-115:

Printed board connectors –

Detail specification for a single-part hybrid connector, with a section of high-speed differential pair connections, and a section of low-speed, power and ground connections between printed boards and backplanes, in accordance with IEC 60917

PUBLICLY AVAILABLE SPECIFICATION



INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

Reference number
IEC/PAS 61076-4-115

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Withdrawn

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

A PAS is a technical specification not fulfilling the requirements for a standard, but made available to the public.

IEC-PAS 61076-4-115 has been processed by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for 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/1004/PAS	48B/1055/RVD

Following publication of this PAS, the technical committee or subcommittee concerned will investigate the possibility of transforming the PAS into an International Standard.

The International Electrotechnical Commission (IEC) draws attention to the fact that is claimed that compliance with this PAS may involve the use of patents concerning

- a) an electrical connector assembly for establishing electrical contact with contacting devices of external terminals, e.g. with solder points of a circuit board;
- b) an electrical connector assembly for establishing electrical contact with external terminals having contacting devices with contact faces, e.g. with solder points of a circuit board;
- c) an electrical connector assembly with an electrical connector having a connecting position and contacting devices for establishing electrical contact between a first and a second printed circuit board.

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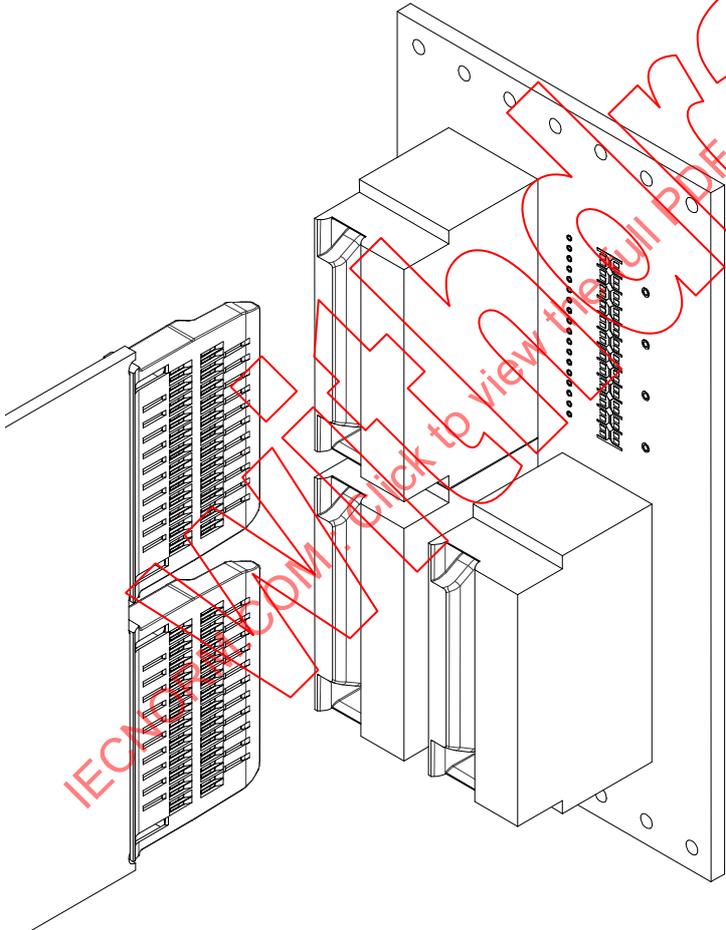
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CONNECTORS FOR ELECTRONIC EQUIPMENT –

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PAS 61076-4-115 – Backplane connector for InfiniBand equipment

<p>International Electrotechnical Commission IEC SC 48B – Connectors</p>	
<p>Electronic components of assessed quality in accordance with: GENERIC SPECIFICATION IEC 61076-1, Issue 1 1995</p>	<p>Blank detail specification: IEC 61076-4-001, Issue 1 1996</p>
	<p>Single-part hybrid connector, with a section for high-speed on a 3 mm grid and a low-speed section with power and ground connections on a 2 mm grid, for printed boards and backplanes in accordance with IEC 60917.</p> <p>Hybrid connector having one section containing 2 rows of 12 contact pairs for differential pair transmission on a 3 mm pitch and one section with 1 row of 18 contacts for low-speed and power connections on a 2 mm pitch. The fixed connectors are 50 mm high, pressed-in or surface mount soldered onto the backplane. The plug-in card interface is protected by a paddle-guard.</p> <p>Performance levels (PL): 1</p>

Information on the availability of components qualified to this detail specification is given in the qualified product list.

1. General data

1.1. Recommended method of mounting

Three methods of mounting to the backplane may be adopted.

a. **Press-in / compression connections**

The fixed connector is pressed-in onto the backplane, using 18 press-in low-speed connections and four press-in pins.

The high-speed contacts to the backplane are using compression connections.

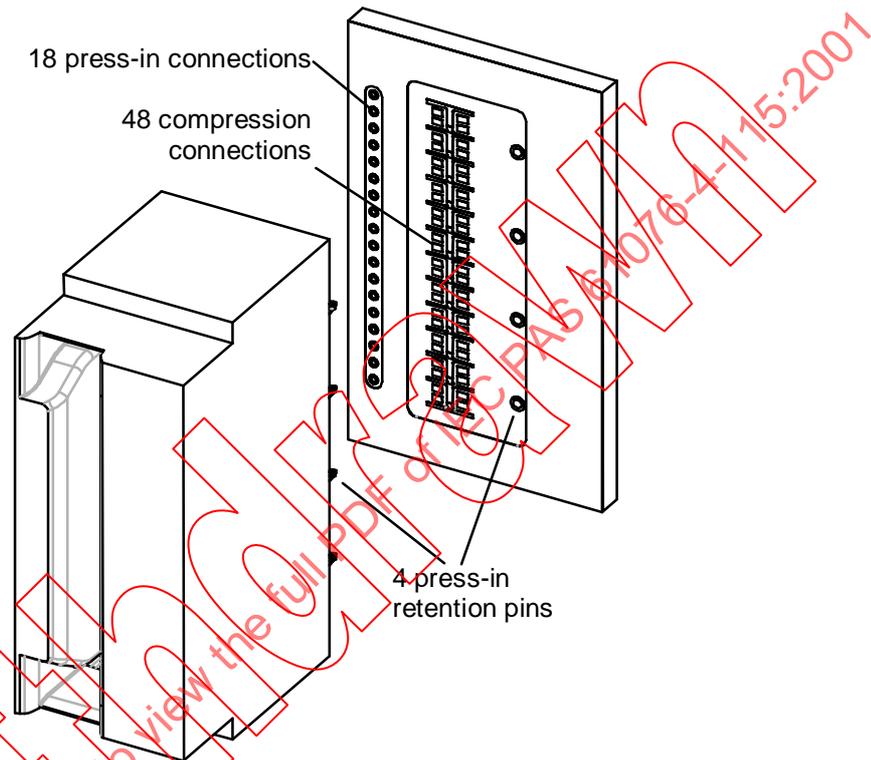


Figure 1 – Press-in / compression method of mounting

b. **Press-in connections only**

Under consideration

c. **Surface mount soldered connections**

Under consideration

The plug-in card

has an extension in the form of a paddle, with contact pads for compression connections.

The paddle shall be protected by a paddle-guard, which may be mounted in a removable or permanent way.

1.1.1. Number of contacts and contact cavities

Table 1 - Number of contacts for fixed connector

Styles	Number of I/O channels	Differential pairs	Low-speed contacts
A	4x I/O channels	4 + 4	18
C	12x I/O channels	12 + 12	18

Table 2 - Number of cavities for paddle guard

Styles	Cavities for differential pair entries	Cavities for low-speed entries
I	12 + 12	18

1.2. Ratings and characteristics

High-speed section

Compression connections	bifurcated contacts with independently operating beams
Creepage and clearance	0,3 mm min. between contacts mutually and ground
Rated voltage	within same pair 100 V r.m.s. pair to ground 100 V r.m.s.
Current rating	0,5 A per contact pair at 70°C (all contacts loaded)
Insulation resistance	1 GΩ min.
Differential impedance	100 Ω ± 10 Ω at 100 ps risetime in the connector

Low-speed section

Compression connections	bifurcated contacts with independently operating beams
Creepage and clearance	0,8 mm min. between contacts mutually and ground
Rated voltage	contact/contact 500 V r.m.s. contact to ground 500 V r.m.s.
Current rating	2,5 A per contact at 70°C (all contacts loaded)
Insulation resistance	5 GΩ min.
Printed board	thickness range for use with same fixed connector = 1,44 mm to 2,64 mm thickness range for a given paddle-guard = ± 10 % of nominal thickness
Backplane	1,6 mm min. plated-through press-in hole for low-speed connections = Ø 0,6 mm ± 0,05 mm press-in hole diameter for fixed connector retention pins = Ø 1 mm +0,09/-0,06 mm

1.3. Normative references

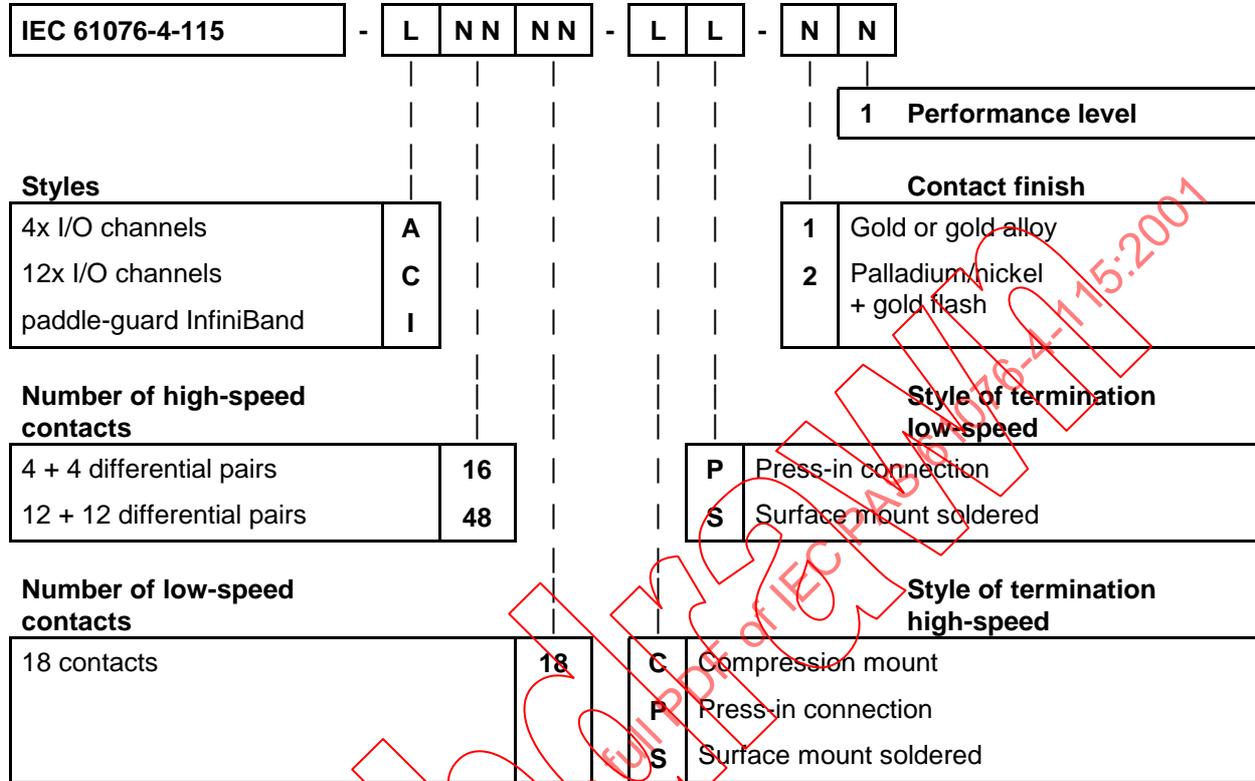
The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of IEC 61076. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and users of this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

<i>IEC 60068-1: 1988</i>	<i>Environmental testing Part 1: General and guidance</i>
<i>IEC 60352-5: 1995</i>	Solderless connections Part 5: Solderless press-in connections – General requirements, test methods and practical guidance
<i>IEC 60512-1: 1994</i>	Electromechanical components for electronic equipment – Basic testing procedures and measuring methods Part 1: General
<i>IEC 60512-2: 1985</i>	Part 2: General examination, electrical continuity and contact resistance tests, insulation tests and voltage stress tests
<i>IEC 60512-3: 1976</i>	Part 3: Current-carrying capacity tests
<i>IEC 60512-4: 1976</i>	Part 4: Dynamic stress tests
<i>IEC 60512-5: 1992</i>	Part 5: Impact tests (free components), static load tests (fixed components), endurance tests and overload tests
<i>IEC 60512-6: 1984</i>	Part 6: Climatic tests and soldering tests
<i>IEC 60512-7: 1993</i>	Part 7: Mechanical operating tests and sealing tests
<i>IEC 60512-8: 1993</i>	Part 8: Connector tests (mechanical) and mechanical tests on contacts and terminations
<i>IEC 60512-9: 1992</i>	Part 9: Miscellaneous tests
<i>IEC 60512-20-1: 2000</i>	Part 20: Fire hazard tests Test 20a – Flammability, needle-flame
<i>IEC 60512-23-4: 2000</i>	Part 23: Shielding and filtering tests Test 23d – Transmission line reflections of connectors in the time domain
<i>IEC 60512-25-1: 2000</i>	Part 25: Signal integrity tests Test 25a – Crosstalk ratio
<i>IEC 60512-25-2: 2000</i>	Test 25b – Attenuation
<i>IEC 60512-25-4: 2000</i>	Test 25d – Propagation delay
<i>IEC 60917: 1988</i>	Modular order for the development of mechanical structures for electronic equipment practices
<i>IEC 60917-2-2: 1994</i>	Part 2: Sectional specification – Interface co-ordination dimensions for the 25 mm equipment practice Section 2: Detail specification – Dimensions for subracks
<i>IEC 61076-1: 1995</i>	Connectors with assessed quality for use in d.c. low frequency analogue and digital high-speed data applications Part 1: Generic specification
<i>IEC 61076-4: 1995</i>	Part 4: Sectional specification – Printed board connectors
<i>IEC 61076-4-001: 1996</i>	Section 001: Blank detail specification
<i>ISO 1302: 1995</i>	Technical drawings – Method of indicating surface texture

1.4. Marking

The marking of the connector and the package shall be in accordance with 2.6 of IEC 61076-4.

1.5. IEC type designation



See 2.1 for definitions and 2.2 for designation of styles and variants.
The designation shall be derived in accordance with 2.5 of IEC 61076-4.

Example for fixed connector

A style C fixed connector, press-in / compression mounted, with 2 x 12 differential pairs and 18 low-speed contacts, gold plated, meeting performance level 1, is designated as follows:

IEC 61076-4-115 – C4818 – CP – 11

Example for paddle-guard

A style I paddle-guard, with apertures for 2 x 12 differential pairs and 18 low-speed contacts, meeting performance level 1, is designated as follows:

IEC 61076-4-115 – I4818 – CP – 11

1.6. Ordering information

For ordering connectors according to this detail specification, the IEC type designation described in 1.5 shall be used.

2. Technical data

2.1. Definitions

For the purpose of this section the following definitions apply:

2.1.1. Mechanical features

paddle-guard – Protective plastic glove that covers the milled edges of the board paddle at the plug-in unit. It is a robust and accurate interface to the fixed connector; it aligns the contact beams to the pads and activates the mating movement of the high-speed section during insertion and withdrawal of the plug-in unit.

2.1.2. Contacts and terminations

contact range - The range from minimum to maximum distance between the reference planes of the fixed and free boards, within which the specified contact resistance is met.

contact beam – Part of the contact that makes the contact to the pad on the board, this part is usually plated and shaped like the back of a spoon.

compression connection – Solderless connection between a contact beam and a contact pad on the board, accomplished through a specific pressure in the contact area, generated by a continuous compression force and a spherical shape of the beam.

dual compression connection – Connection between a bifurcated contact beams and one contact pad on the board.

2.1.3. Engagement sequence

contact level - set of contacts which engage/separate simultaneously, taking the accuracy required by the engaging sequence into account.

engaging sequence - given order of engagement/separation of contacts belonging to different contact levels, which assures that all contacts of a given level do close/open after the previous level and before the next level.

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2.2. Survey of styles and variants

2.2.1. Styles of connectors

Table 3 – Survey of fixed connectors

Style	Colour	I/O Channels	Length
A	Peddle grey	4x	50 mm
C	Blue	12x	50 mm

Table 4 – Survey of paddle-guards

Style	Engagement sequence low-speed
I	InfiniBand configuration (see 3.7.2)

2.2.2. Styles of termination

Termination to the backplane

Table 5 – Survey of terminations to the backplane

Method of mounting	Section	Style of termination	Dimensions
Press-in / compression	High-speed	Dual compression connection	-
	Low-speed	Press-in connection, according to IEC 60352 – 5	∅ 0,6 ± 0,05 mm
Press-in only	High-speed	Under consideration	Under consideration
	Low-speed	Press-in connection, according to IEC 60352 – 5	∅ 0,6 ± 0,05 mm
Surface mount soldered	High-speed	Under consideration	-
	Low-speed	Under consideration	-

Termination to the plug-in card

All bifurcated contacts shall make a dual compression connection to the contact pads at the plug-in card.

2.2.3. Variants of the paddle-guard

Thickness of the plug-in card

Table 6 – Survey of paddle-guard variants

Variant	Thickness of plug-in card	Tolerance range on thickness
1	1,6 mm	1,44 mm – 1,76 mm
2	2 mm	1,8 mm – 2,2 mm
3	2,4 mm	2,16 mm – 2,64 mm

2.3. Information on application

2.3.1. Description of the connector

The connector is basically a one-part fixed connector, mounted on the backplane.

On the plug-in card however, a paddle-guard shall be applied.

Only the outer features and characteristics of the paddle-guard that determine the interface to the fixed connector are a normative part of this specification.

The footprint and the plating of the contact pads on the plug-in card are equally important for the functionality of the interface and also a normative part of this specification.

Details about the shape of the plug-in card paddle and the features needed for paddle-guard assembly however are shown for guidance and as an example for information only.

