

# INTERNATIONAL STANDARD

**Connectors for electrical and electronic equipment –  
Part 6: Detail specification for 2-way and 4-way (data/power), shielded, free and  
fixed connectors for power and data transmission with frequencies up to  
600 MHz**

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INTERNATIONAL  
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**CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –****Part 6: Detail specification for 2-way and 4-way (data/power),  
shielded, free and fixed connectors for power and data  
transmission with frequencies up to 600 MHz**

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This second edition cancels and replaces the first edition published in 2020. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Mating conditions changed, see Figure 2, Figure 4, Figure 13, Figure 15, Figure 19 and Figure 21.
- b) Voltage proof requirement added, 2 250 V DC, see 5.7.2.
- c) Mechanical shock requirement added, see 5.7.6 (the requirement itself already was specified indirectly by Ed1 due to the specification of the test EP3 of Table 14 which is still identical to Ed1).

d) Styles added, 6P-M8CI and 6J-M8CI, see Table 1.

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

FDIS	Report on voting
48B/2907/FDIS	48B/2917/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

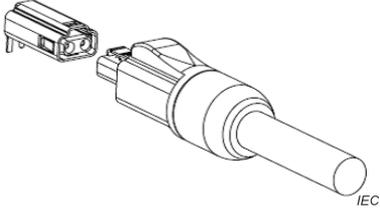
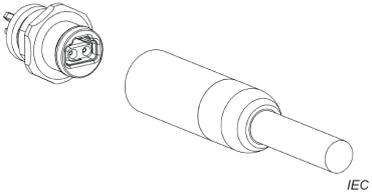
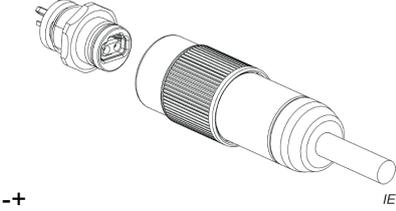
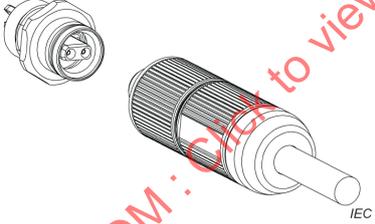
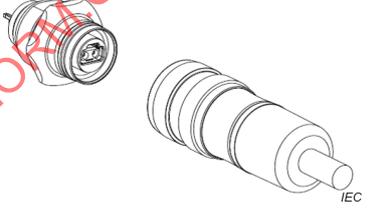
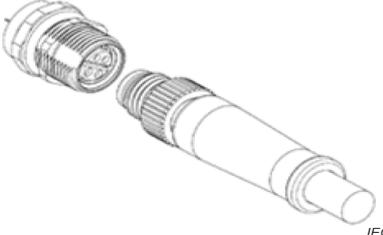
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A list of all parts in the IEC 63171 series, published under the general title *Connectors for electrical and electronic equipment*, can be found on the IEC website.

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<b>IEC SC 48B – Electrical connectors</b> <b>Specification available from: IEC General secretariat or from the addresses shown on the inside cover.</b>	<b>IEC 63171-6 Ed. 2</b>
DETAIL SPECIFICATION in accordance with IEC 61076-1	
	2-way data IP20, latch locking
	2-way data IP65/IP67, snap-in locking
	2-way data IP65/IP67, push-pull locking
	2-way data IP65/IP67, M8 screw locking
	2-way data IP65/IP67, M12 screw locking or push-pull locking (or both)
	4-way (2 power + 2 data) IP65/IP67, M8 screw locking

## CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –

### Part 6: Detail specification for 2-way and 4-way (data/power), shielded, free and fixed connectors for power and data transmission with frequencies up to 600 MHz

#### 1 Scope

This document covers 2-way and 4-way (data/power), shielded, free and fixed connectors for data transmission with frequencies up to 600 MHz and specifies the common dimensions, mechanical, electrical and transmission characteristics and environmental requirements as well as test specifications.

NOTE 1 This 63171-6 document is not fully harmonized with the content and structure of IEC 63171. There are several specifications in both documents which are overlapping. In any case the provisions within this document prevail.

NOTE 2 The connectors are intended to be used for single-pair Ethernet (SPE) according to the following IEEE Standards: 10BaseT1 (IEEE 802.3cg), 100Base-T1 (IEEE 802.3bw), 1000Base-T1 (IEEE 802.3bp), and optionally with Power over Data line (PoDL) power supply according to IEEE 802.3bu.

#### 2 Normative references

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

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

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

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

IEC 60352 (all parts), *Solderless connections*

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

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 60512-2-5, *Connectors for electronic equipment – Tests and measurements – Part 2-5: Electrical continuity and contact resistance tests – Test 2e: Contact disturbance*

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 60512-6-4, *Connectors for electronic equipment – Tests and measurements – Part 6-4: Dynamic stress tests – Test 6d: Vibration (sinusoidal)*

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

IEC 60512-9-2, *Connectors for electronic equipment – Tests and measurements – Part 9-2: Endurance tests – Test 9b: Electrical load and temperature*

IEC 60512-11-3, *Connectors for electronic equipment – Tests and measurements – Part 11-3: Climatic tests – Test 11c: Damp heat, steady state*

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 60512-11-10, *Connectors for electronic equipment – Tests and measurements – Part 11-9: Climatic tests – Test 11j: Cold*

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

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

IEC 60512-13-5, *Connectors for electronic equipment – Tests and measurements – Part 13-5: Mechanical operation tests – Test 13e: Polarizing and keying method*

IEC 60512-15-6, *Connectors for electronic equipment – Tests and measurements – Part 15-6: Connector tests (mechanical) – Test 15f: Effectiveness of connector coupling devices*

IEC 60512-25-7, *Connectors for electronic equipment – Tests and measurements – Part 25-7: Test 25g – Impedance, reflection coefficient, and voltage standing wave ratio (VSWR)*

IEC 60512-25-9, *Connectors for electrical equipment – Tests and measurements – Part 25-9: Signal integrity tests – Test 25i: Alien crosstalk*

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 60512-28-100, *Connectors for electrical and electronic equipment – Tests and measurements – Part 28-100: Signal integrity tests up to 2 000 MHz – Tests 28a to 28g*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60603-7:2020, *Connectors for electronic equipment – Part 7: Detail specification for 8-way, unshielded, free and fixed connectors*

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

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

IEC 61076-2-010, *Connectors for electrical and electronic equipment – Product requirements – Part 2-010: Circular connectors – Detail specification for connectors with outer or inner push-pull locking mechanism, based on mating interfaces according to IEC 61076-2-101, IEC 61076-2-109, IEC 61076-2-111 and IEC 61076-2-113*

IEC 61076-2-101: *Connectors for electronic equipment – Product requirements – Part 2-101: Circular connectors – Detail specification for M12 connectors with screw-locking*

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

IEC 61156 (all parts), *Multicore and symmetrical pair/quad cables for digital communications*

IEC 61984, *Connectors – Safety requirements and tests*

IEC 62153-4-15, *Metallic communication cable test methods – Part 4-15: Electromagnetic compatibility (EMC) – Test method for measuring transfer impedance and screening attenuation – or coupling attenuation with triaxial cell*

IEC 63171:2021, *Connectors for electrical and electronic equipment – Shielded or unshielded free and fixed connectors for balanced single-pair data transmission with current-carrying capacity – General requirements and tests*

### **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 Common features and typical connector pair**

### **4.1 Systems of levels – Compatibility levels**

#### **4.1.1 Performance level**

Connectors according to this document are classified by mating performance level (MPL). See 5.7.1 for details.

#### **4.1.2 Compatibility levels**

##### **Compatibility levels are according to IEC 61076-1**

##### **a) Intermateability**

Intermateability as defined in Clause B.3 of IEC 61076-1:2006 standardizes only dimensions of electrical and mechanical interfaces. Intermateability shall be 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 as defined in Clause B.5 of IEC 61076-1:2006 shall be assured by compliance with the specified interface dimensions and by compliance with the requirements in 5.2 through 5.7 proven by the respective testing sequences in Clause 6.

### **4.2 Classification into climatic categories**

See 5.2.

### **4.3 Clearance and creepage distances**

See 5.3.1.

### **4.4 Current carrying capacity**

See 5.3.4

### **4.5 Marking**

The marking of the connector and the packaging shall be in accordance with 2.7 of IEC 61076-12006.

### **4.6 Dimensional information**

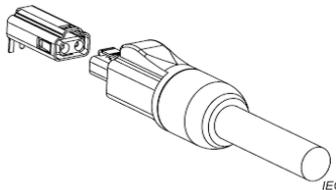
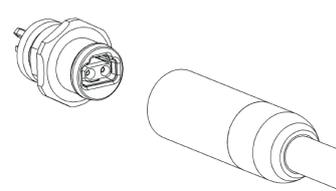
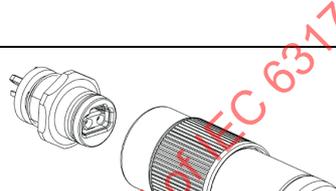
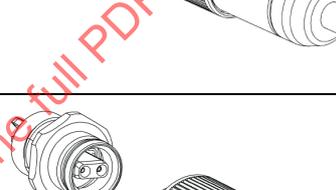
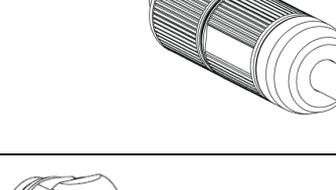
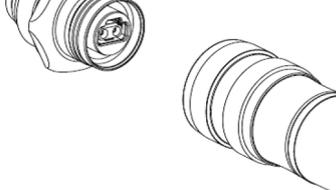
#### **4.6.1 General**

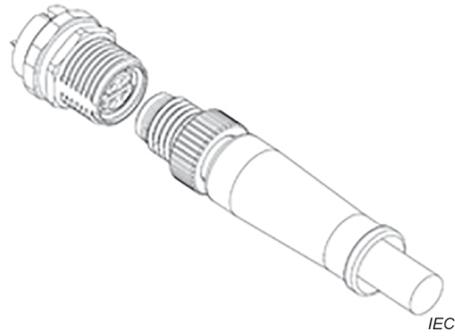
Drawings are shown in the first angle projection. The shape of connectors may deviate from those shapes given in the following figures as long as the specified dimensions are not influenced. Coordination dimensions are dimensions without tolerances which indicate the boundary or centre-line references in order to allow for (modular) arrangement.

#### **4.6.2 Isometric view and common features – Connector styles**

Table 1 shows an overview of connector styles specified in this document.