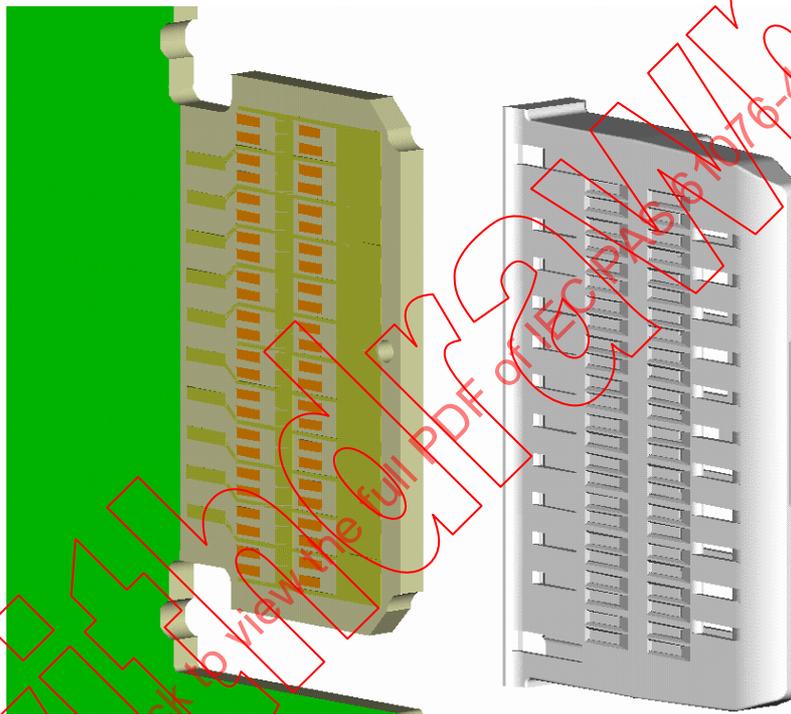


Figure 2 – Example of a paddle-guard, to be mounted on the plug-in card paddle

The two sections in the connector

The high-speed and the low-speed sections have different characteristics and test programs. Their mechanical features and connection technologies are basically different.

High-speed section

The high-speed contact pairs are mounted in an electrically conductive shell. The insertion of the plug-in unit pushes the shell towards the paddle-guard. With this movement the bifurcated contact beams enter the apertures in the paddle-guard and make a dual wiping compression contact to the pads on the component side of the plug-in card.

Withdrawal of the plug-in unit pulls the shell back from the paddle-guard and makes all contact pairs lift off and leave the apertures of the paddle-guard.

Cams on the paddle-guard and on the shell drive the movement of the shell.

Low-speed section

The low speed contacts operate similarly to card-edge connections. However, instead of opening the contact beams with the edge of the plug-in card, the smooth edge of the paddle-guards lifts the bifurcated contact beams over the edge to let them sink into the apertures and make a dual wiping compression connection to the pads on the solder side of the plug-in card.

The staged length of the apertures controls the engaging sequence of the low-speed connections (see 2.3.3).

Plug-in card thickness

The fixed connector is capable of mating with a range of plug-in card thicknesses.

The reference plane of the plug-in unit – the component side – shall always remain in the same position, the difference in thickness must be made up by the flexibility of the low-speed contacts.

The outer dimensions of the paddle-guard remain the same for the whole range of card thicknesses, only the depth of the apertures for the low-speed connections varies according to the chosen card thickness.

2.3.2. Contact designation

Contact designation on the backplane

a. Press-in/compression mounted fixed connector

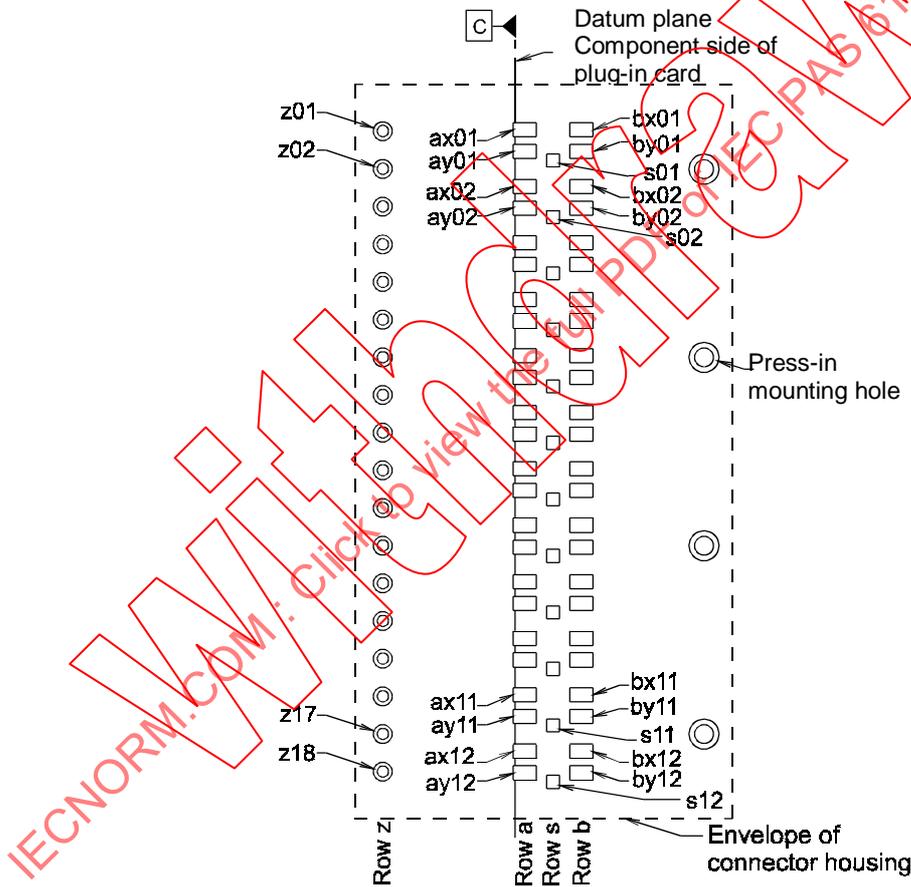


Figure 3 – Designation of contacts on backplane for press-in/compression mounting

b. Press-in mounted fixed connector

Under consideration

c. Surface mount soldered fixed connector

Under consideration

Contact designation on plug-in card

a. Component side of the plug-in card

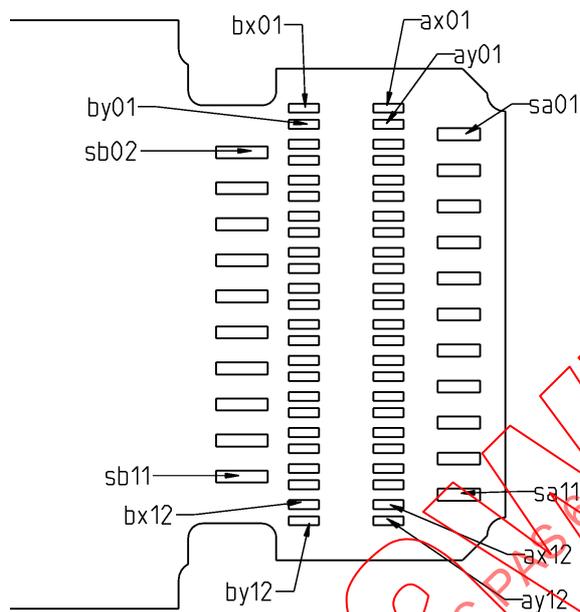


Figure 4 – Designation of contacts on component side

b. Solder side of the plug-in card

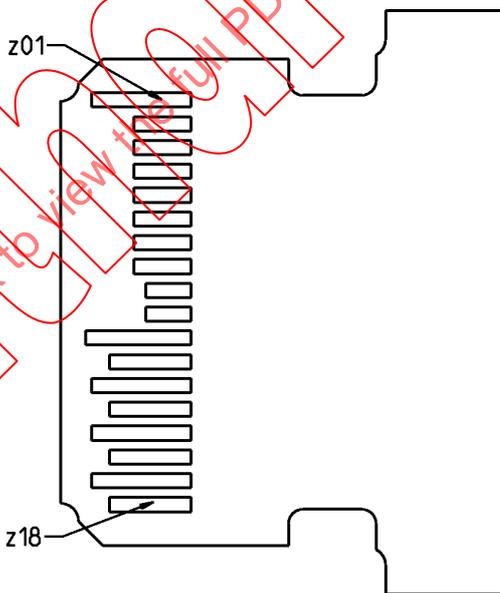


Figure 5 – Designation of contacts on solder side

2.3.3. Arrangement of contact levels

In the high-speed section all connections operate simultaneously. Connections are made no earlier than 2,3 mm before full insertion; reliable connection is achieved no later than 1,7 mm before full insertion.

In the low-speed sections the connections may operate in four different levels, staged by 1,5 mm minimum.

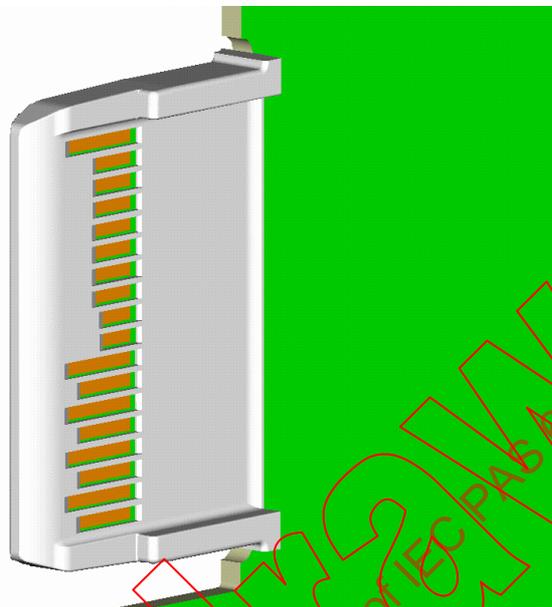


Figure 6 – Low-speed section – Apertures in paddle-guard control engaging sequence

Potential inclination of the incoming plug-in unit shall be taken into account when assigning contact positions to the different contact levels, in order to avoid mismatch in the engaging sequence.

2.3.4. Polarisation and keying

The shape of the card slot in the fixed connector will prevent all wrong engagement. No keying features are provided.

2.3.5. Mounting on backplane

Three alternative methods of mounting to the backplane may be adopted.

a. Press-in / compression connections

The high-speed connections to the backplane are made by bifurcated compression contacts. During the lifetime of the interconnection the press-in attachment to the backplane shall support a reliable pressure on these contacts.

On one side the fixed connector housing is attached to the backplane by 4 metal pins, pressed into plated-through holes, and by the 18 low-speed press-in terminations on the other side.

After provisional placement on the backplane multiple fixed connectors may be pressed-in simultaneously using a flat rock press-in tool.

b. Press-in connections only

Under consideration

c. Surface mount soldered connections

Under consideration

2.3.6. Mounting on the plug-in card

The paddle-guard shall be rigidly fixed to the plug-in card paddle, in a way that the gap between the surface of the board and the slot in the paddle-guard does not exceed 0,1 mm on the component side (datum C).

3. Dimensional Information

3.1. General

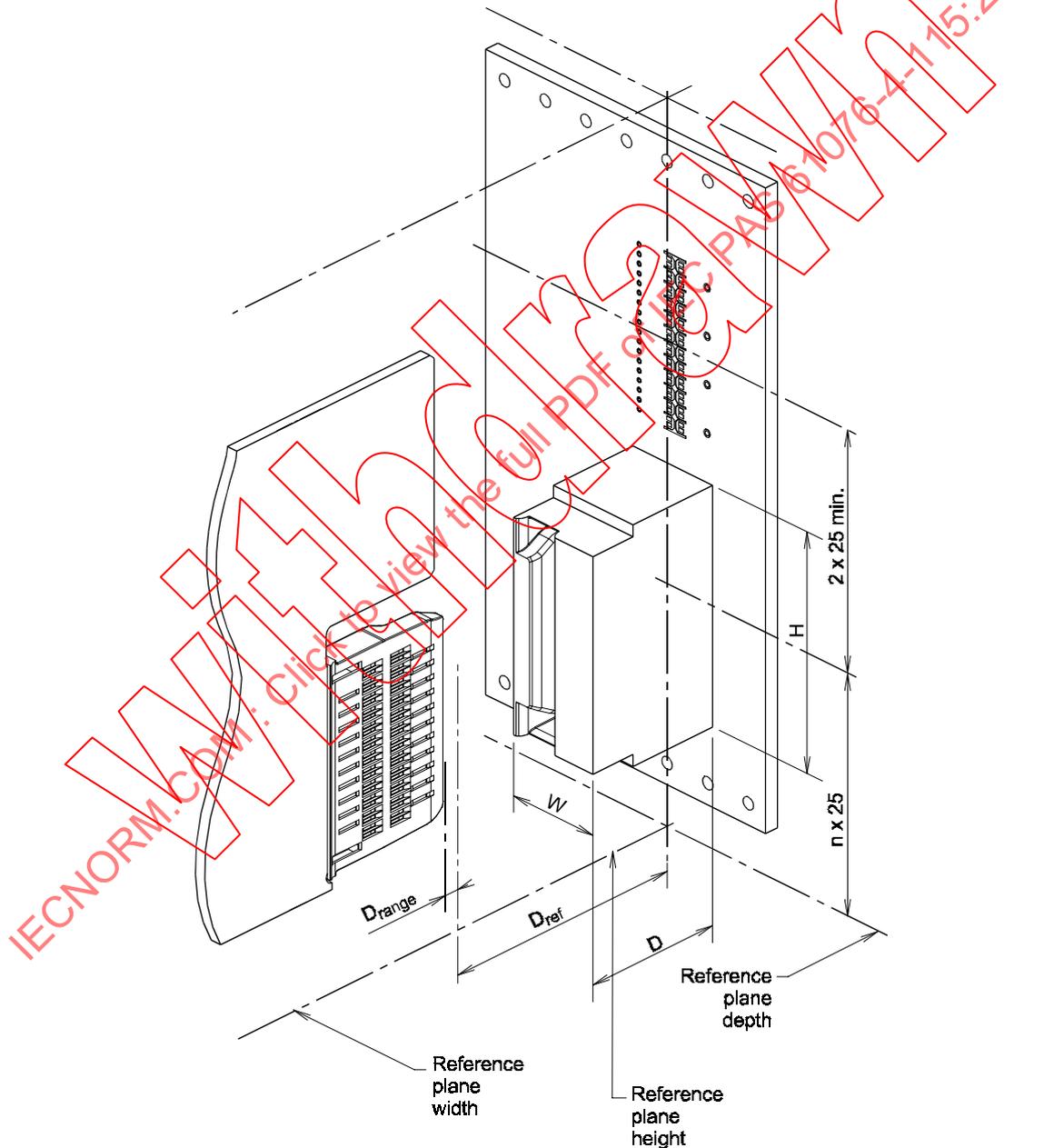
Original dimensions are in millimetres and all dimensions on the drawings and tables are in millimetres.

All drawings are shown in first angle projection.

The shape of the parts may deviate from the one given in the drawings, as long as the specified dimensions are not affected and the intended functionality is provided.

Dimensions not specified may be chosen according to required characteristics and intended use.

3.2. Isometric view and common features



Note – For guidance the reference planes are shown in accordance with IEC 60917-2-2.

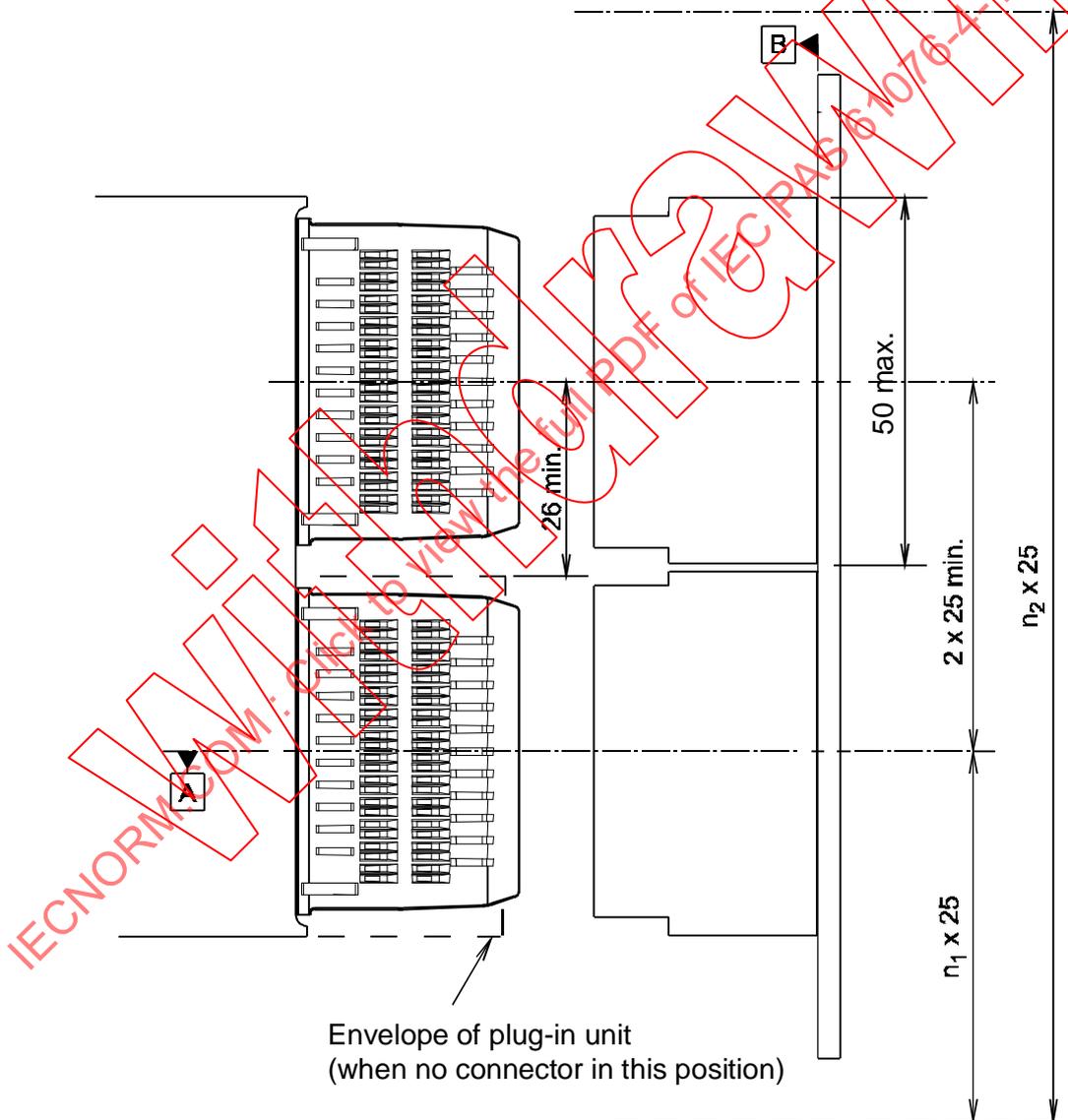
Figure 7 – Co-ordination dimensions

3.2.1. Common features

Table 7 – Co-ordination dimensions and common features

Dimension		Feature description
H	50 mm	Maximum overall height of the fixed connector
D	30 mm	Maximum overall depth of the fixed connector
D _{ref.}	0	Depth co-ordination dimension: tip of paddle-guard stops at backplane
D _{range}	0 to 1,5 mm	Contact range
W	20 mm	Overall width of fixed connector