**Table 1 – Connector styles**

Style	Description	Figures	Picture <sup>3</sup>
2P-L	PLUG <sup>1</sup> – Free 2-way IP20 connector with male contacts, latch locking	Figure 3 Figure 4	
2J-L	JACK <sup>1</sup> – Fixed 2-way IP20 connector with female contacts, latch locking, intended for PCB mounting	Figure 1 Figure 2	
6P-S8		Figure 7	
6J-S8	JACK <sup>1</sup> – Fixed 2-way IP65/IP67 connector with female contacts, size <sup>2</sup> 8, snap-in locking, intended for single hole mounting.	Figure 5 Figure 6	
6P-P8	PLUG <sup>1</sup> – Free 2-way IP65/IP67 connector with male contacts, size 8, push pull locking	Figure 11 Figure 8	
6J-P8		Figure 8 Figure 9	
6P-M8	PLUG <sup>1</sup> – Free 2-way IP65/IP67 connector with male contacts, size 8, M8-screw locking	Figure 12 Figure 13	
6J-M8	JACK <sup>1</sup> – Fixed 2-way IP65/IP67 connector with female contacts, size 8, M8 thread locking, intended for single hole mounting.	Figure 8 Figure 10	
6P-P12	PLUG <sup>1</sup> – Free 2-way IP65/IP67 connector with male contacts, size <sup>2</sup> 12, push pull locking	Figure 14 Figure 17	
6P-M12	PLUG <sup>1</sup> – Free 2-way IP65/IP67 connector with male contacts, size 12, M12 thread locking	Figure 16	
6J-P12	JACK <sup>1</sup> – Fixed 2-way IP65/IP67 connector with female contacts, size 12, push pull locking, intended for single hole mounting	Figure 14 Figure 15	
6J-M12	JACK <sup>1</sup> – Identical to 6J-P12 but with M12 thread locking instead of push pull, intended for single hole mounting	Figure 14 Figure 15	
6J-C12	JACK <sup>1</sup> – Combination of 6J-P12 and 6J-M12: With both, M12 thread and push pull locking, intended for single hole mounting	Figure 14 Figure 15	

Style	Description	Figures	Picture <sup>3</sup>
6P-M8C	PLUG <sup>1</sup> – Free 4-way IP65/IP67 connector with male contacts, size 8, M8 thread locking	Figure 21 Figure 22 Figure 18	
6J-M8C	JACK <sup>1</sup> – Fixed 4-way IP65/IP67 connector with female contacts, size 8, M8 thread locking, intended for single hole mounting	Figure 18 Figure 19	
6P-M8CI	PLUG <sup>1</sup> – Free 4-way IP65/IP67 connector with female contacts, “inverse style”, size 8, M8 thread locking	Figure 19 Figure 23	
6J-M8CI	JACK <sup>1</sup> – Fixed 4-way IP65/IP67 connector with male contacts, “inverse style”, size 8, M8 thread locking, intended for single hole mounting	Figure 20 Figure 21	
<p><sup>1</sup> The terms PLUG and JACK are used only for easier reading since they are widely used.</p> <p><sup>2</sup> The designation “size 8” and “size 12” indicates roughly the diameter of the jack in millimetres.</p> <p><sup>3</sup> The pictures are only intended to give an idea of the components, the visible details are not binding.</p>			

### 4.6.3 Overall and mating dimensions by style

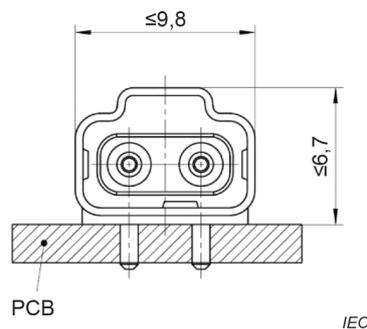
#### 4.6.3.1 2-way connectors

##### 4.6.3.1.1 Styles 2J-L and 2P-L

##### 4.6.3.1.1.1 Style 2J-L, jack

Figure 1 shows the overall dimensions of fixed 2-way IP20 connector with female contacts, latch locking, intended for PCB mounting. Figure 2 shows its mating dimensions.

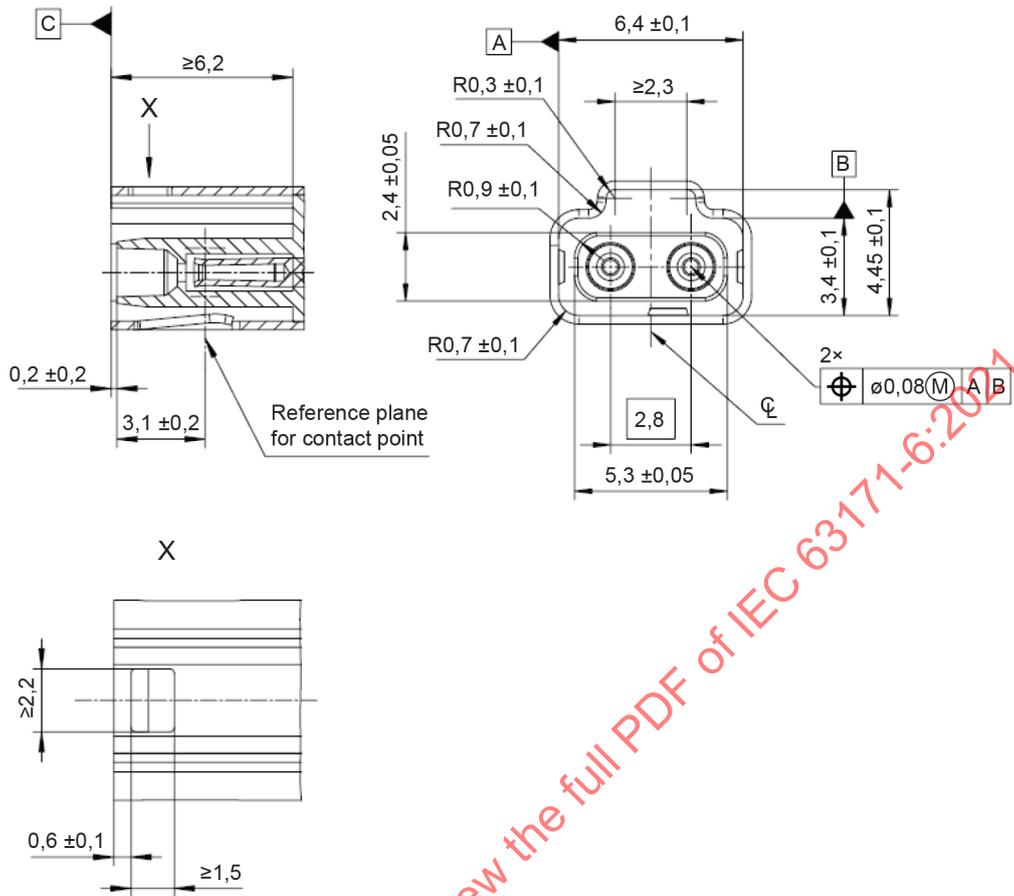
Dimensions in millimetres



**Figure 1 – Style 2J-L, overall dimensions**

NOTE The PCB is shown only for illustration purposes.

Dimensions in millimetres



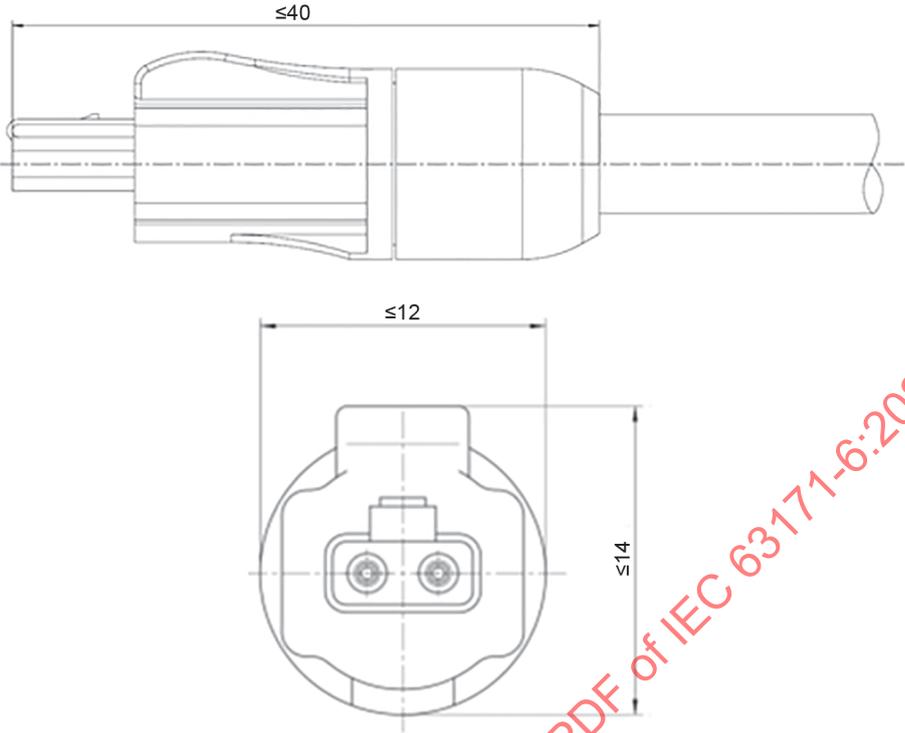
IEC

Figure 2 – Style 2J-L, mating dimensions

4.6.3.1.1.2 Style 2P-L, plug

Figure 3 shows the overall dimensions of the free, 2-way IP20 connector with male contacts, latch locking. Figure 4 shows its mating dimensions.

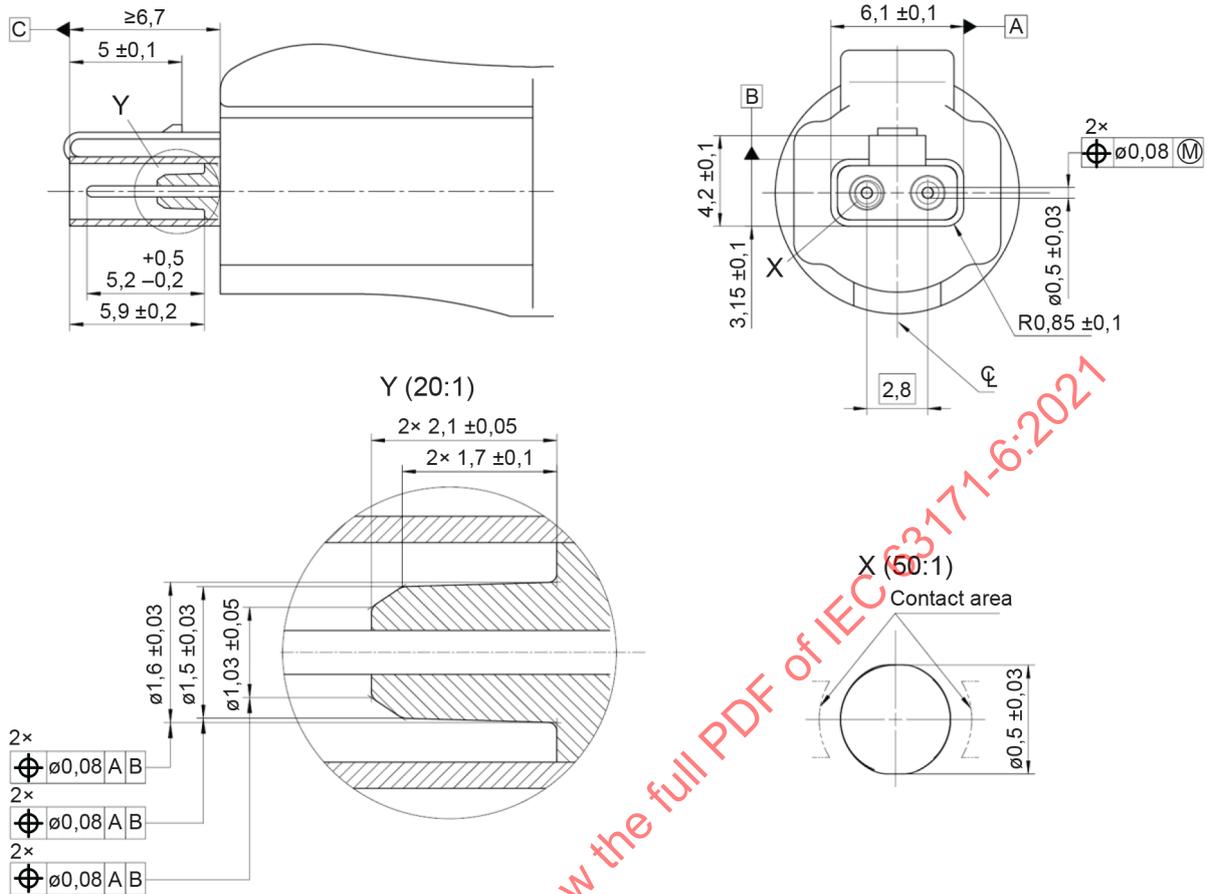
Dimensions in millimetres



IEC

Figure 3 – Style 2P-L, overall dimensions

Dimensions in millimetres



IEC

Figure 4 – Style 2P-L, mating dimensions

#### 4.6.3.1.2 Styles 6J-S8 and 6P-S8,

##### 4.6.3.1.2.1 Size 8 snap-in jack, 6J-S8

Figure 5 shows the overall dimensions of fixed 2-way IP65/IP67 connector with male contacts, size 8, snap-in locking, intended for single hole mounting. Figure 6 shows its mating dimensions.

Dimensions in millimetres

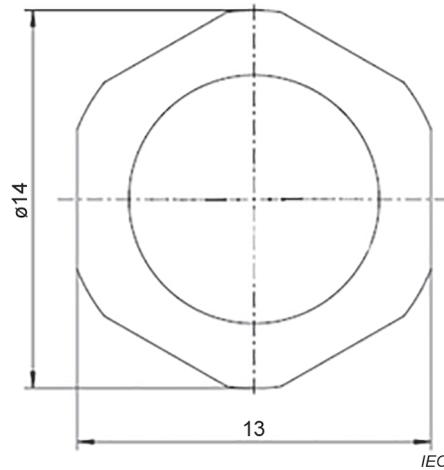


Figure 5 – Style 6J-S8, overall dimensions

NOTE For this style no axial overall dimensions are specified besides those which are concluded from by the mating dimensions in Figure 6.

Dimensions in millimetres

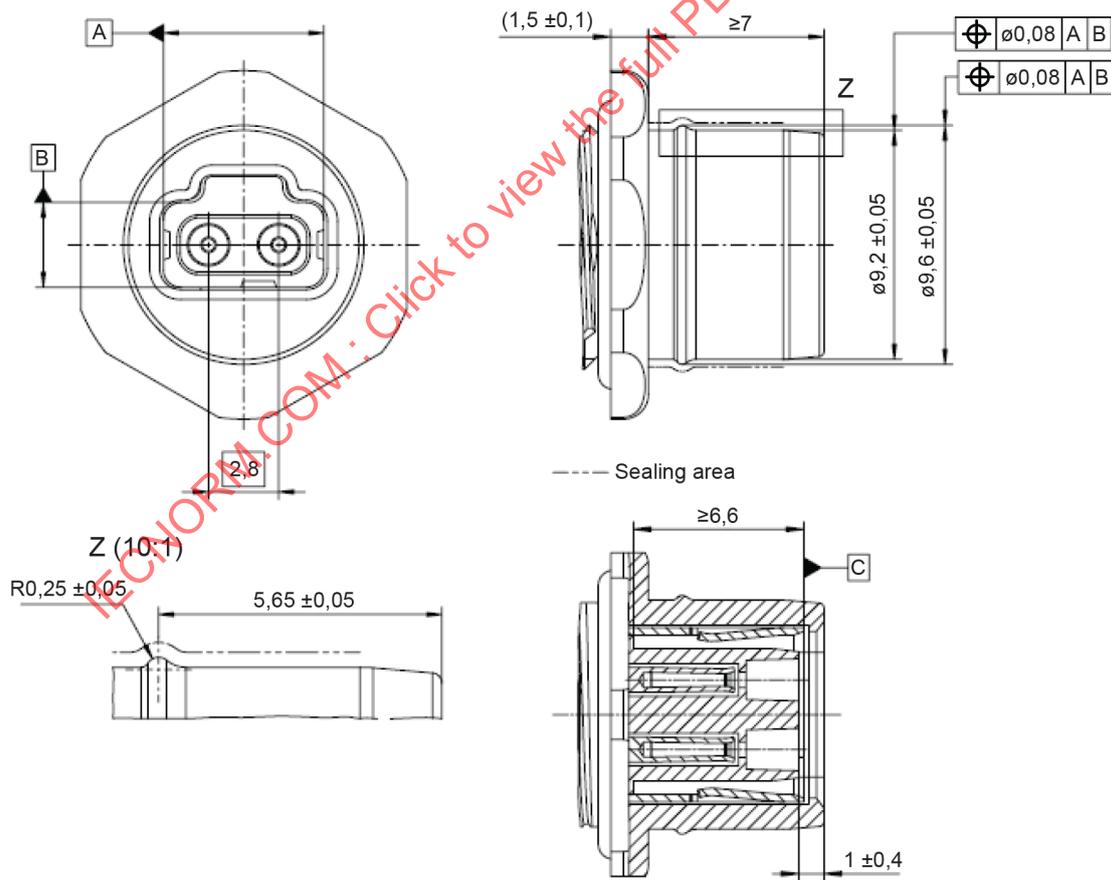


Figure 6 – Style 6J-S8, mating dimensions

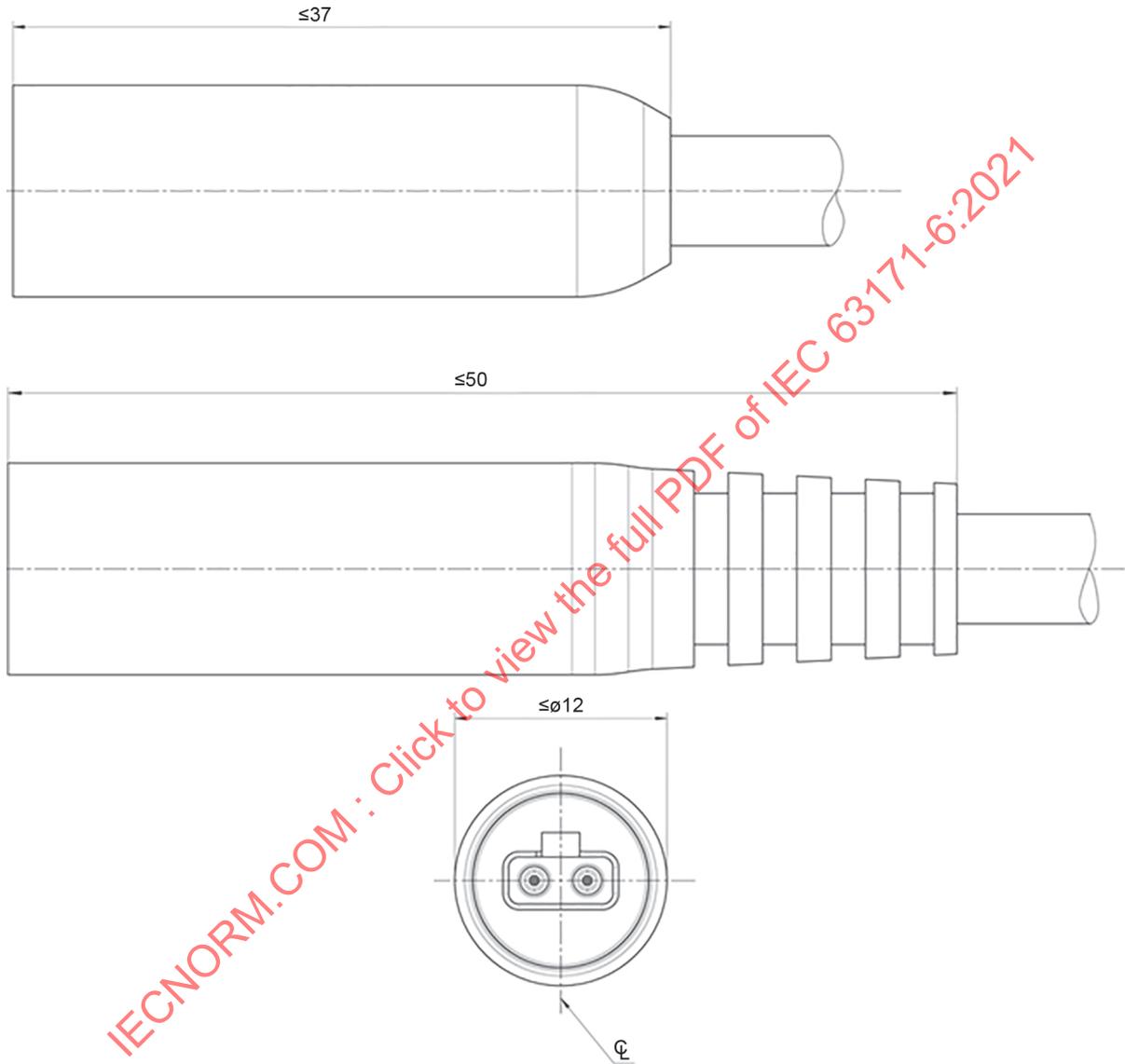
Figure 2 applies respectively.

**4.6.3.1.2.2 Size 8 snap-in plug, 6P-S8**

Figure 7 shows the overall dimensions of free 2-way IP65/IP67 connector with male contacts, size 8, snap-in locking.

NOTE Besides Figure 4 for this style there are no additional mating dimensions specified.

Dimensions in millimetres



IEC

NOTE Side views: Short, field attachable version (top) and longer, non field attachable version (middle).

**Figure 7 – Style 6P-S8, overall dimensions**

**4.6.3.1.3 Styles 6J-P8, 6J-M8, 6P-P8 and 6P-M8**

**4.6.3.1.3.1 Size 8 push pull jack, 6J-P8 and M8 thread jack, 6J-M8**

Figure 8 shows the overall dimensions of fixed IP65/IP67 connector with female contacts and push pull or M8 thread locking, intended for single hole mounting. Figure 9 shows the mating dimensions of the push pull jack, 6J-P8. Figure 10 shows the mating dimensions of the M8 thread jack, 6P-M8.