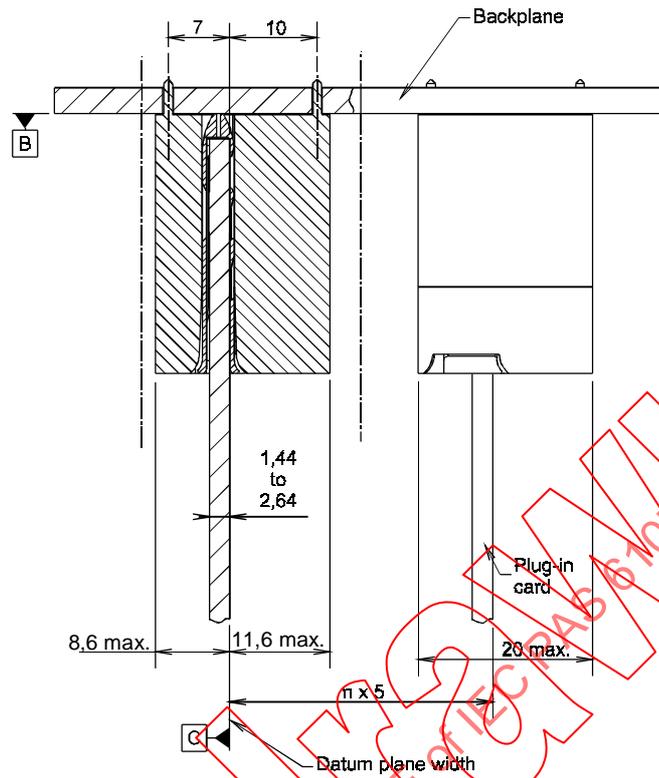
3.2.2. Height dimensions



Note – For guidance the reference planes are shown in accordance with IEC 60917-2-2.

Figure 8 – Height dimensions and mounting pitch

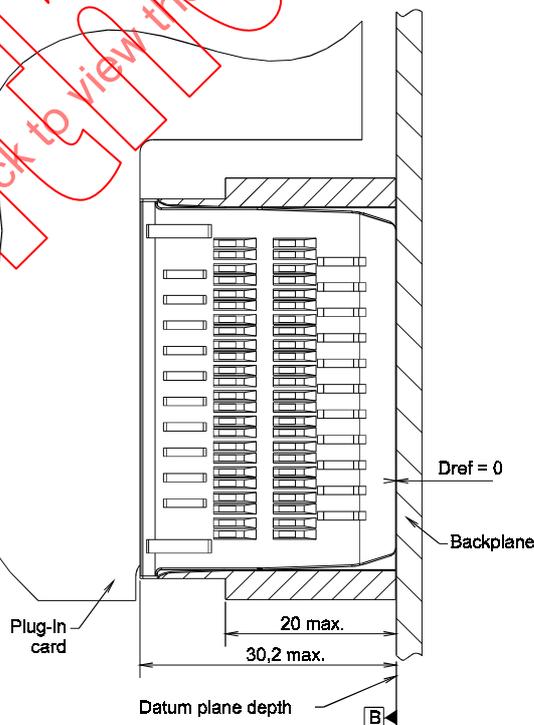
3.2.3. Width dimensions



Note – For guidance the reference planes are shown in accordance with IEC 60917-2-2.

Figure 9 – Width dimensions and mounting pitch

3.2.4. Depth dimensions



Note – For guidance the reference planes are shown in accordance with IEC 60917-2-2.

Figure 10 – Depth dimensions

3.3. Mating information

3.3.1. Engaging direction

Contact range

In the equipment practice the reference plane depth is the front face of the backplane.

On the plug-in unit it is the tip of the paddle-guard.

On full insertion the tip of the paddle-guard comes to a physical stop on the backplane.

The specified contact resistance is guaranteed in a range of 0 to 1,5 mm. This means that the sum of deviations given by potential bow of the backplane (to the rear) and incomplete or tilted insertion of the plug-in unit shall not exceed 1,5 mm.

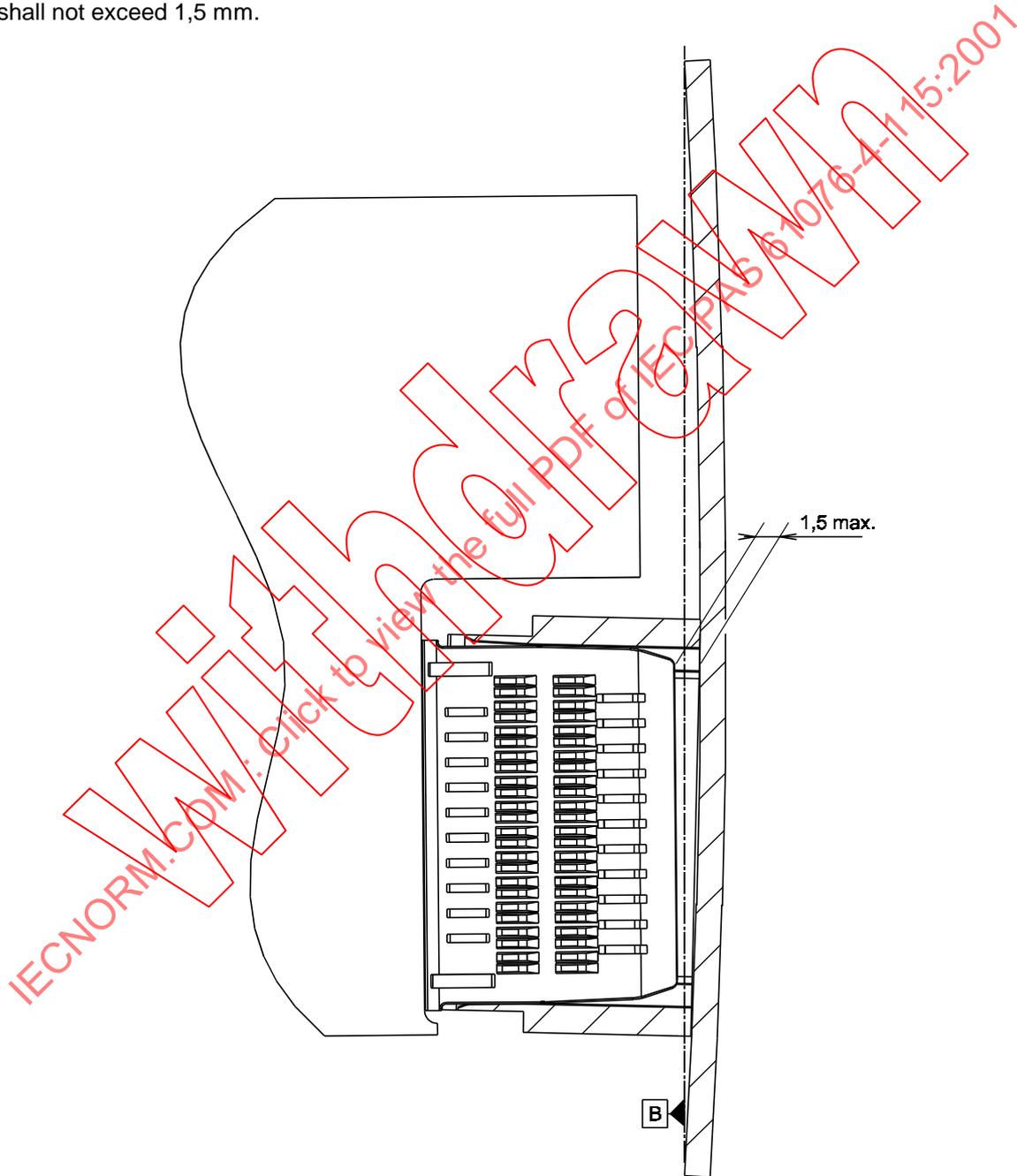


Figure 11 – Contact range in relation to bow and insertion depth

3.3.2. Perpendicular to engaging direction

The design of the lead-in slot and the shape of the paddle-guard shall accept a misalignment of ± 2 mm between paddle-guard and fixed connector in height and width directions.

The card guide shall allow the plug-in unit to align itself freely to the fixed connector.

On the backplane up to four fixed connectors may be stacked in one line, and one plug-in unit may carry up to four paddle-guards. As long as true positioning tolerances in the drilled pattern are in accordance to the mounting dimensions given in 3.7 this shall not cause interferences during engagement.

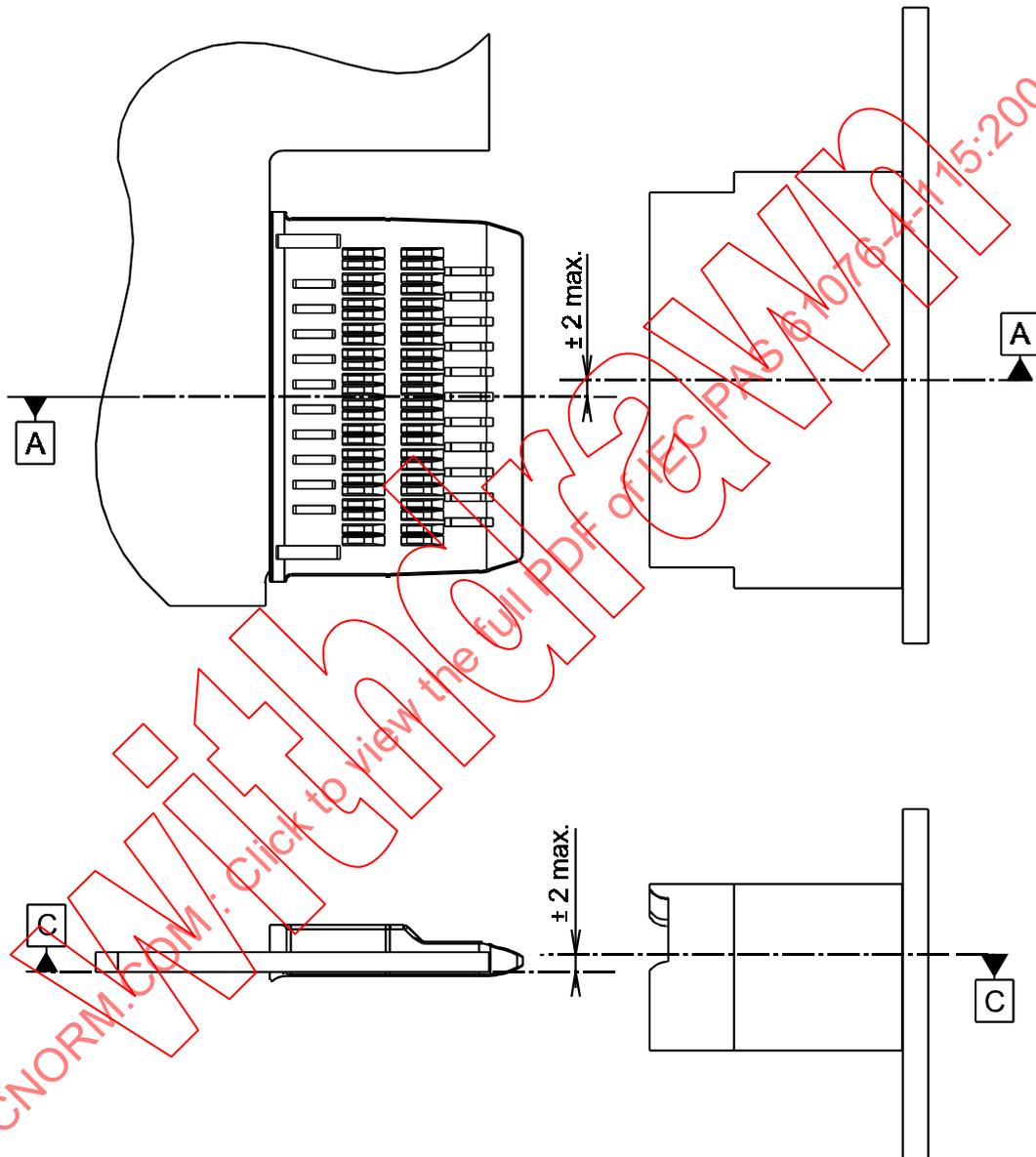


Figure 12 – Allowed misalignment in height and width directions

3.3.3. Inclination

During insertion the inclination of the plug-in unit shall be limited by the card guides of the subrack, it shall never exceed 3° in height and width direction.

In mated situation the inclination of the plug-in unit shall be kept below $\pm 1^\circ$ in height and width direction.

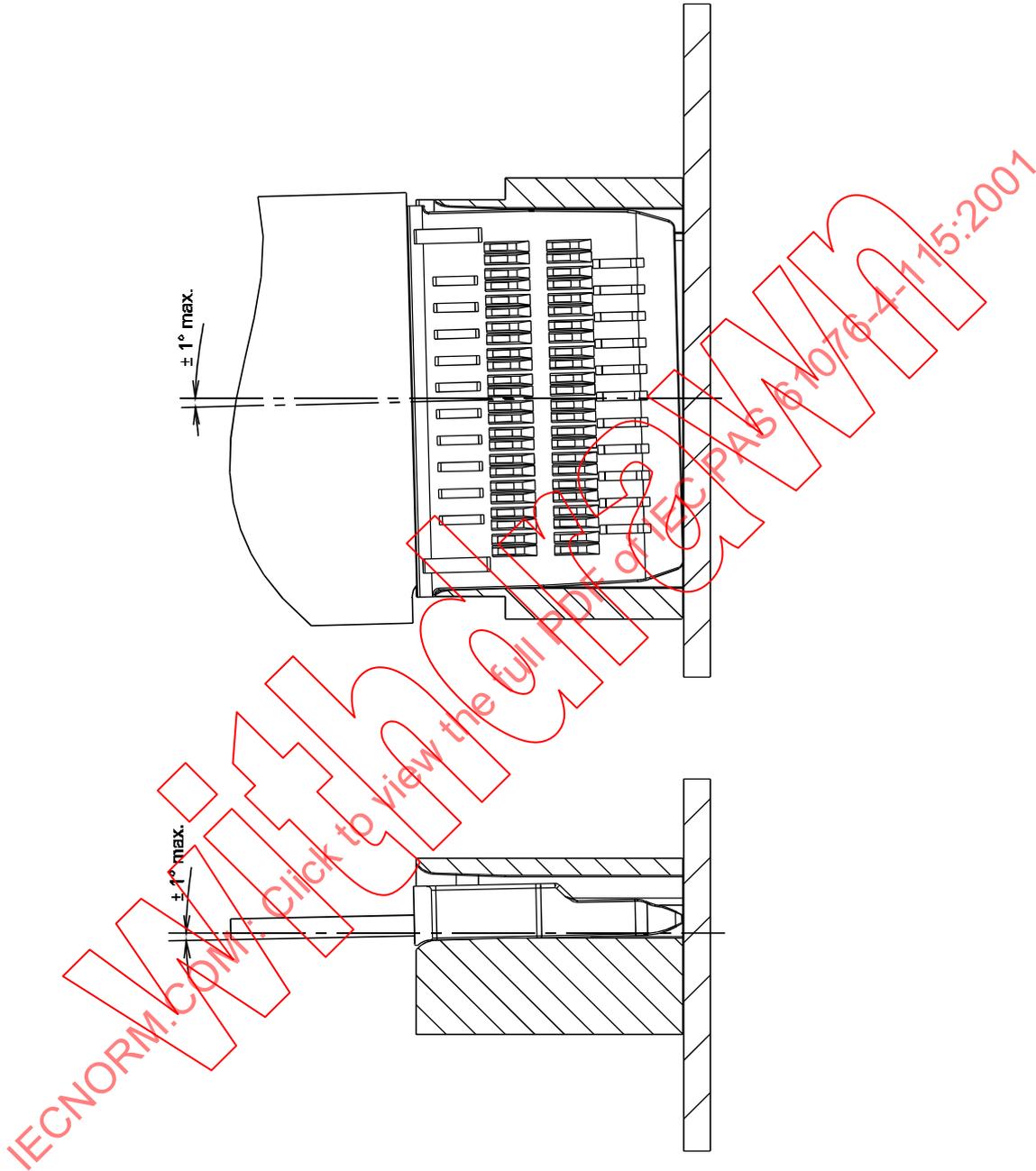


Figure 13 – Allowed inclination in height and width directions (mated situation)

3.4. Fixed connector

3.4.1. Dimensions of fixed connector

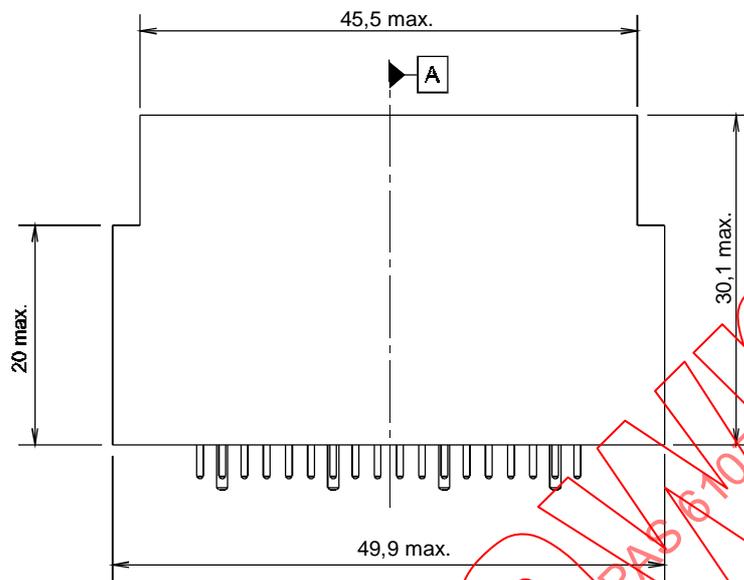


Figure 14 – Overall dimensions of fixed connectors style A and style C

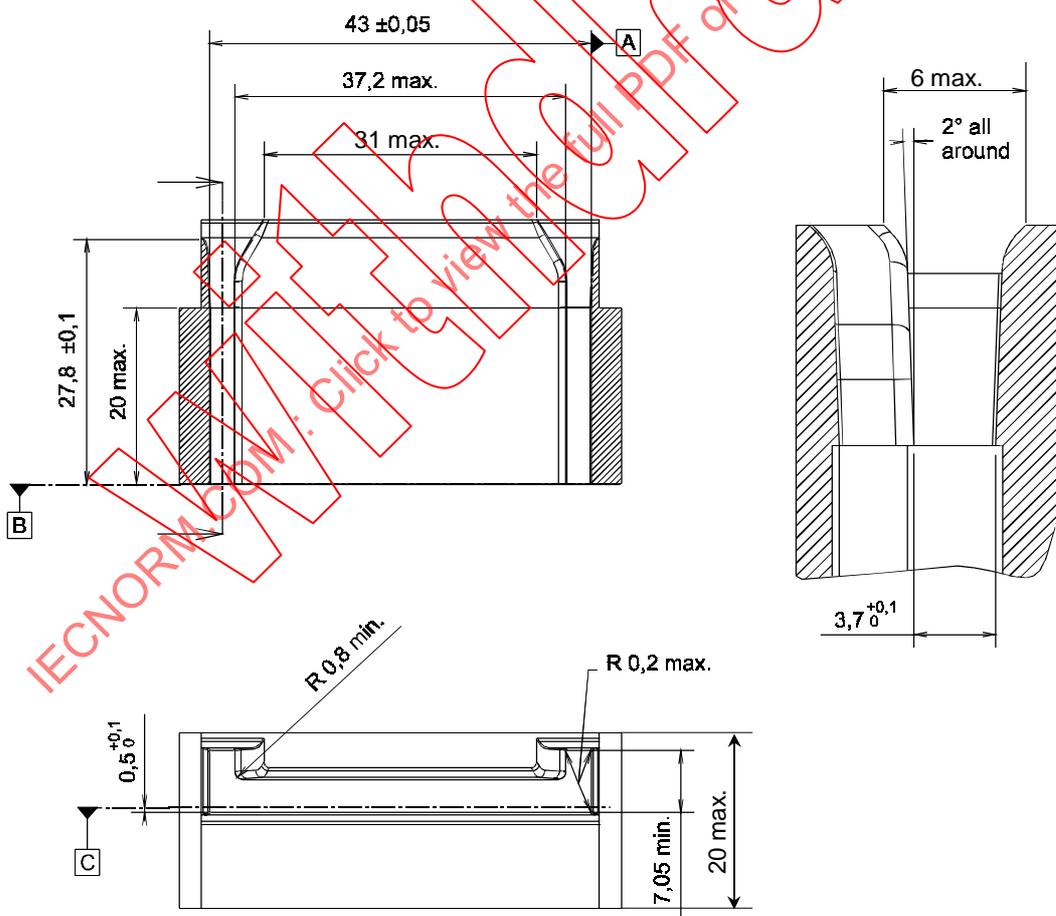


Figure 15 – Detailed dimensions of the lead-in slot

3.4.2. Dimensions of contacts and terminations

In the mated situation the bifurcated beams of the contacts shall meet the positions given below.

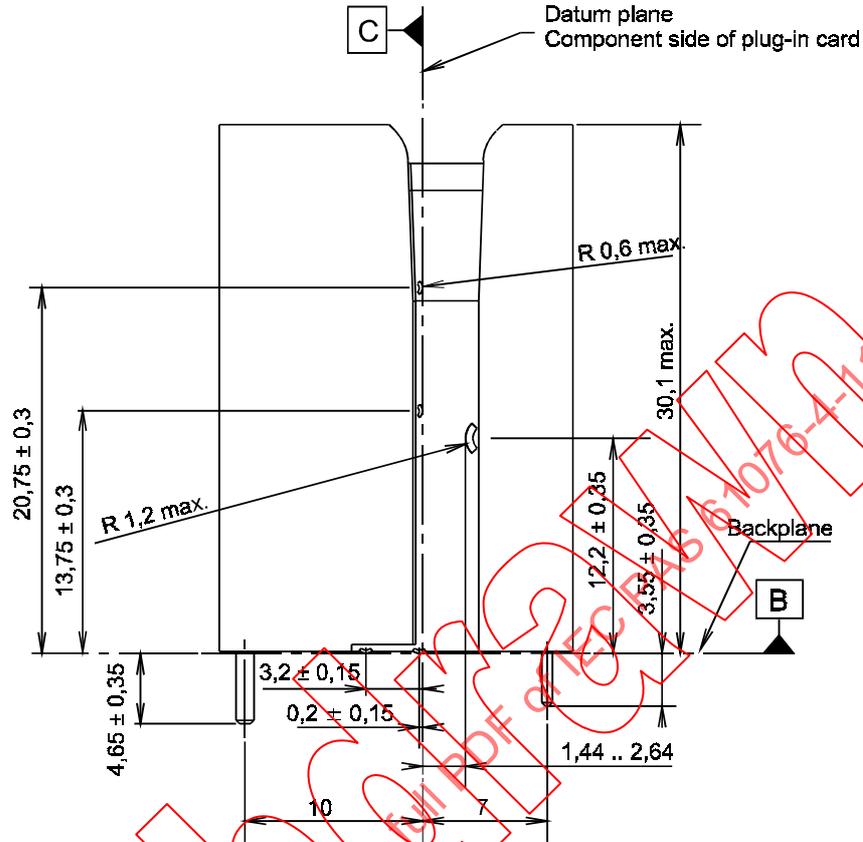


Figure 16 – Position of bifurcated contact beams in mated condition

3.5. Plug-in card paddle

3.5.1. Dimensions of paddle-guard

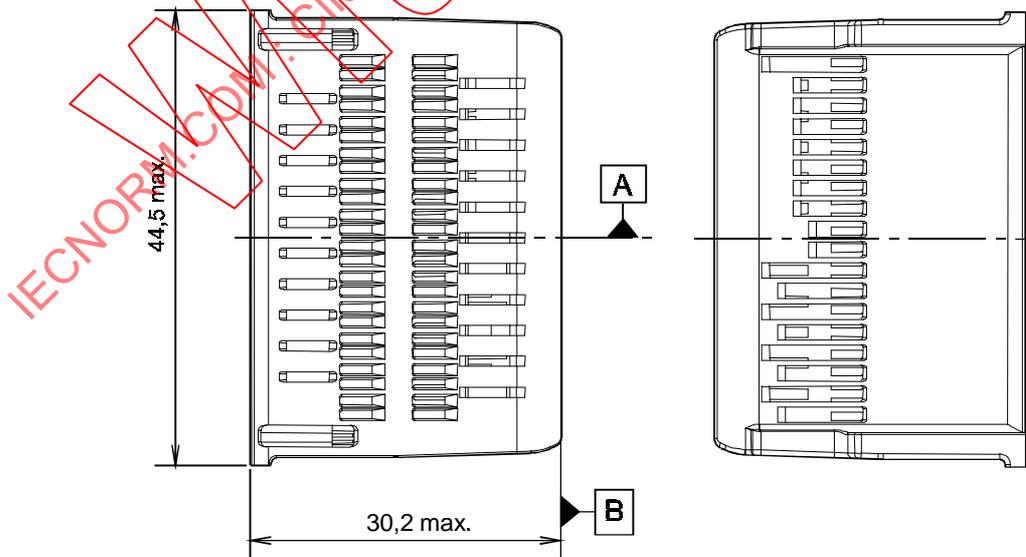
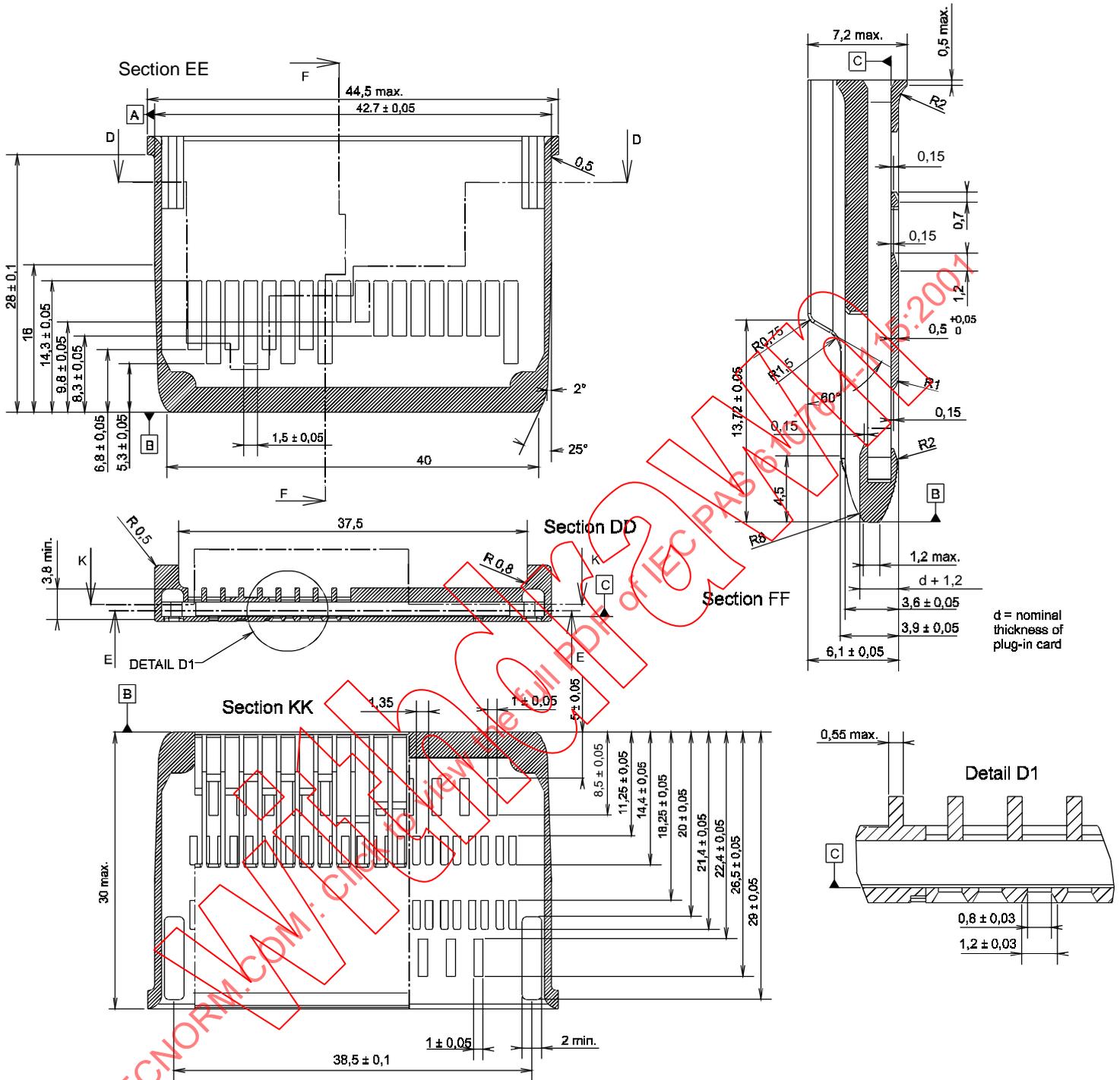


Figure 17 – Overall dimensions of paddle-guard



Note 1 – The apertures of the low-speed section determine the engaging sequence (see 2.3.3). The figure shows the configuration for paddle-guard style I, for InfiniBand applications. Other configurations are under consideration.

Note 2 – The shape of the cavity for the paddle is shown as an example for information only.

Figure 18 – Detailed dimensions of paddle-guard style I

3.6. Mounting information for fixed connector

3.6.1. Footprint for press-in / compression mounted fixed connector

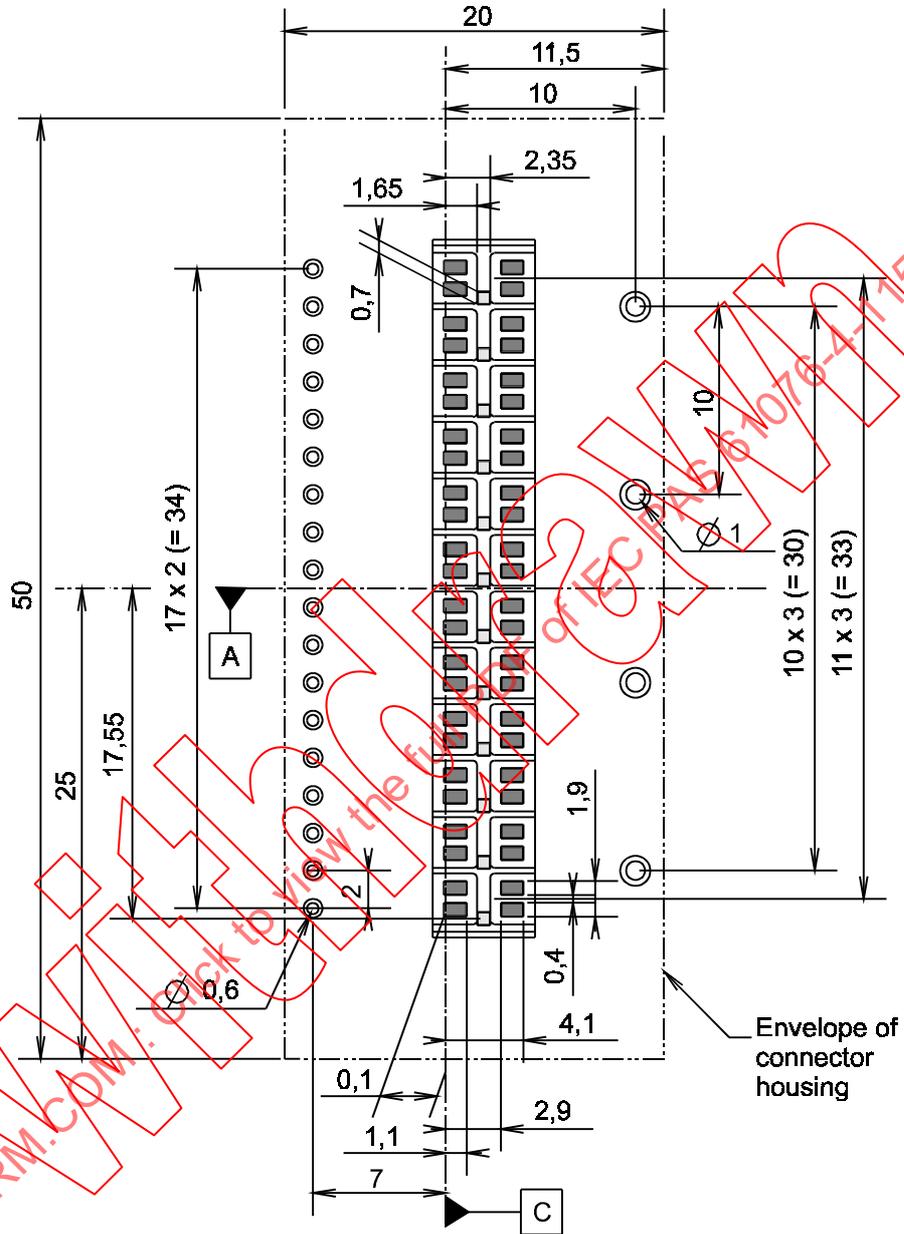


Figure 19 – Footprint on backplane for press-in / compression mounted fixed connector

3.6.2. Footprint for press-in only mounted fixed connector

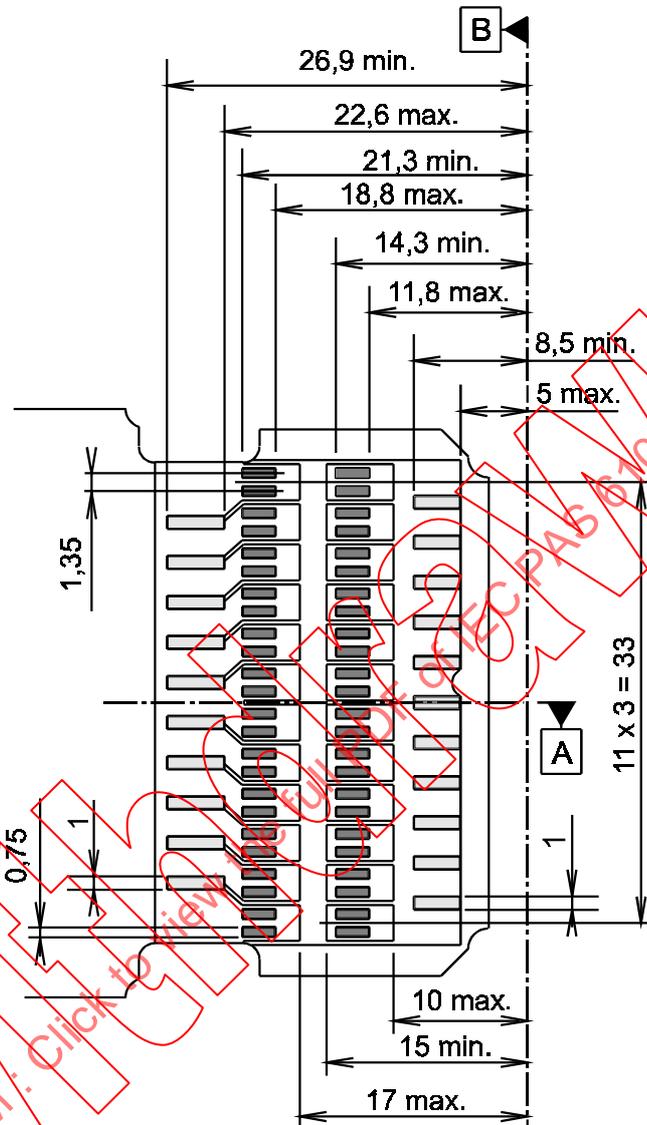
Under consideration

3.6.3. Footprint for surface-mount soldered fixed connector

Under consideration

3.7. Mounting information for paddle-guard

3.7.1. Footprint for high-speed and shielding ground connections

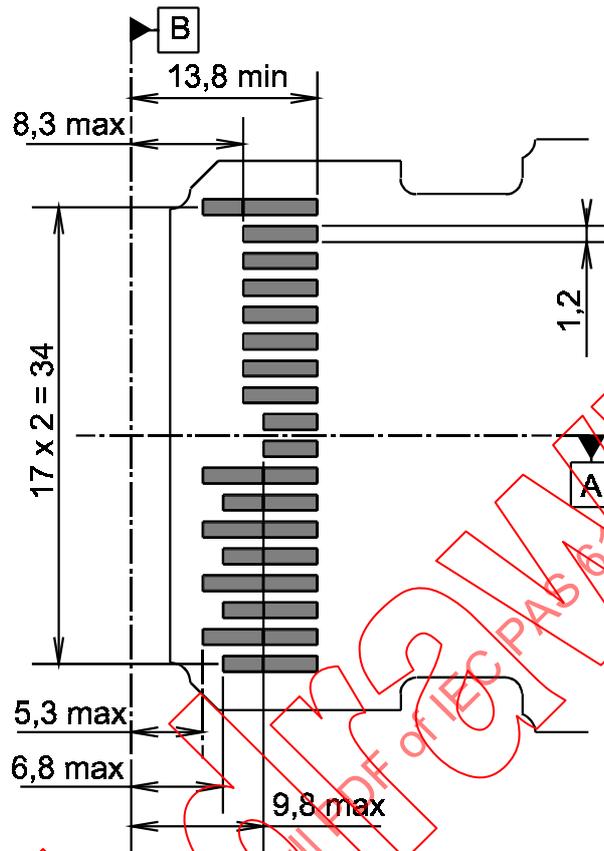


Note 1 – Milled and drilled contours of paddle are shown as an example for information only.