Dimensions in millimetres

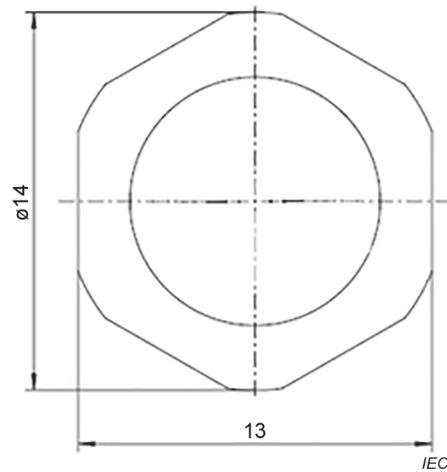


Figure 8 – Styles 6J-P8 or 6J-M8, overall dimensions

NOTE For this style no axial overall dimensions are specified besides those which are concluded from by the mating dimensions.

Dimensions in millimetres

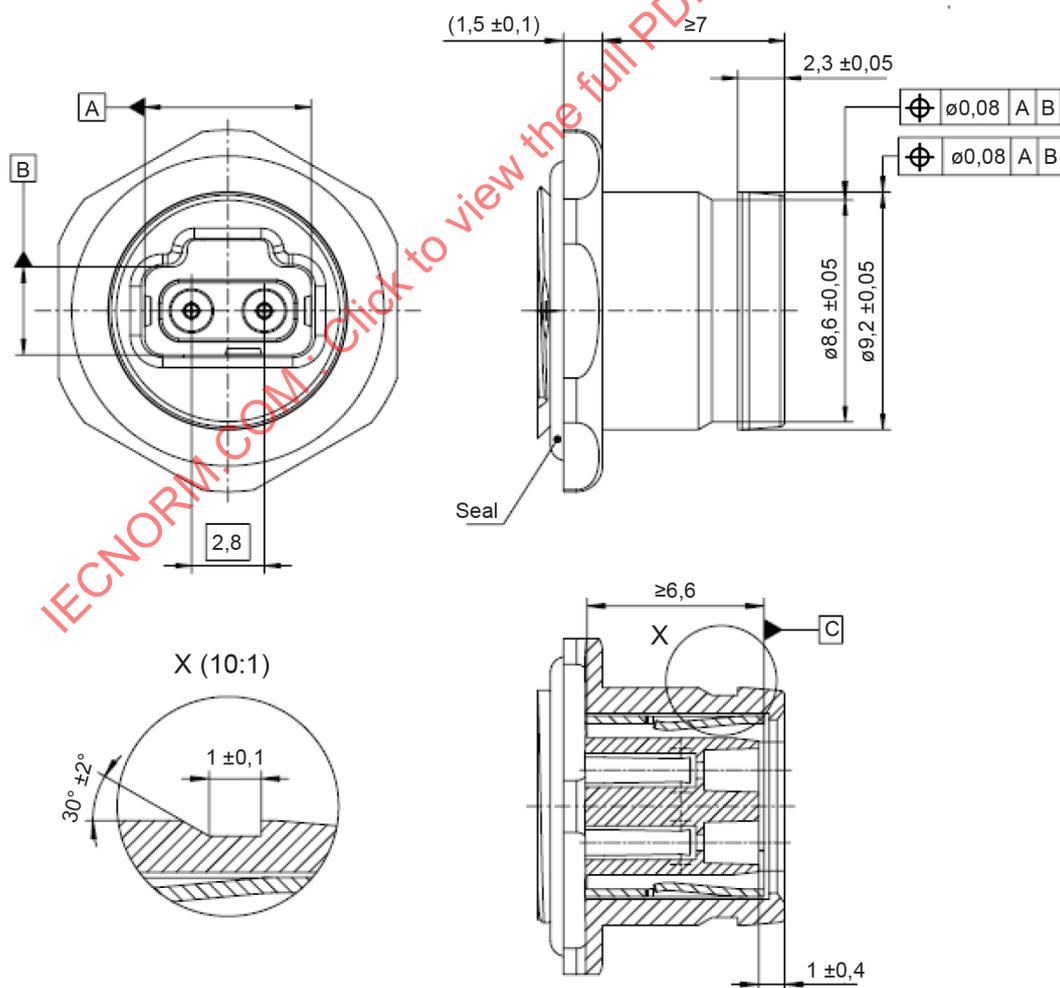


Figure 9 – Style 6J-P8, size 8 push pull jack, mating dimensions

IEC

Figure 2 applies respectively.

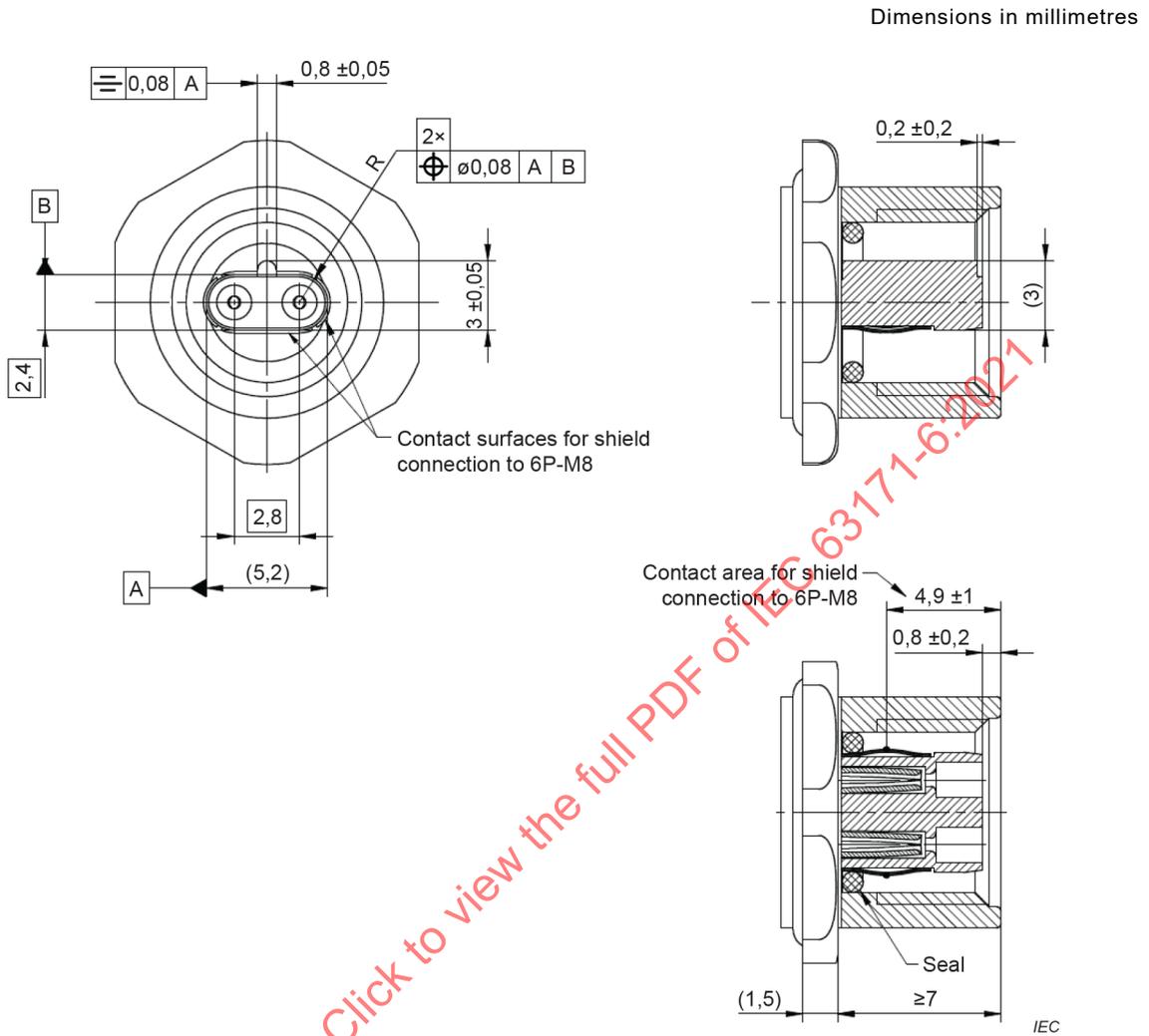


Figure 10 – Style 6J-M8, M8 thread jack, mating dimensions

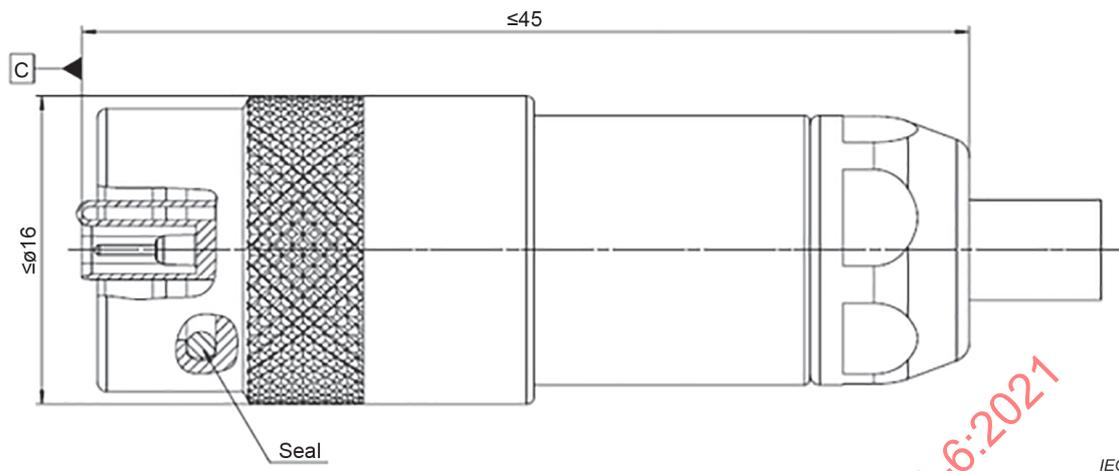
Figure 2 applies respectively.

#### 4.6.3.1.3.2 Size 8 push pull plug, 6P-P8

Figure 11 shows the overall dimensions of free IP65/IP67 connector with male contacts and push pull locking.

NOTE Besides Figure 4 for this style, there are no additional mating dimensions specified.

Dimensions in millimetres

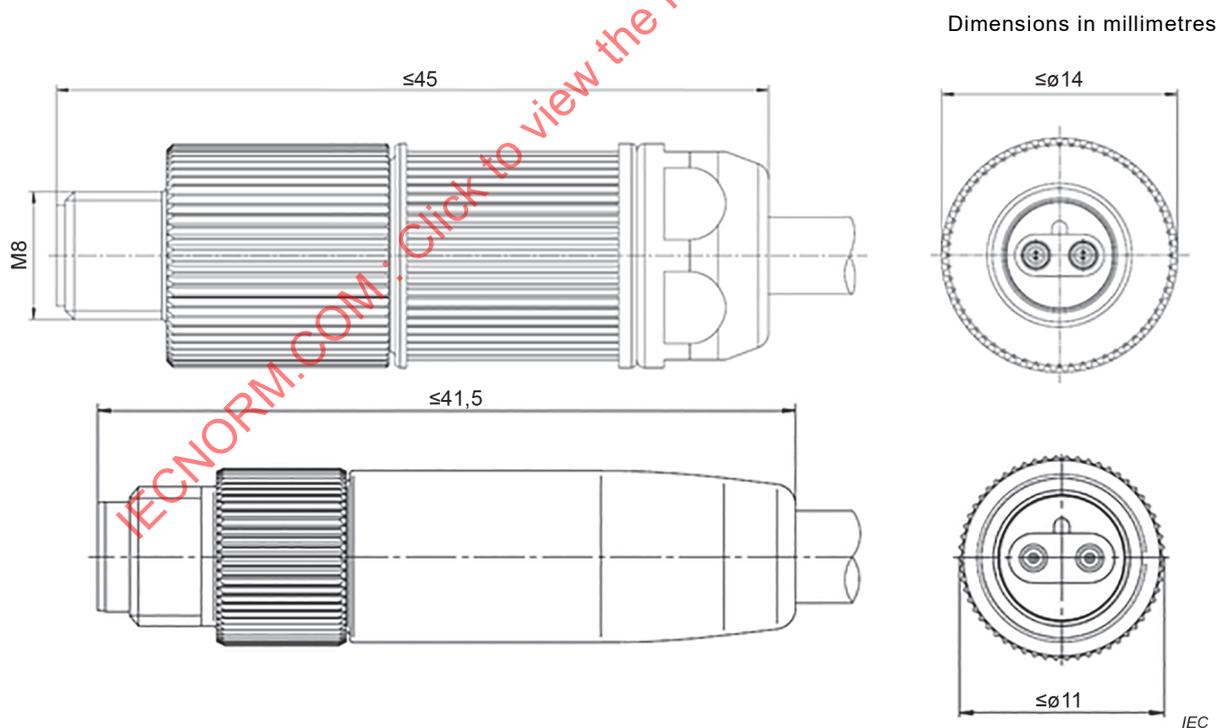


**Figure 11 – Styles 6P-P8, overall dimensions**

Figure 4 applies respectively.

#### 4.6.3.1.3.3 M8 thread plug, 6P-M8

Figure 12 shows the overall dimensions of the free IP65/IP67 connector with male contacts and M8 thread locking. Figure 13 shows its mating dimensions.



**Figure 12 – Style 6P-M8, overall dimensions, field attachable version (top), non field attachable version (bottom)**

Dimensions in millimetres

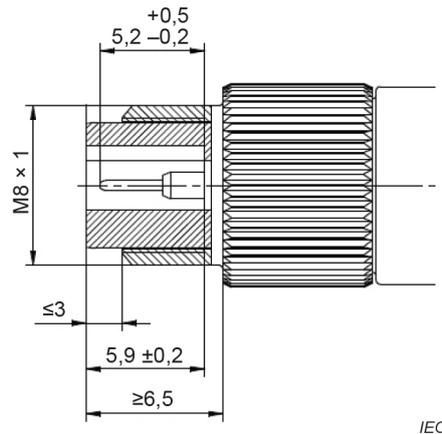


Figure 13 – Style 6P-M8, mating dimensions

Figure 4 applies respectively.

**4.6.3.1.4 Styles 6J-P12, 6J-M12, 6J-C12, 6P-P12, 6P-M12**

**4.6.3.1.4.1 Size 12 jacks, 6J-P12, 6J-M12, 6J-C12**

Figure 14 shows the overall dimensions of fixed 2-way IP65/IP67 fixed connector with female contacts, size 12, various locking mechanisms intended for single hole mounting.

NOTE For these styles no axial overall dimensions are specified besides those which are concluded from the mating dimensions.

Dimensions in millimetres

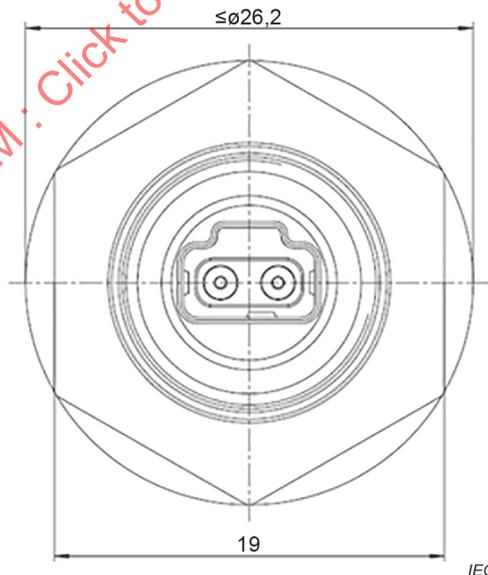
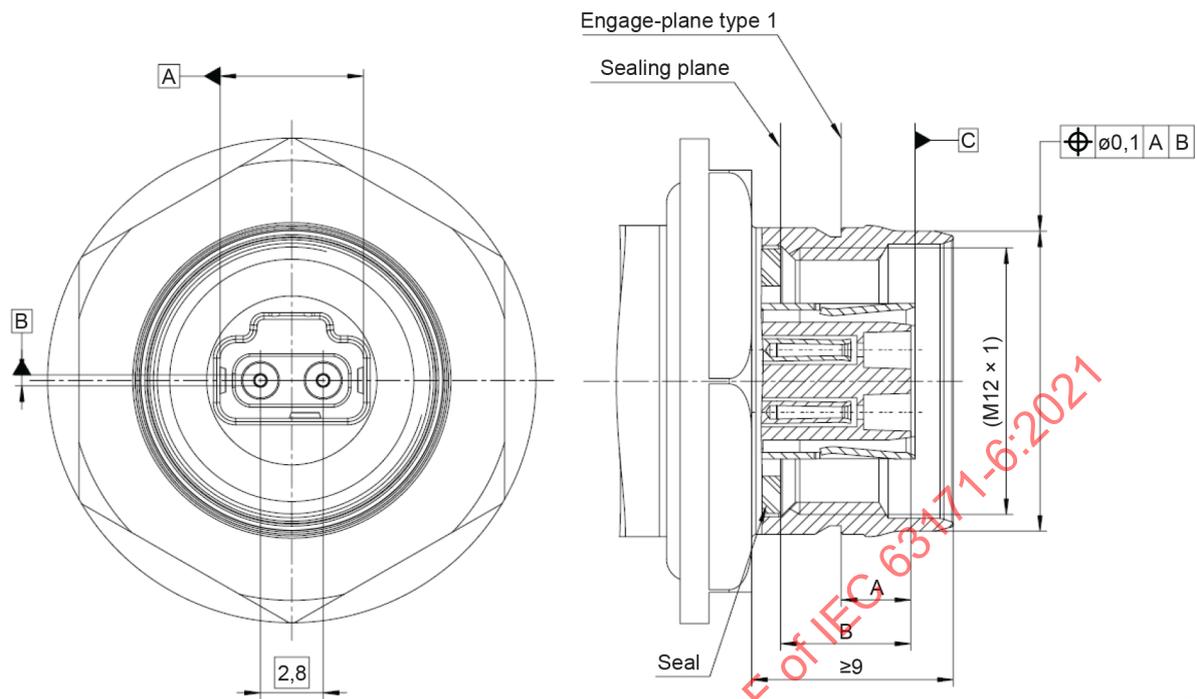


Figure 14 – Styles 6J-P12, 6J-M12, 6J-C12, overall dimensions

The three different styles of size 12 jacks have many common mating dimensions. Thus, the mating dimensions of all three styles are laid down within one drawing shown in Figure 15.

Dimensions in millimetres



IEC

**Figure 15 – Styles 6J-C12, 6J-P12 and 6J-M12, mating dimensions**

With the 6J-P12 style the M12 thread is omitted, with the 6J-M12 style the circumferential groove (detail X) is omitted.

Figure 2 applies respectively.

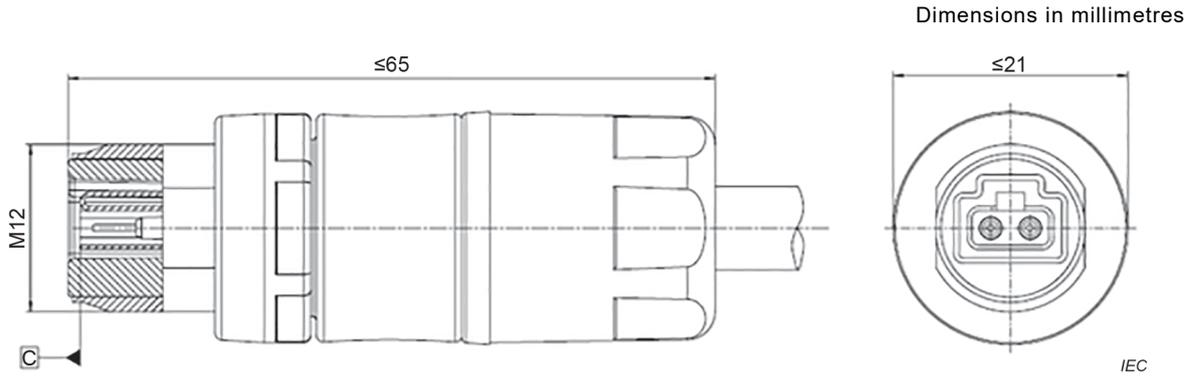
Dimensions for the thread and push pull locking given by IEC 61076-2-101 and IEC 61076-2-010 apply respectively. The corresponding axial position references, dimensions A and B, are given in Table 2.

**Table 2 – Geometrical position of planes**

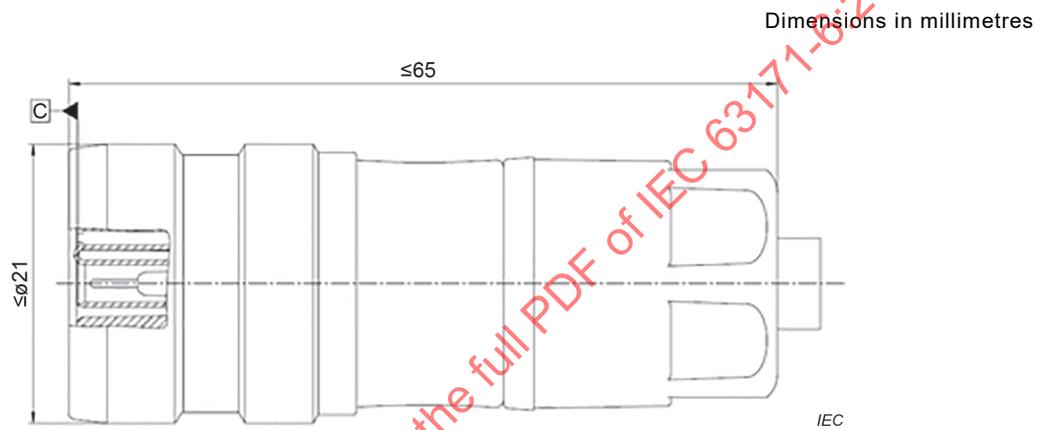
Style/Locking	Referenced standard	Designation of plane in referenced standard	Position of plane in referenced standard with respect to plane C in Figure 15
6J-P12/Push Pull Locking	61076-2-010	Engage-plane type 1	Dimension A: 3,1+ $-0,4$
6J-M12/Screw locking	61076-2-101	Sealing plane	Dimension B: 5,8+ $-0,5$

#### 4.6.3.1.4.2 Styles 6P-M12, 6P-P12

Figure 16 shows the overall dimensions of the free 2-way IP65/IP67 connector with male contacts, size 12, M12 locking. Figure 17 shows the overall dimensions of the free 2-way connector with male contacts, size 12, push pull locking.