Note 2 – On the component side of the plug-in card the gap between the surface of the paddle and the slot in the paddle-guard shall not exceed 0,1 mm (datum C).

Figure 20 – Detailed dimensions of contact pads for high-speed and shielding ground planes

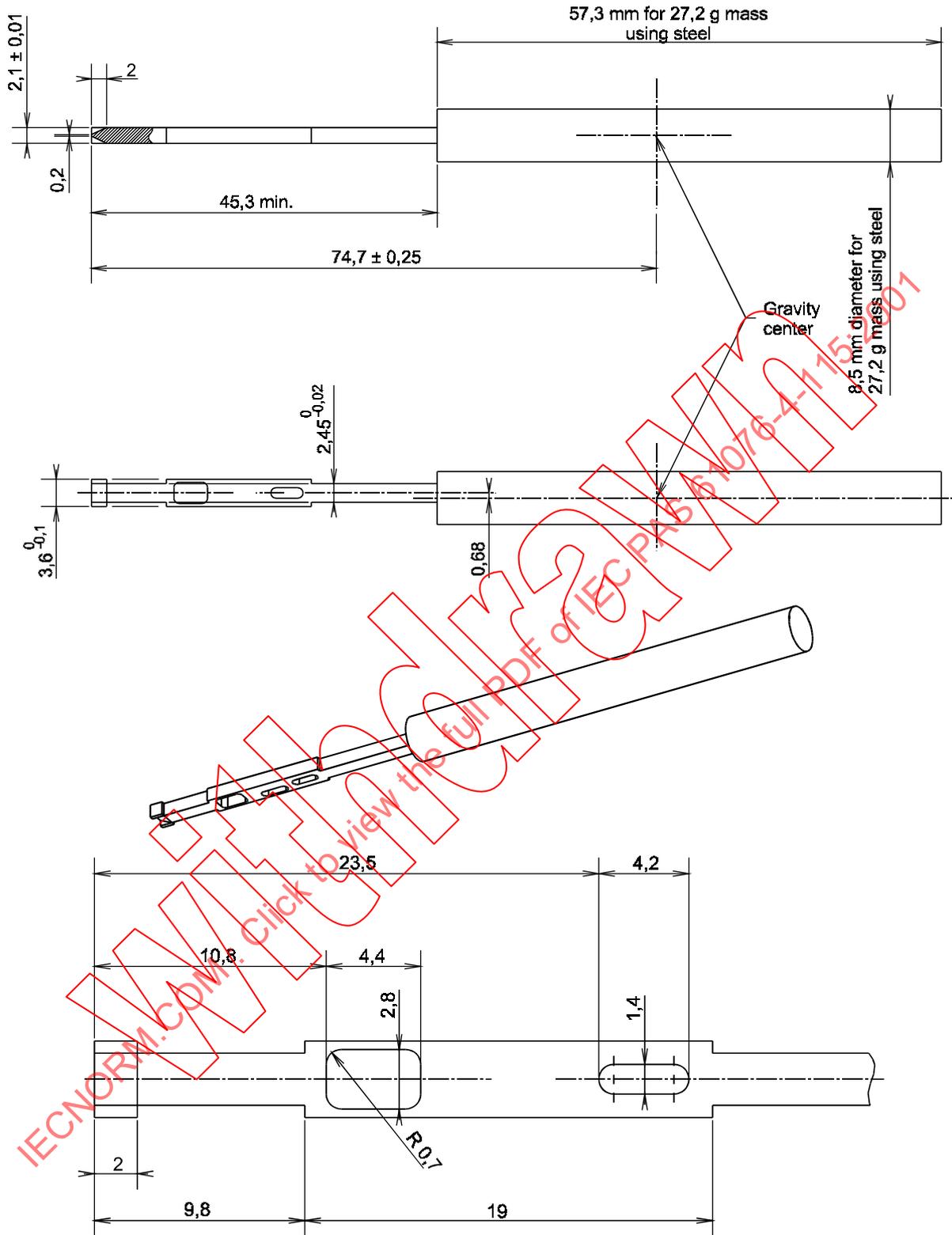
3.7.2. Footprint for low-speed connections



Note – Configuration of mating levels is in accordance with paddle-guard style I and is shown for guidance and information only.

Figure 21 – Detailed dimensions of contact pads for low-speed – example for InfiniBand application

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Note 1 – The leverage factor for the weight of the test gauge is 3,6. In order to test a force of 1 N at 20,75 mm from its tip, the gauge shall have a mass of 27,2 g with its centre of gravity at 74,7 mm from the tip.

Note 2 – The size of the mass is given for information only.

Figure 23 – Gauges for high-speed contacts in row b

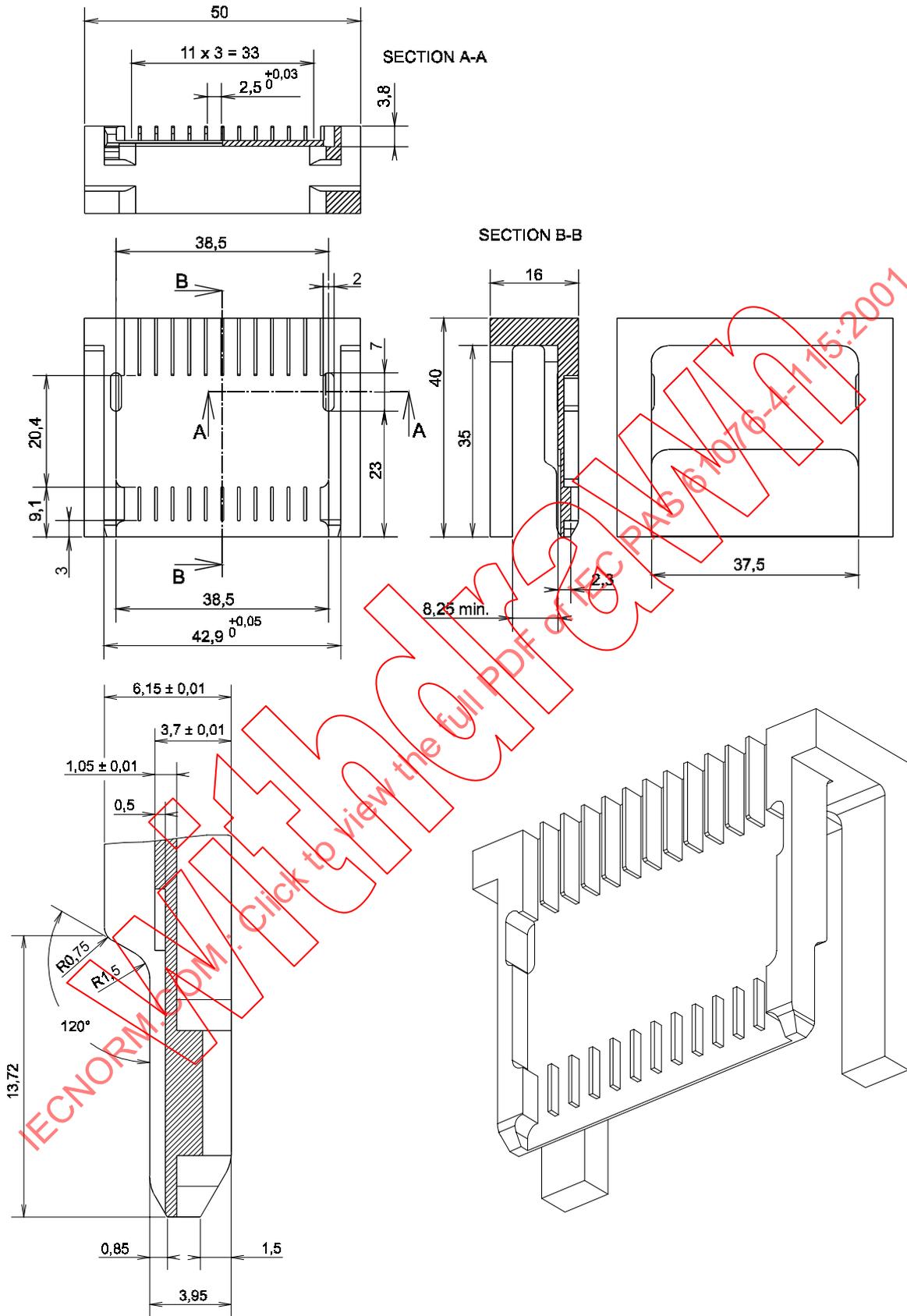


Figure 24 – Holder for test gauges for high-speed section

3.8.2. Sizing and supporting force gauges for low-speed section

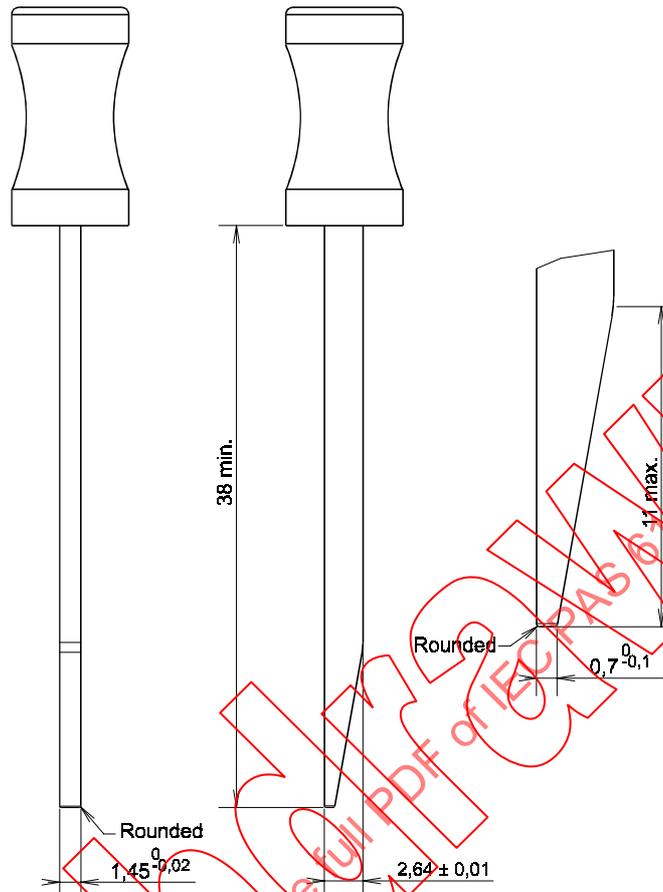
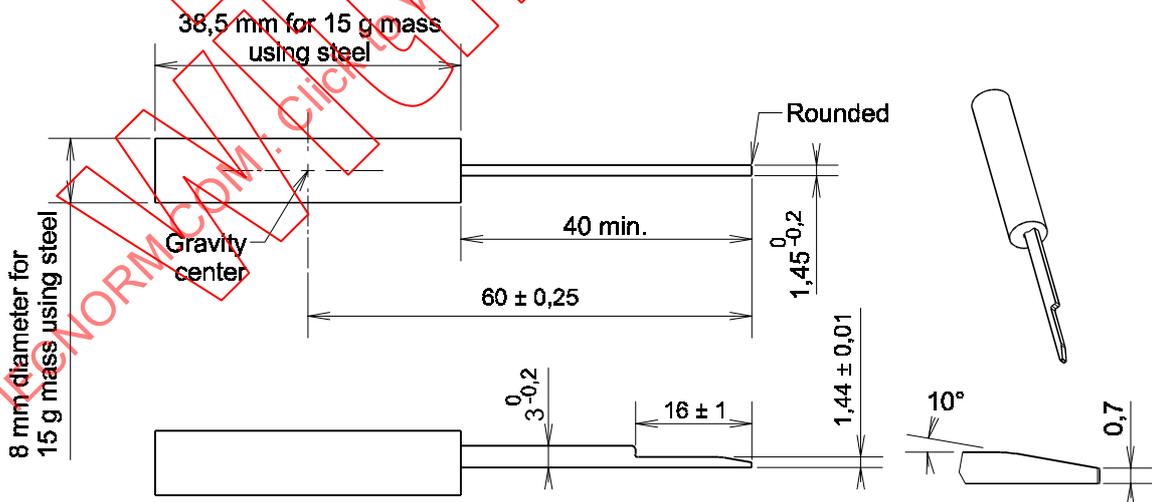


Figure 25 – Sizing gauge for low-speed contacts



Note 1 – The leverage factor for the weight of the test gauge is five. In order to test a force of 0,75 N at 12,2 mm from its tip, the gauge shall have a mass of 15 g with its centre of gravity at 60 mm from the tip.

Note 2 – The size of the mass is given for information only.

Figure 26 – Test gauge for low-speed contacts

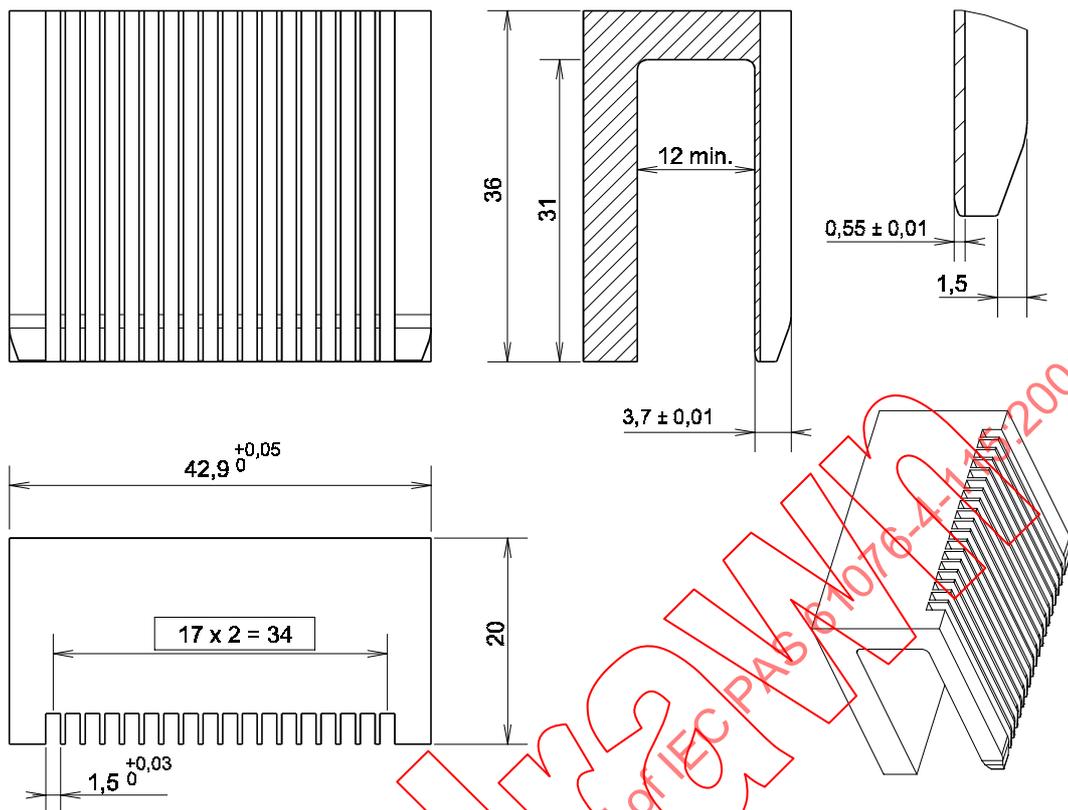


Figure 27 – Holder for test gauges for low-speed section

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4. Characteristics

4.1. Climatic category

Table 8 - Climatic category

Performance level	Climatic category	Category Temperature		Damp Heat, Steady State
		Lower °C	Upper °C	
1	40/100/21	-40	100	21

4.2. Electrical

4.2.1. Creepage and clearance distances

Table 9 – Creepage and clearance distances

	High-speed section	Low-speed section
Between signal and signal	0,3 mm min.	0,8 mm min.
Between signal and ground	0,3 mm min.	0,8 mm min.