**Figure 16 – Style 6P-M12, overall dimensions**



**Figure 17 – Style 6P-P12, overall dimensions**

Figure 4 applies respectively.

#### 4.6.3.2 4-way connectors

##### 4.6.3.2.1 Style 6J-M8C

Figure 18 shows the overall dimensions of the fixed 4-way IP65/IP67 connector with female contacts, size 8, M8 thread locking, intended for single hole mounting (rear mounting). Figure 19 shows its mating dimensions.

Dimensions in millimetres

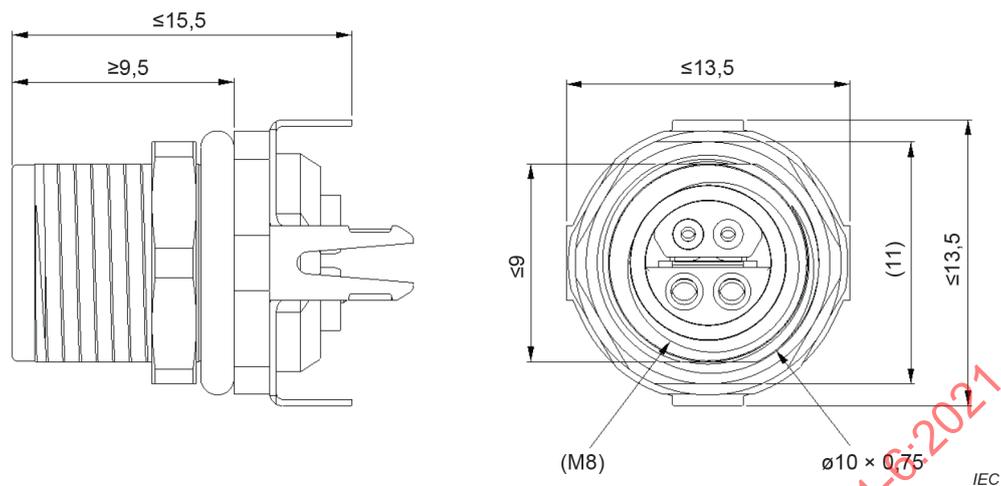


Figure 18 – Style 6J-M8C, overall dimensions

Dimensions in millimetres

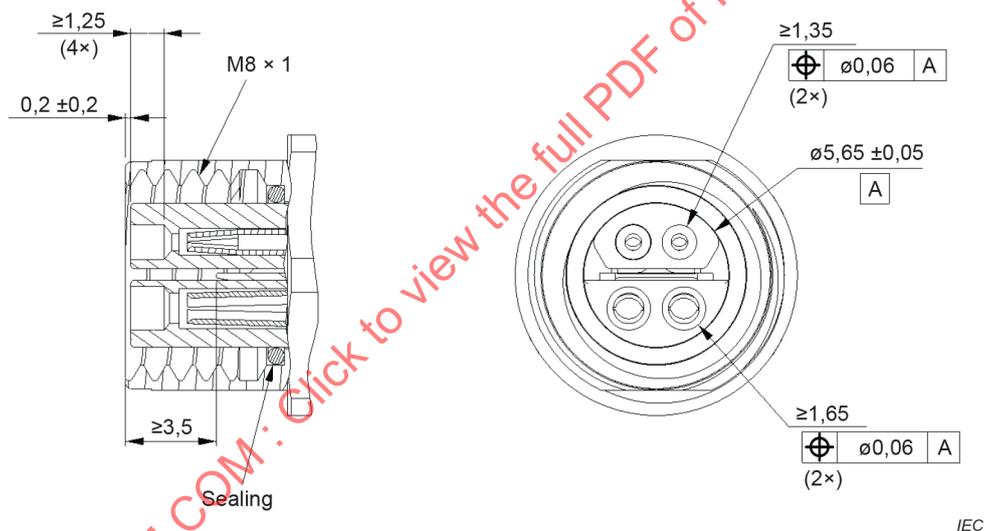


Figure 19 – Styles 6J-M8C, 6P-M8CI, mating dimensions

#### 4.6.3.2.2 Style 6J-M8CI

Figure 20 shows the overall dimensions of the fixed 4-way IP65/IP67 connector with male contacts, “inverse style”, size 8, M8 thread locking, intended for single hole mounting (rear mounting). The mating dimensions are shown in Figure 21 and are identical to those of style 6P-M8C.

Dimensions in millimetres

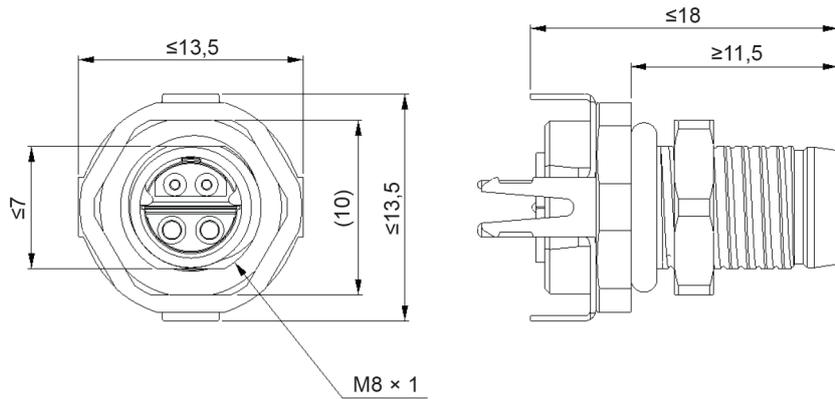


Figure 20 – Style 6J-M8CI, overall dimensions

Dimensions in millimetres

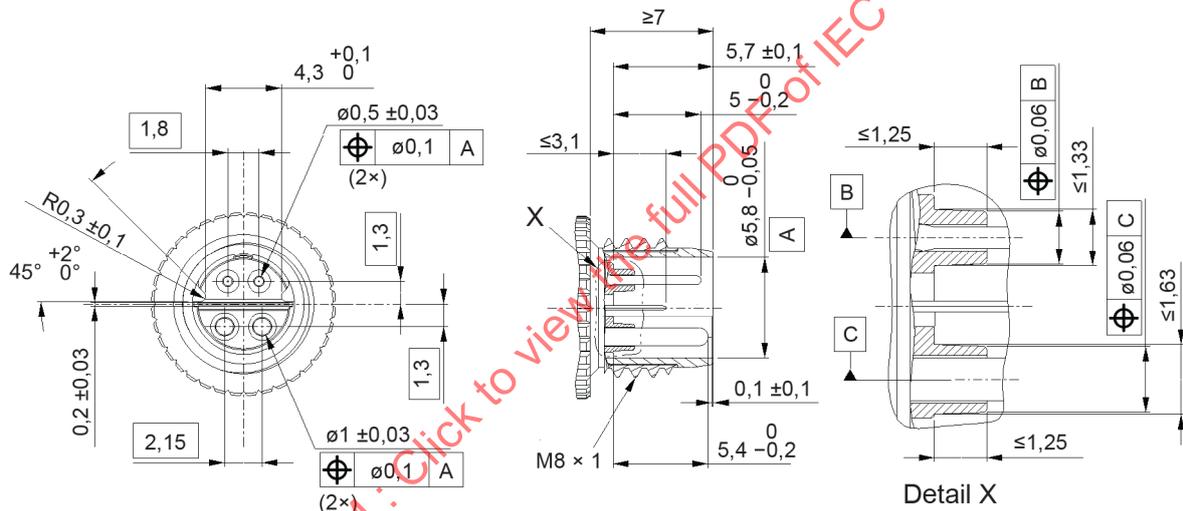
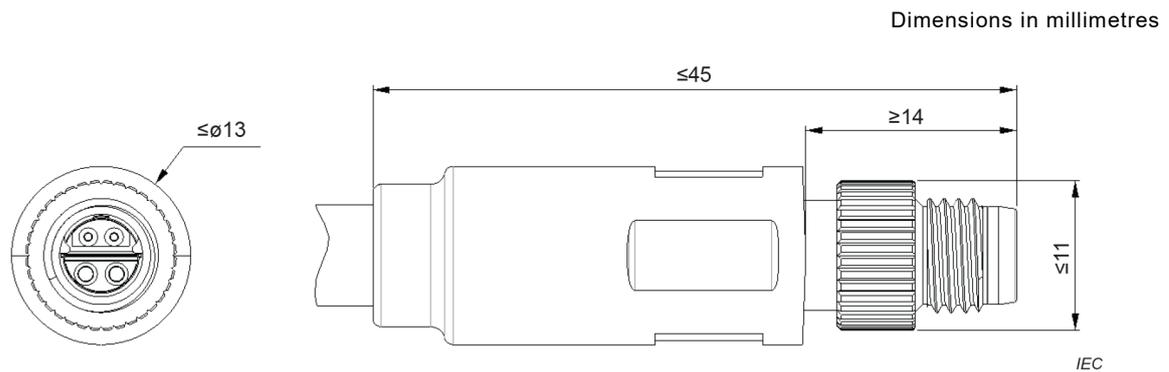


Figure 21 – Styles 6J-M8CI, 6P-M8C, mating dimensions

4.6.3.2.3 Style 6P-M8C

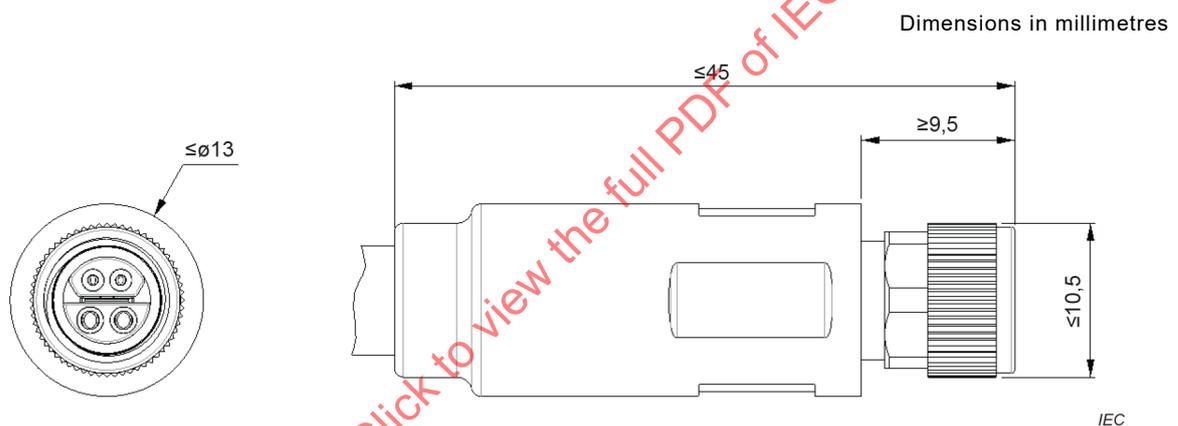
Figure 22 shows the overall dimensions of the free 4-way IP65/IP67 connector with male contacts, size 8, M8 thread locking. The mating dimensions are shown in Figure 21 and are identical to those of style 6J-M8CI.