4.2.2. Voltage proof

Conditions: IEC 60512-4-1 Test 4a
 Standard atmospheric conditions
 Mated and unmated plug-in card
 Wiring arrangement according to 5.1.5

Table 10 – Rated impulse voltages

	Peak impulse voltage	Overtoltage category	Pollution degree
High-speed signal to signal	800 V	I	1
High-speed signal to ground	800 V	I	1
Low-speed signal to signal	1500 V	II	2 (inside fixed connector)
Low-speed signal to ground	1500 V	II	2 (inside fixed connector)

Table 11 – Rated insulation voltages

	Insulation voltage	Pollution degree
High-speed signal to signal	125 V	1 (inside fixed connector)
High-speed signal to ground	125 V	1 (inside fixed connector)
Low-speed signal to signal	320 V	2
Low-speed signal to ground	320 V	2

4.2.3. Current carrying capacity

Conditions: IEC 60512-5-2 Test 5b
 All contacts loaded
 Standard atmospheric conditions
 Derating curve = 80 % of measured current carrying capacity

High-speed contacts

0,25 A per differential pair at 70°C ambient temperature

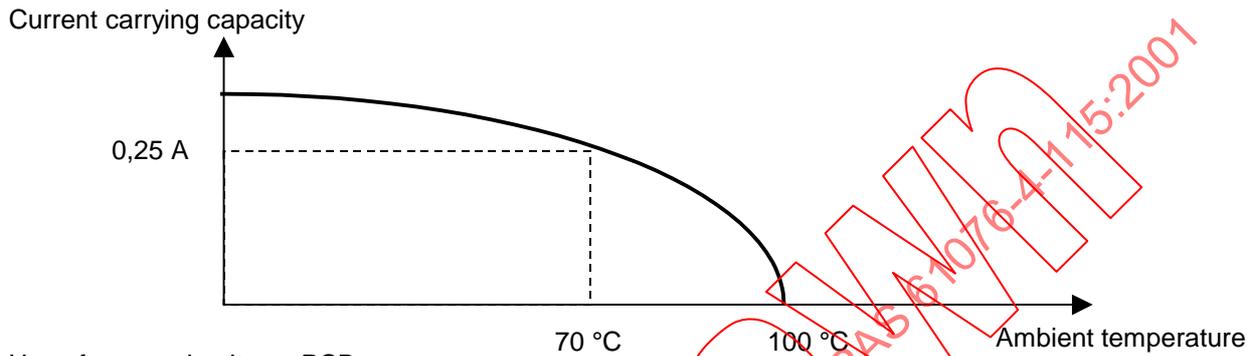


Figure 28 – Derating curve for differential pairs

Low-speed contacts

2,5 A per contact at 70°C ambient temperature

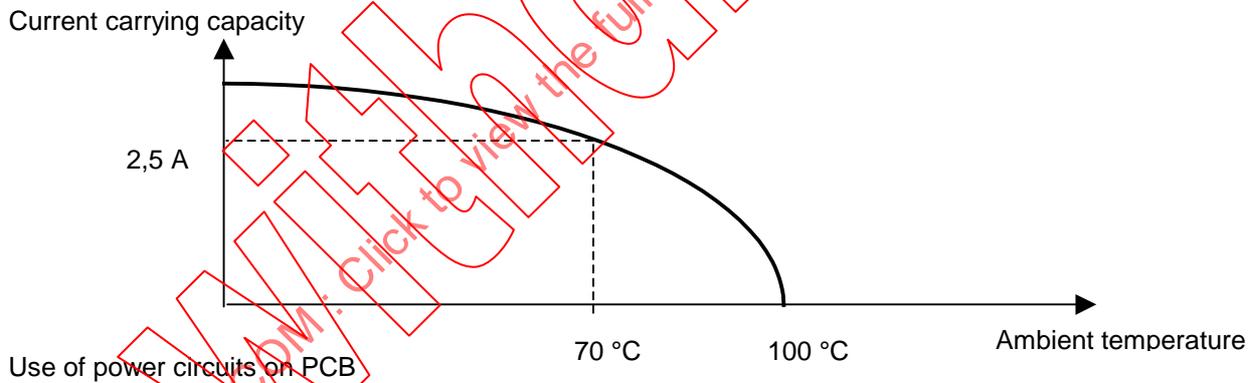


Figure 29 – Derating curve for low-speed contacts

4.2.4. Contact resistance

Conditions IEC 60512-2-1 Test 2a
 Standard atmospheric conditions
 Mated plug-in card
 Connecting points as specified in 5.1.3

Requirements

Table 12 – Maximum contact resistances

	Initial contact resistance	Rise in relation to initial value
High-speed contacts	200 mΩ	20 mΩ
Ground plane around high-speed section	250 mΩ	25 mΩ
Low-speed contacts	15 mΩ	10 mΩ

4.2.5. Insulation resistance

Conditions: IEC 60512-3-1 Test 3a
 Standard atmospheric conditions
 Method B, arrangement see table below
 Mated plug-in card
 Test voltage 100 V d.c.

Table 13 – Minimum Insulation Resistances

	Arrangement	Initial value	After moisture
High-speed contact/contact	12 left to 12 adjacent right contacts	1000 MΩ	50 MΩ
High-speed contact/ground	12 contacts to ground	1000 MΩ	50 MΩ
Low-speed contact/contact	9 contacts to 9 adjacent contacts	5000 MΩ	50 MΩ
Low-speed contact/ground	18 contacts to ground	5000 MΩ	50 MΩ

4.2.6. Inductance

Line inductance in low-speed contact = 50 nH max.

Loop inductance between two adjacent low-speed contacts = 30 nH max.

4.3. Mechanical

4.3.1. Mechanical operation

Conditions	IEC 60512-9-1 Test 9a Standard atmospheric conditions Speed of operations: 10 mm/s max., rest 5 s (unmated)
Requirement	250 mating cycles

4.3.2. Engaging and separating forces

Conditions	IEC 60512-13-1 Test 13a Standard atmospheric conditions Rate of engagement and separation: 10 mm/s max.
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Table 14 – Maximum engaging and separating forces

Style of connector	Style A	Style C
Engaging force	30 N	75 N
Separating force	30 N	75 N

4.3.3. Gauge supporting force

Conditions:	Test procedure see annex A Test gauges and holder for high-speed contacts, see 3.8.1 Sizing and test gauges and holder for low-speed contacts, see 3.8.2 Test arrangement for high-speed section, see 5.1.6 Test arrangement for low-speed section, see 5.1.7
Requirement:	The gauges shall be kept up

4.3.4. Vibration (sinusoidal)

Conditions	IEC 60512-6-4 Test 6d Standard atmospheric conditions. Mated plug-in card The specimen shall be installed in a suitable fixture, as specified in 5.1.4.
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Table 15 - Vibration

Severity	Requirement
10 Hz to 500 Hz with an amplitude of 0,35 mm or an acceleration of 50 m/s ² 8 sweepings in each of three axes, total duration 3x2 h	Duration of contact disturbance 1 µs max.

4.3.5. Shock

Conditions IEC 60512-6-3 Test 6c
 Standard atmospheric conditions. Mated plug-in card
 The specimen shall be installed in a fixture as specified in 5.1.4.

Table 16 - Shock

Severity	Requirement
Shock acceleration 500 m/s ² , duration of impact 11 ms Five shocks in two directions/axis, in three axes	Duration of contact disturbance 1 μs max.

4.3.6. Polarising method

Conditions IEC 60512-13-5 Test 13e
 Standard atmospheric conditions
 The plug-in card shall be aligned to the slot in the fixed connector after a 180° rotation.
 Rate of engagement: 10 mm/s max.

Requirement The polarising features on the fixed connector housing and on the paddle-guard shall withstand an engagement force of 250 N without damage that would impair normal operation.

4.3.7. Retention of fixed connector on backplane

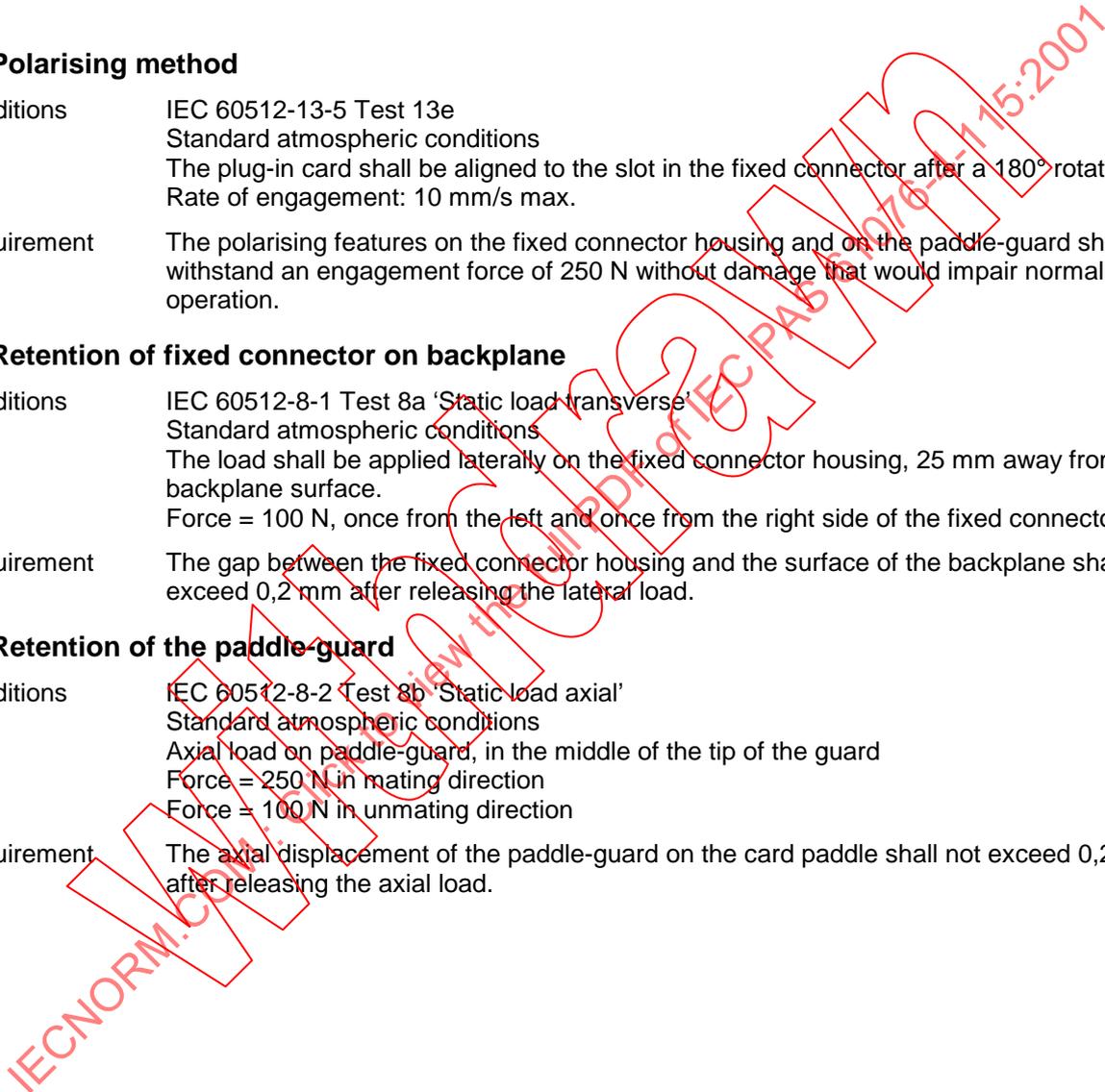
Conditions IEC 60512-8-1 Test 8a 'Static load transverse'
 Standard atmospheric conditions
 The load shall be applied laterally on the fixed connector housing, 25 mm away from backplane surface.
 Force = 100 N, once from the left and once from the right side of the fixed connector.

Requirement The gap between the fixed connector housing and the surface of the backplane shall not exceed 0,2 mm after releasing the lateral load.

4.3.8. Retention of the paddle-guard

Conditions IEC 60512-8-2 Test 8b 'Static load axial'
 Standard atmospheric conditions
 Axial load on paddle-guard, in the middle of the tip of the guard
 Force = 250 N in mating direction
 Force = 100 N in unmating direction

Requirement The axial displacement of the paddle-guard on the card paddle shall not exceed 0,2 mm after releasing the axial load.



4.4. High-speed characteristics

4.4.1. Differential impedance

Conditions	IEC 60512-23-4 Test 23d Test method B, layout of test boards see, 5.1.2 Specimen environment impedance = 100 Ω differential Measured step risetime (10% - 90%) throughout the connector 100 ps max. Adjacent lines terminated at both ends Signal to ground pattern according to footprints in 3.6.1 and 3.7.1
Requirements	Impedance profile of contact rows a and b, including contact pads and via-holes if applicable: Average value = 100 $\Omega \pm 5 \Omega$ Peak tolerance band = 100 $\Omega \pm 10 \Omega$

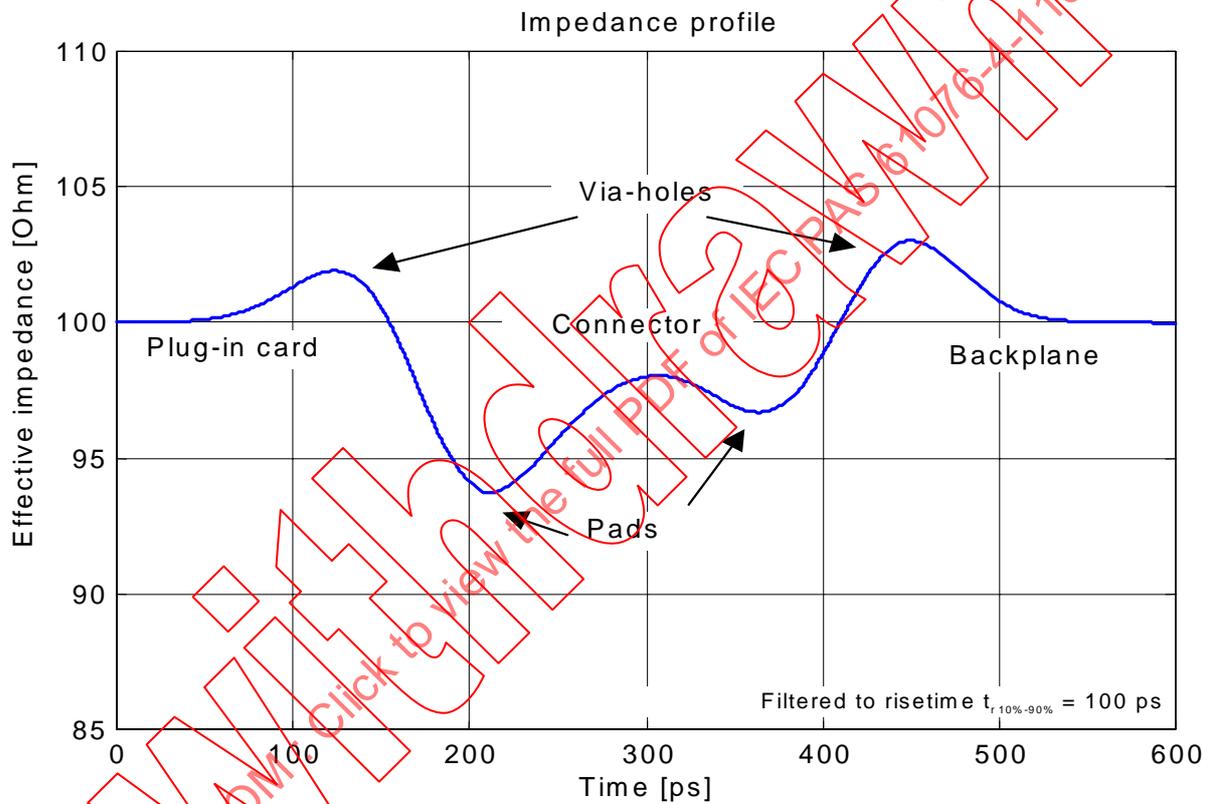


Figure 30 – Typical impedance profile, including pads and via-holes (example for guidance only)

4.4.2. Differential crosstalk

Conditions IEC 60512-25-1 Test 25a
Method A time domain, layout of test boards see 5.1.2
Specimen environment impedance = 100 Ω differential
Measured step risetime (10% - 90%) throughout the connector 100 ps max.
Adjacent lines terminated at both ends
Signal to ground ratio according to footprints in 3.6.1 and 3.7.1

Requirements All crosstalk characteristics to be provided as time domain graphs, showing their relative position to the connector area including contact pads and via-holes (if applicable).

Differential near-end crosstalk and far-end crosstalk

Crosstalk between facing pairs in rows a and b < 1 %

Crosstalk between adjacent pairs in row a < 1,5 %

Crosstalk between adjacent pairs in row b < 1,5 %

Crosstalk between one silent pair (in row a as well as in row b) and five surrounding pairs being driven simultaneously < 3 %.

The five following values shall be superimposed:

- to the left and to the right
- facing to the next row
- diagonally facing to the left and to the right in the next row.

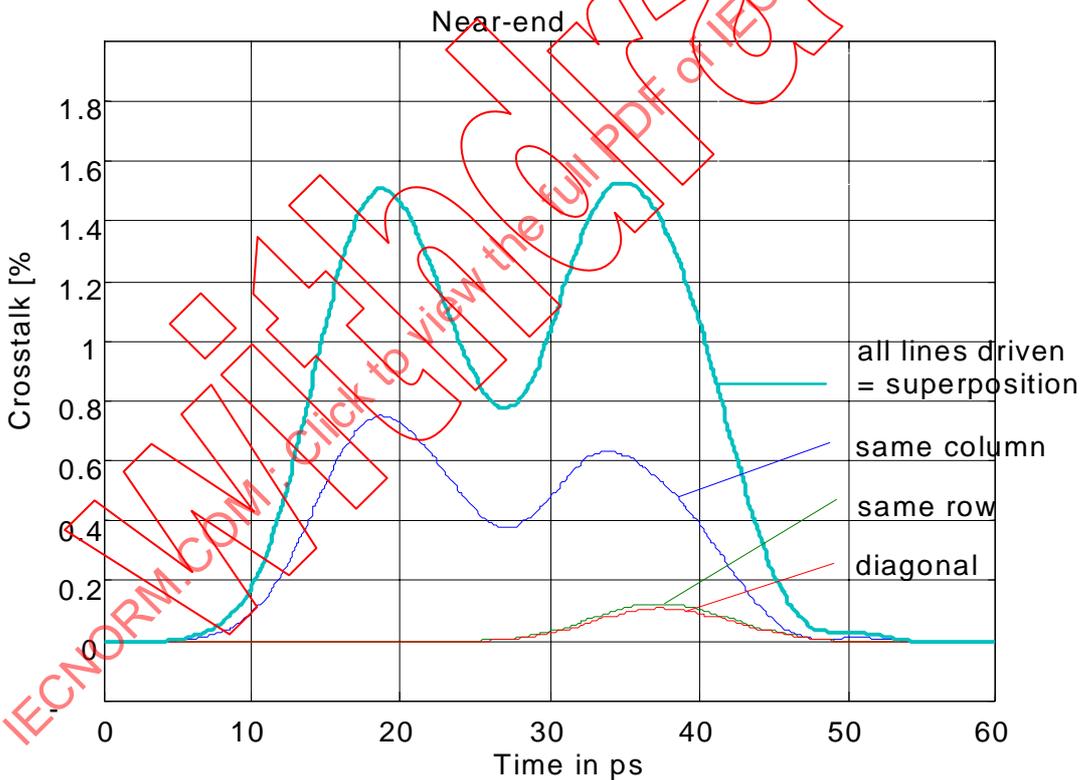


Figure 31 – Superposition of typical near-end cross-talk curves (example for guidance only)

4.4.3. Differential attenuation

Conditions	IEC 60512-25-2 Test 25b Layout of test boards see 5.1.2 Specimen environment impedance = 100 Ω differential Adjacent lines terminated at both ends Signal to ground ratio according to footprints in 3.6.1 and 3.7.1
Requirement	Differential attenuation < 5% at 1,25 GHz Frequency domain graph of attenuation in % for contact rows a and b Frequency range 0 Hz to 5 GHz Measured transmission line shall include contact pads and via-holes (if applicable).

4.4.4. Propagation delay skew

The measured transmission line shall include contact pads and via-holes (if applicable).

Table 17 - Propagation delay skew

Skew within differential pair	5 ps max.
Skew between pairs in the same row	10 ps max.
Skew between pairs in different rows	50 ps max.

5. Test schedule

5.1. General

This test schedule shows all 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.

Unless otherwise specified, mated sets of fixed connectors and plug-in cards shall be tested. Care shall be taken to keep the particular combinations of fixed connectors and plug-in cards together during the complete test sequence, i.e. when unmating is necessary for a certain test, the same fixed connectors and plug-in cards as before shall be mated for the subsequent tests.

- **For the test groups P to F (electromechanical test sequence)**, a set of two mounted fixed connectors on one test backplane and a test plug-in card with two paddle-guards is called a "specimen". The two connectors in a given specimen shall be used for the following measurements :
 Connector a = contact resistance measurements
 Connector b = contact disturbance / current carrying capacity / insulation resistance / voltage proof

One specimen in test group P shall not be mounted and be dedicated to the test phase P1, visual examination and examination of dimensions and mass. This specimen is not available for further testing.

When the initial tests have been completed, all 24 specimens shall be divided up according to the remaining test groups.

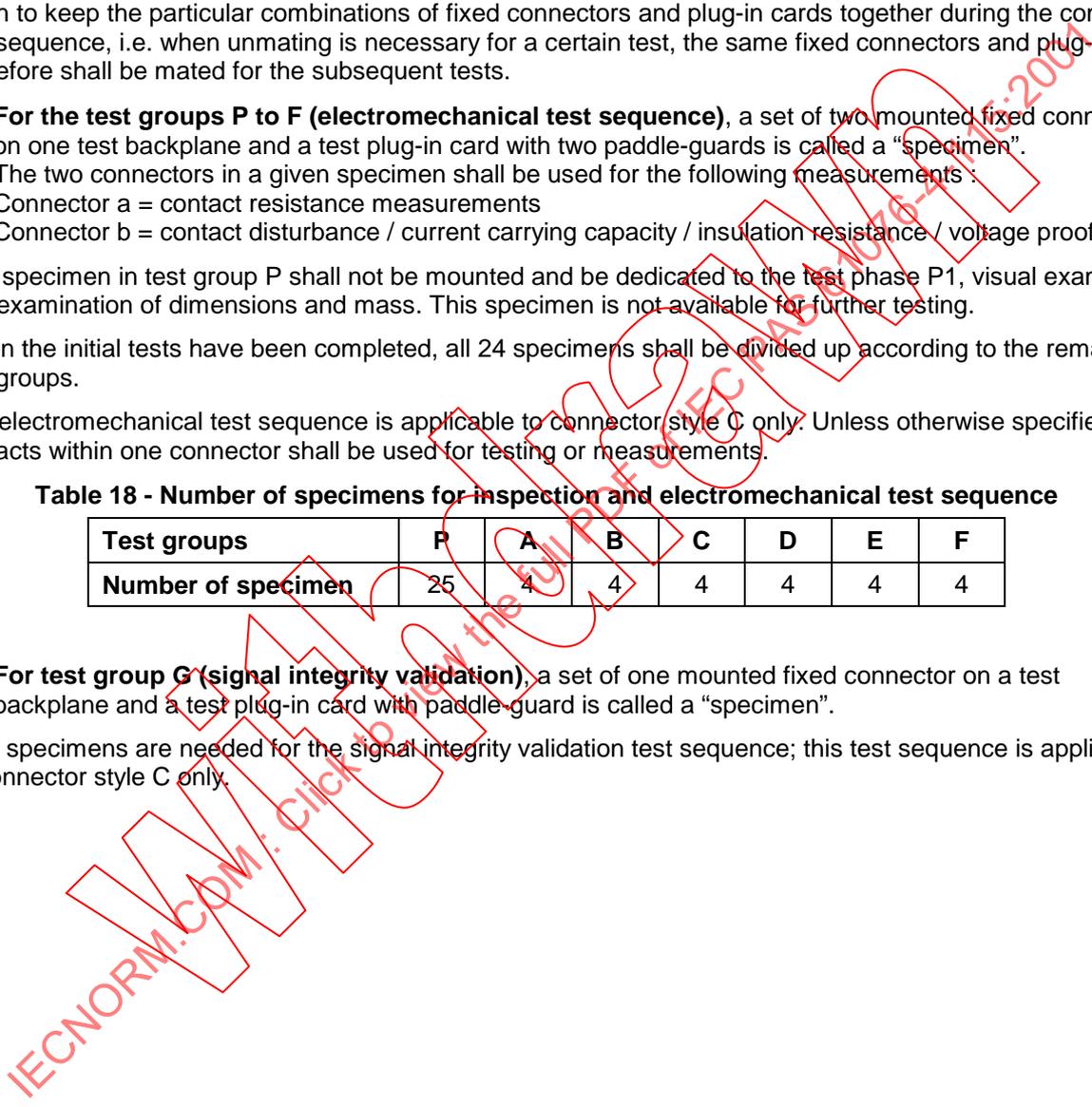
The electromechanical test sequence is applicable to connector style C only. Unless otherwise specified all contacts within one connector shall be used for testing or measurements.

Table 18 - Number of specimens for inspection and electromechanical test sequence

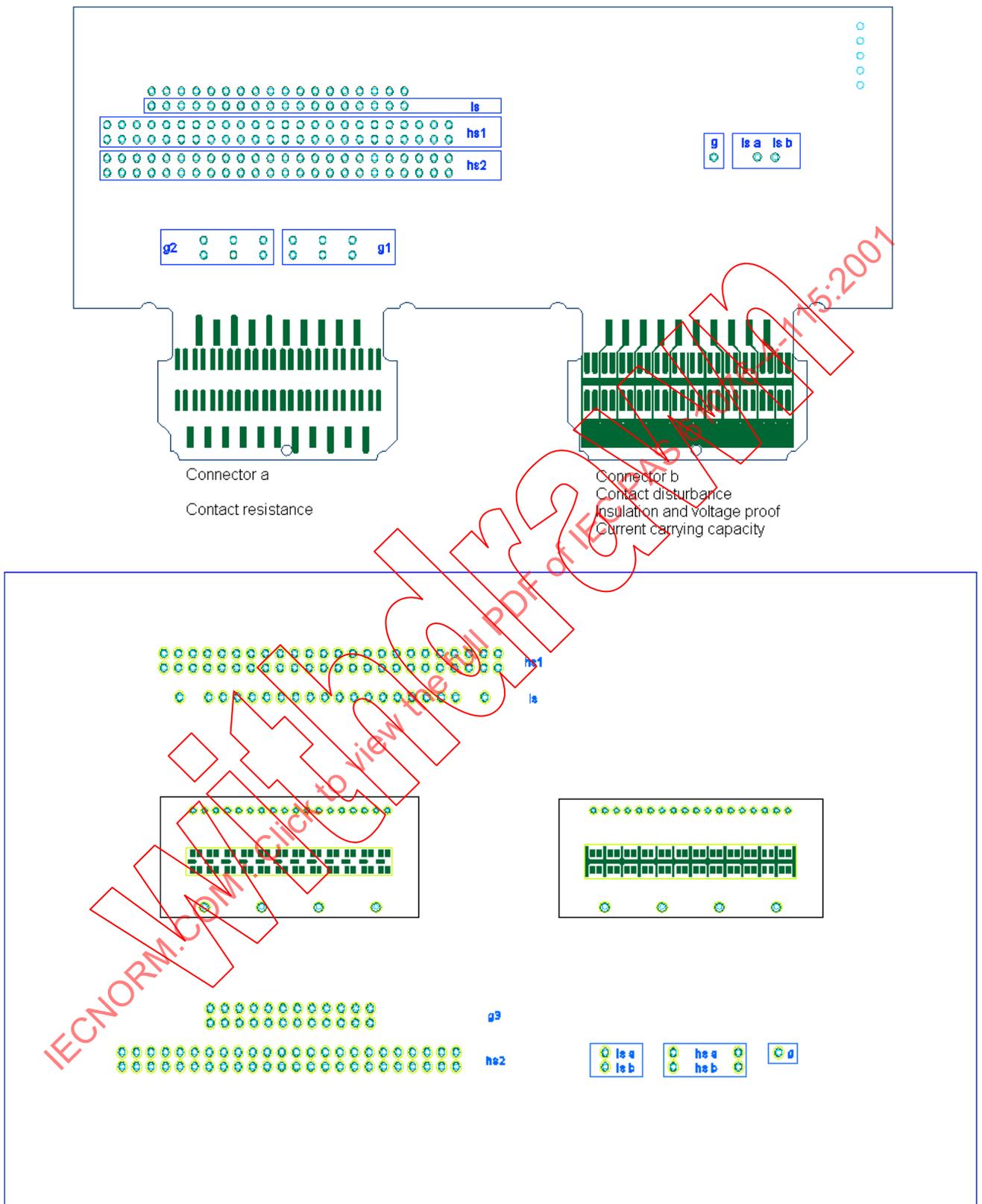
Test groups	P	A	B	C	D	E	F
Number of specimen	25	4	4	4	4	4	4

- **For test group G (signal integrity validation)**, a set of one mounted fixed connector on a test backplane and a test plug-in card with paddle-guard is called a "specimen".

Four specimens are needed for the signal integrity validation test sequence; this test sequence is applicable to connector style C only.



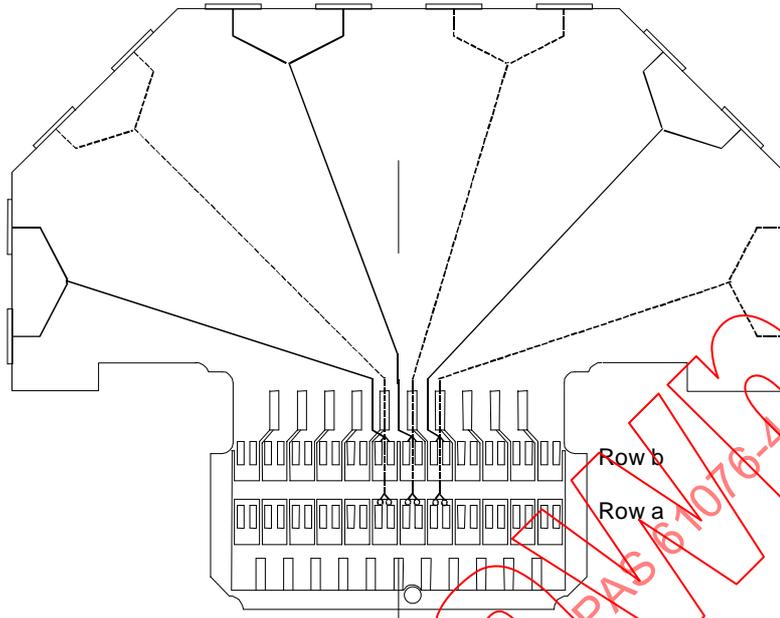
5.1.1. Layout of printed circuit boards for electromechanical tests



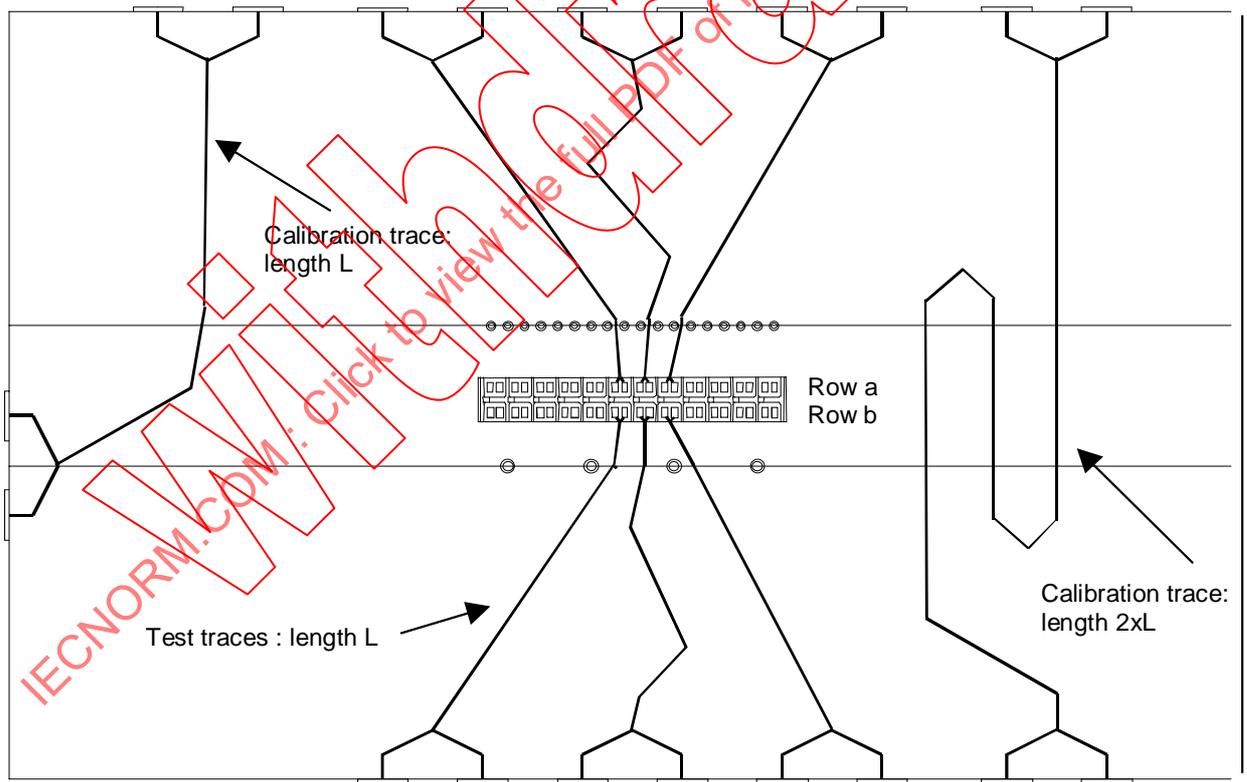
Note – The arrangement of the connectors for measuring purposes is shown as an example for information only.

Figure 32 – Layout of plug-in card and backplane for one electromechanical test specimen

5.1.2. Layout of printed circuit boards for signal integrity validation



Note – Transmission lines to row b may use the top layer, however to reach row a via-holes may be necessary.



Note – Preferably the test board shall provide calibration lines to allow an isolation standard of the test fixture from the interconnection under test.