**Figure 22 – Style 6P-M8C, overall dimensions**

#### 4.6.3.2.4 Style 6P-M8CI

Figure 23 shows the overall dimensions of the free 4-way IP65/IP67 connector with female contacts, “inverse style”, size 8, M8 thread locking. The mating dimensions are shown in Figure 19 and are identical to those of style 6J-M8C.



**Figure 23 – Style 6P-M8CI, overall dimensions**

## 5 Characteristics

### 5.1 General

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

NOTE With respect to the environmental rating scheme defined by ISO/IEC 11801-1:2017, 6.2.2 (MICE classes) components according to this document are of higher rating than M1, mechanical. The rating with respect to ingress, chemical and electromagnetical follows the scheme of IEC 61984 and IEC 61076 series and is not comparable to the MICE classification of ISO/IEC 11801-1.

### 5.2 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 3.

**Table 3 – Climatic category**

Climatic category	Category temperature		Damp heat steady state		Days
	Lower °C	Upper °C	Temperature °C	Relative humidity %	
40/085/21	–40	+85	40	93	21

### 5.3 Electrical characteristics

#### 5.3.1 Creepage and clearance distances

Although insulation coordination is not required for safety aspects by the connector covered in this document and in the relevant detail product specification, it is still required for electrical functional requirements. For minimum values for clearance and creepage distances IEC 60664-1 shall apply based on an assigned voltage rating as specified in 5.3.3.

Clearance and creepage distances shall be measured according to IEC 60512-1-2 in mated condition (connector without breaking capacity COC as defined in IEC 61984).

Reductions of creepage or clearance distances may occur due to the conductive pattern of the printed board or the wiring used shall be taken into account.

#### 5.3.2 Voltage proof

- Conditions:
- IEC 60512-4-1, Test 4a, Method A
- Standard atmospheric conditions
- Mated connectors
- All variants:
- 1 000 V DC; one contact to all other contacts connected together
- 2 250 V DC; all contacts connected together to shield

#### 5.3.3 Voltage rating

Intended for a voltage less or equal 60 V DC.

#### 5.3.4 Current-carrying capacity

The rated current specifications are given in Table 4.

- Conditions:
- IEC 60512-5-2, Test 5b
- Standard atmospheric conditions
- Mated connectors

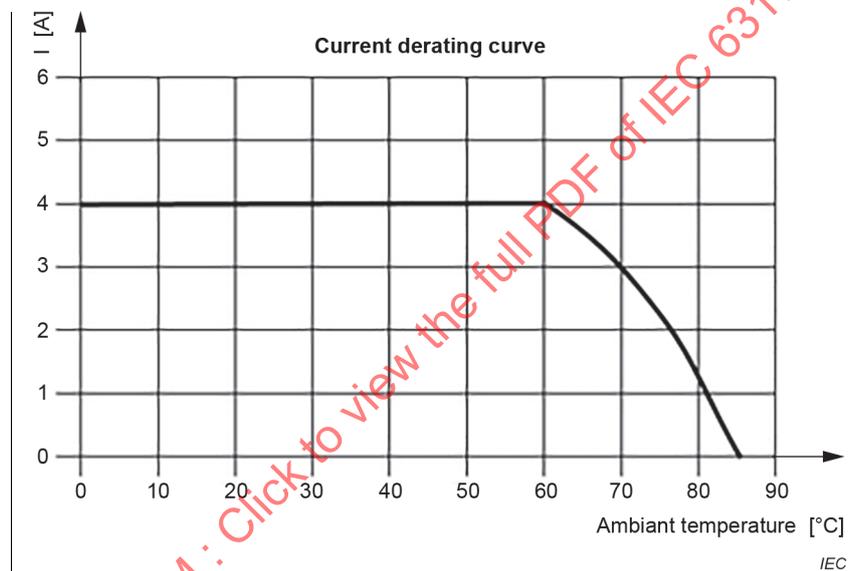
**Table 4 – Current ratings of connectors**

Style	Contacts	Pin diameter mm	Rated current <sup>1, 2</sup> A
2-way data	Data	0,5	4
4-way data/power	Data	0,5	4
	Power	1	8

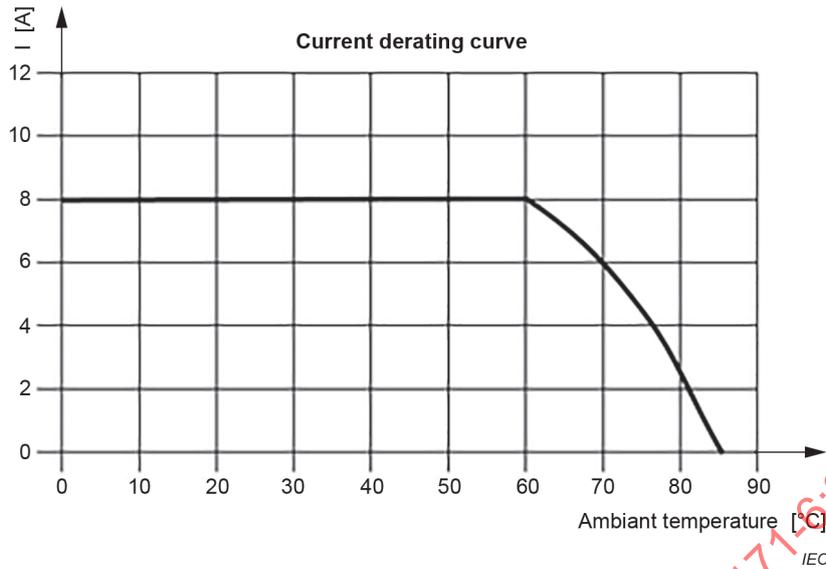
<sup>1</sup> Current-carrying capacity according to derating curve.  
<sup>2</sup> Values at temperature ≤ 60 °C.

The current-carrying capacity of connectors shall comply with the de-rating curve given in Figure 24 and Figure 25 for the data and power contacts respectively.

NOTE The curves specify the minimum values to be maintained. The actual values may be higher according to the manufacturer's specifications.



**Figure 24 – Derating diagram for the Ø 0,5 mm data pins of the 2-way and 4-way connectors**



**Figure 25 – Derating diagram for the Ø 1 mm power pins of the 4-way connector**

### 5.3.5 Contact and shield resistance

Conditions:

- IEC 60512-2-1, Test 2a
- Standard atmospheric conditions
- Mated connectors
- Measuring points according to 6.3.2
- All types: contact resistance 20 mΩ maximum
- The maximum allowable shielding resistance is 100 mΩ

### 5.3.6 Input to output DC resistance

Conditions:

- IEC 60512-2-1, Test 2a
- Arrange according to 6.3.2
- Mated connectors
- Measuring points: A and C
- All types: 50 mΩ maximum

### 5.3.7 Input to output DC resistance unbalanced

Conditions:

- IEC 60512-2-1, Test 2a
- Arrange according to 6.3.2
- Mated connectors
- Measuring points: A and C
- Among all signal conductors, maximum difference between maximum and minimum
- All types: 25 mΩ maximum

### 5.3.8 Insulation resistance

Conditions:

- IEC 60512-3-1, Test 3a
- Method A
- Standard atmospheric conditions
- Mated connectors
- Connecting points see 6.3.2
- Test voltage: 500 V DC
- All types: 500 M $\Omega$  minimum

### 5.3.9 Impedance

Conditions: IEC 60512-25-7: Test 25g

The nominal impedance is 100  $\Omega$ .

## 5.4 Not used

## 5.5 Transmission performance

### 5.5.1 General

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

All transmission performance requirements shall apply between the reference planes specified in IEC 60512-28-100.

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

The test conditions and specific requirements shall be as stated in the associated subclauses given herein.

The transmission characteristics as specified in IEC 63171:2021, 5.5.2 through 5.5.7, Category B apply. Further transmission characteristics are specified in 5.5.8 through 5.5.10 of this document.

### 5.5.2 Insertion loss

The provisions of IEC 63171:2021, 5.5.2 apply.

### 5.5.3 Return loss

The provisions of IEC 63171:2021, 5.5.3 apply.

### 5.5.4 Propagation delay

The provisions of IEC 63171:2021, 5.5.4 apply.

### 5.5.5 Transverse conversion loss

The provisions of IEC 63171:2021, 5.5.5 apply.

### 5.5.6 Transverse conversion transfer loss

The provisions of IEC 63171:2021, 5.5.6 apply.

### 5.5.7 Transfer impedance

The provisions of IEC 63171:2021, 5.5.6 apply.

### 5.5.8 Coupling attenuation

Conditions:

- IEC 62153-4-15 for coupling attenuation with triaxial cell.
- Mated connectors, terminated with each cable construction type intended to be allowed for these connectors.
- All types:  $\geq 65 - 20 \log(f/100)$  dB, from 0,1 MHz to 600 MHz.

Whenever the formula results in a value greater than 65 dB, the requirement shall revert to 65 dB.

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

### 5.5.9 Power sum alien (exogenous) NEXT

Conditions:

- IEC 60512-25-9, test 25i
- Only 3 disturbers mated connectors
- $PSANEXT = -10 \log \left( \sum_{i=1}^3 10^{\frac{-ANEXT_i}{10}} \right)$
- $\geq 140 - 20 \log(f)$  dB from 1 MHz to 600 MHz
- Whenever the formula results in a value greater than 84 dB, the requirement shall revert to 84 dB.

The PS ANEXT requirements are fulfilled when the coupling attenuation is verified.

### 5.5.10 Power sum alien (exogenous) FEXT

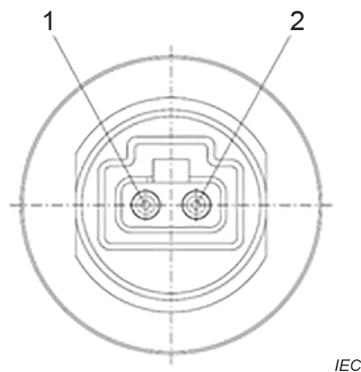
Conditions:

- IEC 60512-25-9, test 25i
- Only 3 disturbers
- Mated connectors
- $PSAFEXT = -10 \log \left( \sum_{i=1}^3 10^{\frac{-AFEXT_i}{10}} \right)$
- $\geq 125 - 20 \log(f)$  dB from 1 MHz to 600 MHz
- Whenever the formula results in a value greater than 84 dB, the requirement shall revert to 84 dB.

The PS AFEXT requirements are fulfilled when the coupling attenuation is verified.

## 5.6 Pin and pair grouping assignment

### 5.6.1 2-way data/power connector (see Figure 26)



**Figure 26 – Connector pin assignment for 2-way free connector, front view**

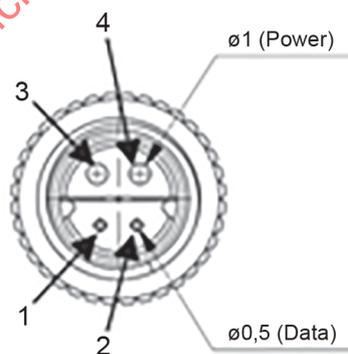
Board connector pin assignment for single pair Ethernet, see Table 5

**Table 5 – 2-way connector signal pin assignment**

Pin No.	Signal	PoDL
1	BI_DA+	PoDL+
2	BI_DA–	PoDL–

### 5.6.2 4-way data/power M8 connector (see Figure 27)

Dimensions in millimetres



**Figure 27 – Connector pin assignment for 4-way M8 connector, front view**

Connector pin assignment single pair Ethernet and separate (non-PoDL) power supply, see Table 6.