Figure 33 – Layout of printed circuit boards for signal integrity validation

5.1.3. Arrangement for contact resistance measurement

Conditions: IEC 60512-2-1 Test 2a

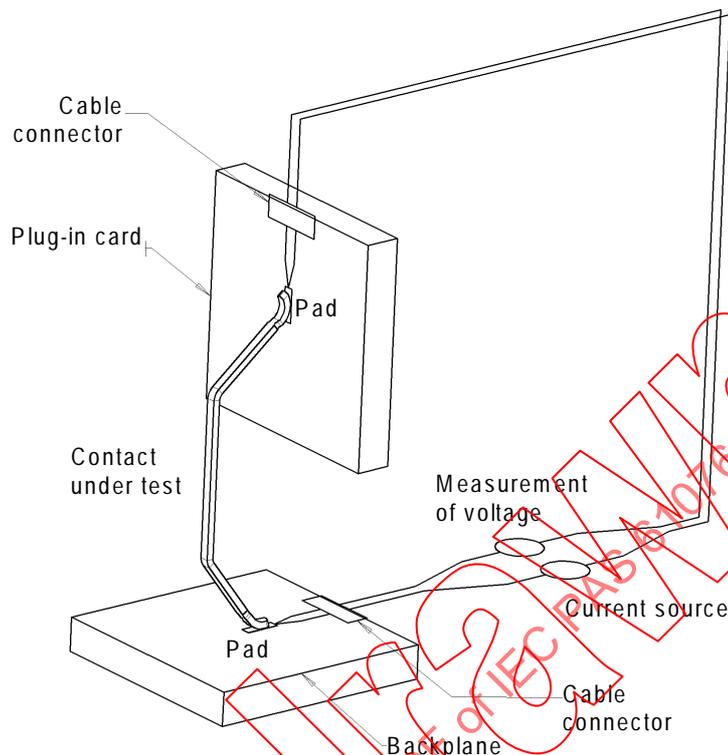


Figure 34 – Arrangement for measurement of contact resistance

5.1.4. Arrangement for dynamic stress tests

Conditions: IEC 60512-6-3 and -6-4 Tests 6c and 6d

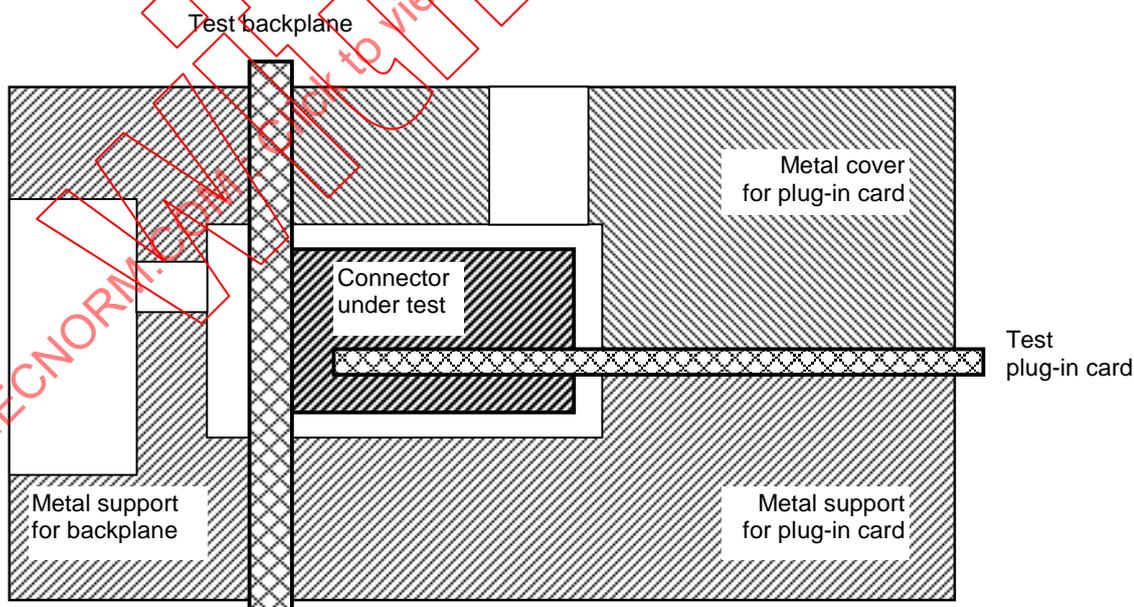


Figure 35 – Fixture for dynamic stress tests

5.1.5. Arrangement for insulation resistance, voltage proof and polarisation voltage

Conditions: IEC 60512-3-1 and -4-1, Tests 3a and 4a and polarisation voltage during damp heat, steady state

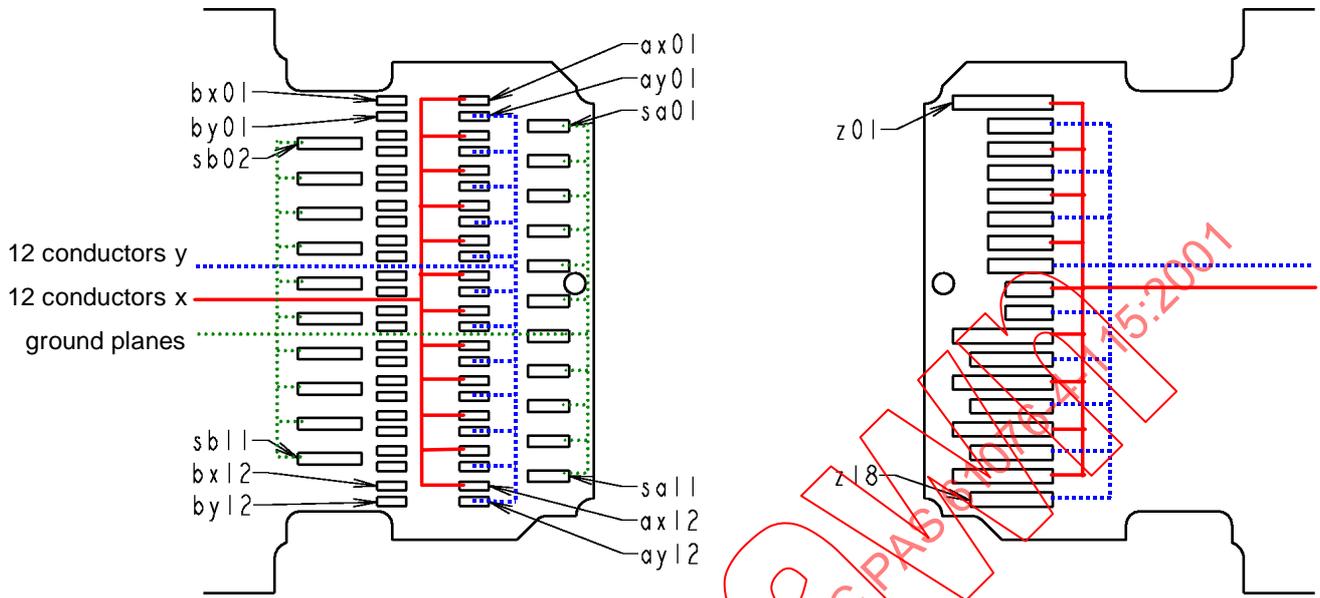
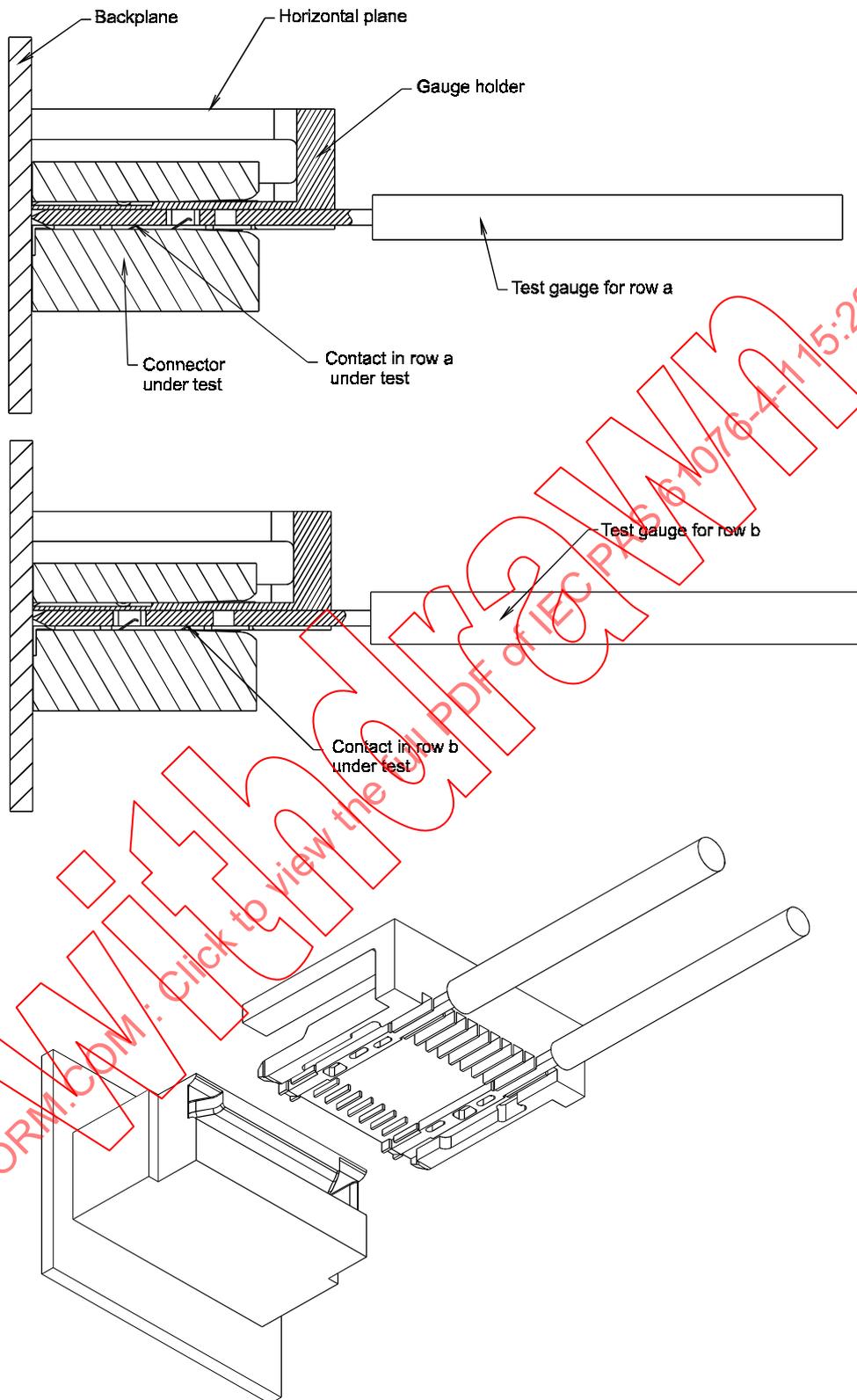


Figure 36 – Wiring arrangement for voltage proof and polarisation voltage

5.1.6. Arrangement for gauge supporting force test on high-speed contacts



Note – The test gauges shall be placed in the gauge holder before inserting them into the fixed connector.

Figure 37 – Arrangement for gauge supporting force test on high-speed contacts

5.1.7. Arrangement for gauge supporting force test on low-speed contacts

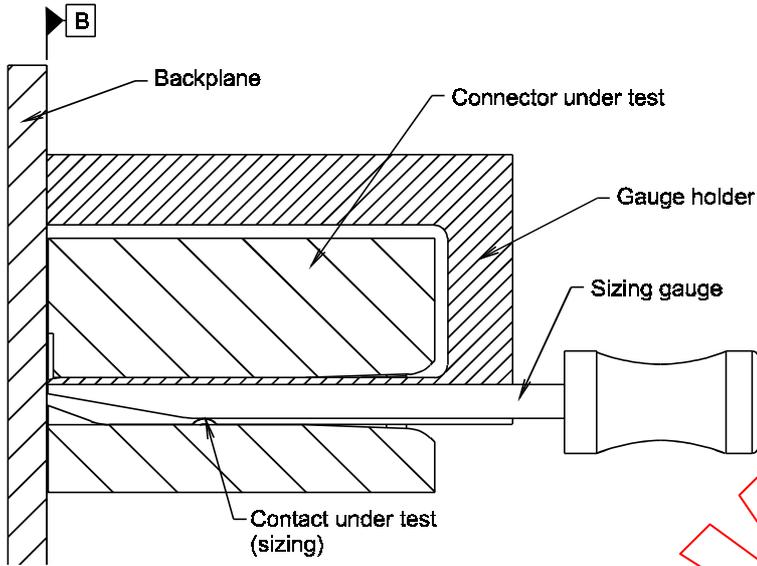


Figure 38 – Arrangement for sizing on low-speed contacts

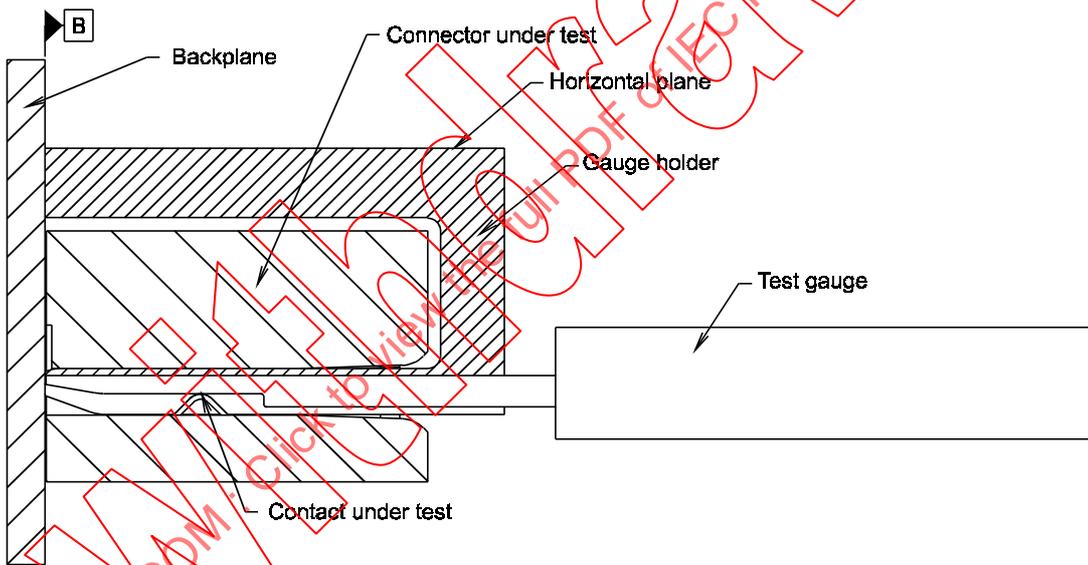


Figure 39 – Arrangement for gauge supporting force test on low-speed contacts

5.2. Test schedule tables

5.2.1. Group P - Preliminary

One specimen shall be used for test phase P1 only, the other 24 specimens shall be submitted to the rest of the electromechanical test sequence.

Table 19 - Group P - Preliminary testing sequence

Test phase	IEC 60512			Measurement to be performed	IEC 60512	Requirements
	Title	Test No.	Severity or condition of test	Title	Test No.	
P1	General examination		One specimen dedicated to examination Unmounted fixed connectors Mounted paddle-guards	Visual examination	1a	There shall be no defect that would impair normal operation
			Connector interface Footprint on backplane Interface dimensions of paddle-guard Creepage and clearance distances	Examination of dimensions and mass	1b	The dimensions shall comply with those specified in 3, including the gap between paddle and paddle-guard (datum C)
P2			Test method see annex A 5 differential pairs per specimen 5 low-speed contacts per specimen Sizing and test gauges see 3.8 Test arrangement see 5.1.6 and 5.1.7	Gauge supporting force		The gauge shall be kept up
P3			Speed = 10 mm/s max. Plug-in card insertion and extraction	Engaging and separating forces	13a	See 4.3.2
P4			Max voltage = 20 mV in open circuit Max current = 100 mA Connecting points: see 5.1.3	Contact resistance	2a	High-speed contacts = 200 mΩ max. Low-speed contacts = 15 mΩ max. Ground planes = 250 mΩ max.
P5			Test voltage 100 V d.c. Method B Mated plug-in cards Arrangement according to 5.1.5	Insulation resistance	3a	1000 MΩ min. between high-speed contacts mutually and between ground 5000 MΩ min. between low-speed contacts mutually and between ground
P6			Method B Mated plug-in cards Test voltage 500 V r.m.s. between high-speed contacts and ground Test voltage 1000 V r.m.s. between low-speed contacts and ground Arrangement according to 5.1.5	Voltage proof	4a	There shall be no breakdown or flashover

The 24 specimens shall be divided into six groups (see 5.1).

5.2.2. Group A - Dynamic / Climatic

Table 20 - Group A - Dynamic / Climatic testing sequence

Test phase	IEC 60512			Measurement to be performed	IEC 60512	Requirements
	Title	Test No.	Severity or condition of test	Title	Test No.	
A1	Vibration	6d	Arrangement in fixture 5.1.4. Frequency 10 Hz to 500 Hz Amplitude 0,35 mm or 50 m/s ² Eight sweepings in each of three axes Full duration 3 × 2 h	Contact disturbance	2e	Duration of disturbance 1 μs max.
			Max voltage = 20 mV in open circuit Max current = 100 mA Connecting points: see 5.1.3	Contact resistance	2a	Rise in relation to initial values High-speed contacts = 20 mΩ max. Low-speed contacts = 10 mΩ max. Ground planes = 5 mΩ max.
			Unmated plug-in card	Visual examination	1a	There shall be no defect that would impair normal operation
A2	Shock	6c	Arrangement in fixture 5.1.4 Shock acceleration 500 m/s ² Duration of impact 11 ms Five shocks in two directions of three axes	Contact disturbance	2e	Duration of disturbance 1 μs max.
			Max voltage = 20 mV in open circuit Max current = 100 mA Connecting points: see 5.1.3	Contact resistance	2a	Rise in relation to initial values High-speed contacts = 20 mΩ max. Low-speed contacts = 10 mΩ max. Ground planes = 5 mΩ max.
			Unmated plug-in card	Visual examination	1a	There shall be no defect that would impair normal operation
A3	Rapid change of temperature	11d	-40 °C to 100 °C Five cycles 30 min/temperature Recovery time 2 h 2 specimens mated, 2 unmated			
			Test voltage 100 V d.c. Method B Mated plug-in cards Arrangement according to 5.1.5	Insulation resistance	3a	1000 MΩ min. between high-speed contacts mutually and between ground 5000 MΩ min. between low-speed contacts mutually and between ground
			Method B Mated plug-in cards Test voltage 500 V r.m.s. between high-speed contacts and ground Test voltage 1000 V r.m.s. between low-speed contacts and ground Arrangement according to 5.1.5	Voltage proof	4a	There shall be no breakdown or flashover
			Unmated plug-in card	Visual examination	1a	There shall be no defect that would impair normal operation
A4	Climatic sequence	11a				
A4.1	Dry heat		100 °C, unloaded Duration 16 h, recovery time 2 h Test voltage 100 V d.c. Method B 2 specimens mated, 2 unmated Arrangement according to 5.1.5	Insulation resistance at high temperature	3a	1000 MΩ min.
A4.2	Damp heat, cyclic first cycle		40 °C, 6 cycles, variant 2 2 specimens mated, 2 unmated			
A4.3	Cold		-40 °C, duration 2 h Recovery time 2 h 2 specimens mated, 2 unmated			