**Table 6 – 4-way M8 connector signal pin assignment**

Pin No.	Signal
1	BI_DA+
2	BI_DA-
3	U
4	GND

## 5.7 Mechanical characteristics

### 5.7.1 Mechanical operation

Conditions:

- IEC 60512-9-1, Test 9a
- Standard atmospheric conditions
- Speed: 10 mm/s maximum
- Rest: 5 s minimum (unmated)
- The number of mechanical operations specified by the manufacturer depending on the style with the mating performance level (MPL). The preferred MPL values defined in Table 7.

**Table 7 – Preferred values for the number of mating cycles**

Mating performance level	Mating cycles
MPL20	20
MPL50	50
MPL100	100
MPL500	500
MPL750	750
MPL1000	1 000
MPL2500	2 500
MPL5000	5 000
Other types	1
<sup>1</sup> Other mating cycles are upon agreement between manufacturer and user.	

NOTE One insertion and one withdrawal = one operations cycle.

### 5.7.2 Effectiveness of connector coupling devices

Conditions:

- IEC 60512-15-6, Test 15f
- Standard atmospheric conditions
- The effectiveness of connector coupling devices specified by the connector style in Table 8. The specified pull-out force shall be applied for  $60 \text{ s} \pm 5 \text{ s}$ .

**Table 8 – Preferred values for the pull-out force**

Connector style	Pull-out force
2P-L, 2J-L	50 N min
6P-S8, 6J-S8	30 N min
6P-P8, 6J-P8	100 N min
6P-P12, 6J-P12	300 N min
6P-M8, 6J-M8 6P-M8C/CI, 6J-M8C/CI 6P-M12, 6J-M12	Not applicable <sup>1</sup>
<sup>1</sup> M8 and M12 screw locking is effective by design.	

**5.7.3 Insertion and withdrawal forces**

Conditions:

- IEC 60512-13-2, Test 13b
- Standard atmospheric conditions
- Speed: Maximum rate of 10 mm/s
- Styles 2P-L, 2J-L: Insertion and withdrawal: 20 N maximum
- All other styles: Insertion and withdrawal: 50 N maximum

**5.7.4 Polarizing method**

Conditions:

- IEC 60512-13-5, Test 13e
- Standard atmospheric conditions
- Engaging force: 1,5 x total insertion force but 50 N minimum

**5.7.5 Vibration resistance**

- IEC 60512-6-4, Test 6d
- Frequency range: 10 Hz – 500 Hz
- Amplitude: 0,35 mm
- Sweep rate: 1 octave/min
- Acceleration: 50 m/s<sup>2</sup>
- Duration: 2 h per axis, total 6 h
- Axes: x, y, z
- Standard atmospheric conditions
- Connectors in mated and locked position
- Arrangement per 6.3.3

**5.7.6 Mechanical shock resistance**

- IEC 60512-6-3, Test 6c
- Acceleration: 300 m/s<sup>2</sup>
- Half-sine shock pulses of 11 ms duration
- 3 shocks in both directions of 3 mutually perpendicular directions (totally 18 shocks)
- Standard atmospheric conditions
- Connectors in mated and locked position

– Arrangement per 6.3.3

### 5.7.7 IP degree of protection

IP20 for styles 2P-L and 2J-L according to IEC 60529 connectors in mated and locked position.

IP65 and IP67 (IP65/IP67) for styles 6P-S8, 6J-S8, 6P-P8, 6J-P8, 6P-M8, 6J-M8, 6P-P12, 6J-P12, 6P-M12, 6J-M12, 6J-C12, 6P-M8C, 6J-M8C, 6P-M8CI and 6J-M8CI according to IEC 60529 connectors in mated and locked position.

IP66, IP68 or other as agreed between manufacturer and user.

## 6 Tests and test schedule

### 6.1 General

This test schedule shows the tests and the order in which they shall be carried out as well as the requirements which shall 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 shall be called a specimen.

The test conditions and specific requirements shall be as stated in the associated subclauses given herein.

Wiring of these connectors shall take into account the wire and cable diameter of the cables defined in the IEC 61156 series as applicable by manufacturer's specification.

Before the tests are carried out, 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.

### 6.2 Test procedures and measuring methods

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

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

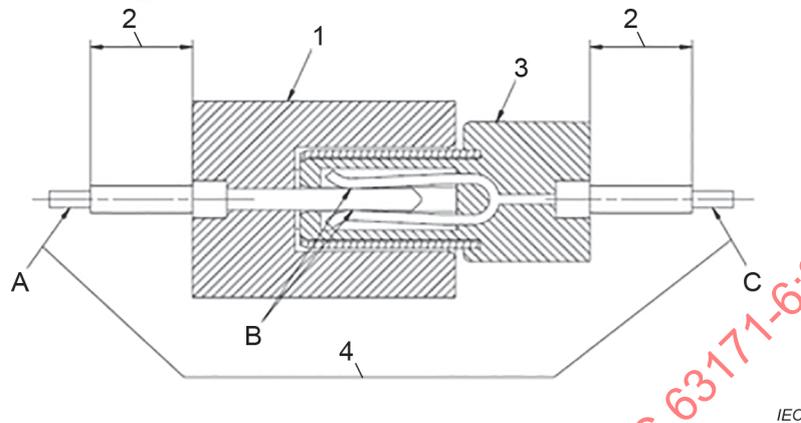
### 6.3 Mounting of specimens

#### 6.3.1 General

When mounting is required in a test, the connectors shall be rigidly mounted on a metal plate, a printed board or to specified accessories, whichever is applicable, using the normal mounting method, fixing devices and panel cut-out.

### 6.3.2 Arrangement for contact resistance measurement

- 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 28 shows a contact resistance arrangement.



#### Key

- 1 Fixed connector
- 2 Attached wires: as short as practical
- 3 Free connector
- 4 Contact resistance measuring points
- A Measuring point A
- B Measuring points B (one on the male contact, one on the female contact)
- C Measuring point C

**Figure 28 – Contact resistance arrangement**

The test procedure is as follows:

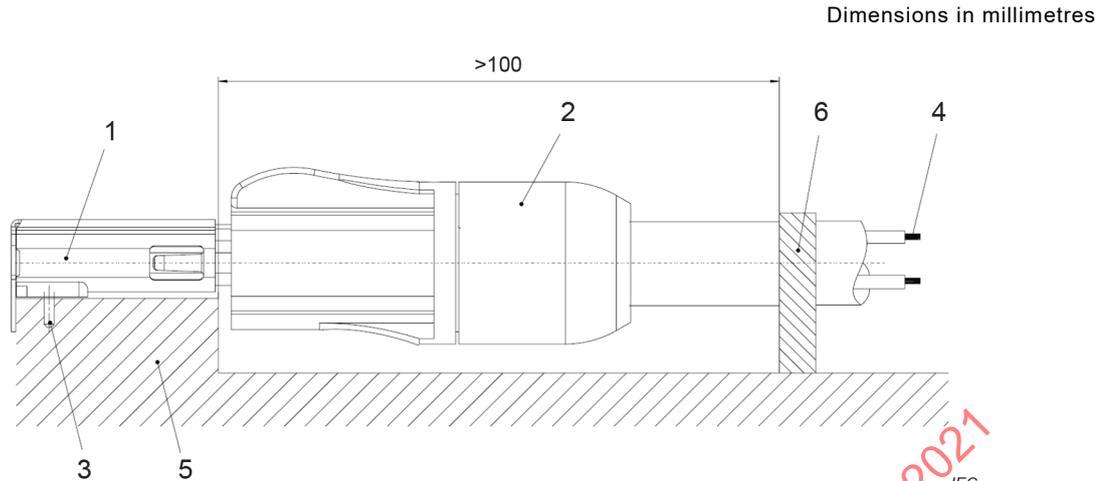
- a) Determine the bulk resistance of the fixed connector between points A and B of Figure 28 by calculation or by measurement. This resistance is noted and recorded as  $R_{AB}$ .
- b) Determine the bulk resistance of the free connector between points B and C of Figure 28 by calculation or by measurement. This resistance is noted and recorded as  $R_{BC}$ .
- c) Measure the total mated connector resistance between points A and C following requirements and procedures of IEC 60512-2-1, Test 2a. This resistance is 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.
 
$$R_{\text{contact}} = R_{AC} - (R_{AB} + R_{BC})$$

NOTE "I" indicates the initial value.

### 6.3.3 Arrangement for dynamic stress tests

The fixed and free connector shall be rigidly installed in a suitable fixture as specified in Figure 29.

Cable shall have maximum wire size. Connectors with over moulded cables can be used without modification.



**Key**

- 1 Fixed connector vibration feature
- 2 Free connector
- 3 Contact resistance measuring point, fixed connector
- 4 Contact resistance measuring point, cable end
- 5 Mounting plate
- 6 Cable clamp

**Figure 29 – Arrangement for vibration and mechanical shock tests**

**6.3.4 Wiring of specimens**

The terminations shall be wired, in accordance with the relevant part of IEC 60352. Also, the wiring shall be according to the connector manufacturer’s instructions.

**6.4 Test schedules**

**6.4.1 Basic (minimum) test schedule**

Not applicable.

**6.4.2 Full test schedule**

**6.4.2.1 General**

The following tests specify the characteristics to be checked and the requirements to be fulfilled. All specimens shall be subjected to the preliminary group P as specified within 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 in Table 10 through Table 16.

For a complete test sequence, 20 specimens are needed (Test groups AP, BP, DP and EP shall each consist of 3 specimens. Test group CP consists of 6 specimens. Test group FP consists of 2 specimens).

Contact resistance tests apply only to the interface.

NOTE For better readability some requirements from Clause 5 have been repeated in the following tables.

## 6.4.2.2 Test group P – Preliminary

Table 9 – 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 4.6.3.
P2			All contacts / specimens	Contact resistance	2a	Initial value 20 mΩ maximum Shielding resistance 100 mΩ maximum
P3			500 V DC 1 min hold, method A	Insulation resistance	3a	500 MΩ minimum
P4			Contact to contact: 1 000 V DC peak Method A mated connectors	Voltage proof	4a	no breakdown or flashover
			Contact to shield: 2 250 V DC peak Method A mated connectors			

## 6.4.2.3 Test group AP – Dynamic/Climatic

Table 10 – 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	Connector locking device depressed (if applicable)		Measure the force necessary to insert / withdraw the specimens (latching mechanism inactivated)	Insertion and withdrawal forces	13b	See 5.7.3
AP2	Effectiveness of connector coupling device	15f	See 5.7.2 Not applicable for connectors with screw locking mechanism.			Meet visual requirements, show no physical damage
AP3	Rapid change of temperature	11d	Subject mated specimens to 10 cycles between -40 °C and 85 °C with 30 min dwell at temp. extremes. Transfer time $t_2$ according to IEC 60068-2-14: 1 min max.			Meet visual requirements, show no physical damage.