

# INTERNATIONAL STANDARD



**Connectors for electrical and electronic equipment –  
Part 7: Detail specification for up to 7 ways including PE or FE (data/power) and  
shield pin, free and fixed circular connectors for balanced single-pair data  
transmission with current-carrying capacity – Mechanical mating information,  
pin assignment and additional requirements for type 7**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –****Part 7: Detail specification for up to 7 ways including PE or FE (data/power) and shield pin, free and fixed circular connectors for balanced single-pair data transmission with current-carrying capacity – Mechanical mating information, pin assignment and additional requirements for type 7**

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

Draft	Report on voting
48B/3033/FDIS	48B/3044/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.

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.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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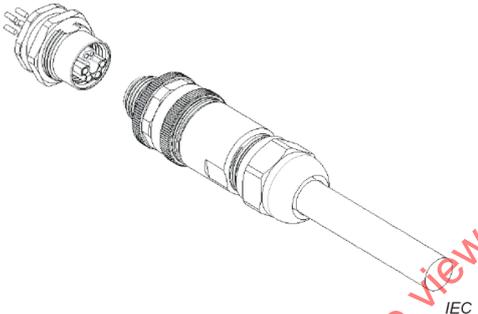
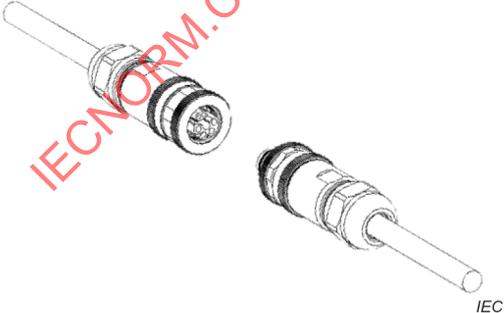
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## INTRODUCTION

IEC 63171 is the base specification of the whole series. Subsequent specifications do not duplicate information given in the base document, but list only additional requirements. For the complete specification regarding connectors described in this Part of the IEC 63171 series, read this document in conjunction with IEC 63171.

A general overview about the connectors in this document is shown in Figure 1.

<b>IEC SC 48B – Electrical connectors</b> <b>Specification available from:</b> <b>IEC General secretariat or from the addresses shown on the inside cover.</b>	<b>IEC 63171-7 Ed. 1</b>
DETAIL SPECIFICATION in accordance with IEC 61076-1	M12 screw locking or push-pull locking (or both)
	<p>Circular connectors, size 12, with 4 up to 7 ways including PE or FE (according to coding) for power and data transmission, either</p> <ul style="list-style-type: none"> <li>– with M12 screw-locking mechanism (styles with M12 in the name), or</li> <li>– with a quick-locking push-pull mechanism with a size derived from that (styles with P12 in the name), or</li> <li>– with both mechanisms combined (styles with C12 in the name).</li> </ul> <p>Multiple mating interfaces, each associated with a coding referred to as "type I" through "type VII", differing by power transmission capabilities and intents.</p> <p>2 ways + additional shield pin (to be connected to the cable sheath) support balanced differential data transmission with frequencies up to 600 MHz, Category B as per IEC 63171.</p> <p>Free cable connectors:</p> <ul style="list-style-type: none"> <li>– male or female,</li> <li>– straight connectors,</li> <li>– rewirable or non-rewirable.</li> </ul>
	<p>Fixed connectors:</p> <ul style="list-style-type: none"> <li>– male or female,</li> <li>– single-hole mounting.</li> </ul> <p>With circular mounting orientation</p>

**Figure 1 – Type 7 connector overview**

## CONNECTORS FOR ELECTRICAL AND ELECTRONIC EQUIPMENT –

### Part 7: Detail specification for up to 7 ways including PE or FE (data/power) and shield pin, free and fixed circular connectors for balanced single-pair data transmission with current-carrying capacity – Mechanical mating information, pin assignment and additional requirements for type 7

#### 1 Scope

This part of IEC 63171 covers shielded free and fixed circular connectors with 4 ways up to 7 ways for power and data transmission and specifies the common dimensions, mechanical, electrical and transmission characteristics and environmental requirements as well as test specifications respectively.

The connectors described in this document are either equipped with an M12 screw-locking mechanism (styles with M12 in the name) or a quick-locking push-pull mechanism with a size derived from that (styles with P12 in the name) or both mechanisms combined (styles with C12 in the name). For the sake of simplicity, the connectors' size is denoted as "size 12" in this document.

This document provides multiple mating interfaces each of which is associated with a coding preventing the mating of incompatible male and female connectors. These codings are referred to as "Type x", where "x" is represented by a Roman numeral.

For all codings, two ways and the additional shield pin, which is intended to be connected to the cable screen, support differential data transmission with frequencies up to 600 MHz by meeting the requirements of Category B, as defined in IEC 63171.

NOTE 1 Connecting the shield pin to the cable sheath is also required for data transmission with 20 MHz (IEC 63171, Category A).

NOTE 2 The connectors are intended to be used for single-pair Ethernet (SPE) according to the following IEEE Standards: 10BASE-T1 (IEEE 802.3cg), 100BASE-T1 (IEEE 802.3bw), 1000BASE-T1 (IEEE 802.3bp).

NOTE 3 Power over Data line (PoDL) power supply according to IEEE 802.3bu can be optionally used for the two ways intended for data transmission, even in addition to the power supply provided through the dedicated power ways.

The individual codings differ by their power transmission capabilities and intents. The additional ways provide for DC power transmission with up to 63 V/16 A and 600 V/16 A or AC power transmission with rated voltage and rated current up to 600 V/16 A (single-phase) or 480 V/8 A (three-phase). See Table 11 and Table 12 for the voltage and current ratings, and Table 5 for the pin assignments for the individual codings.

Some codings feature a PE pin for safety purposes.

The PE pin needs to be connected to all accessible metal parts.

#### 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 – Chapter 581: Electromechanical components for electronic equipment*

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

IEC 60352 (all parts), *Solderless connections*

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

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

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

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

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

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

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

IEC 60512-11-1, *Connectors for electrical and electronic equipment – Tests and measurements – Part 11-1: Climatic tests – Test 11a: Climatic sequence*

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 11-10: 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 60512-28-100, *Connectors for electronic equipment – Tests and measurements – Part 28-100: Signal integrity tests up to 1000 MHz on 60603-7 and 61076-3 series connectors – Tests 28a to 28g*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

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

IEC 61984:2008, *Connectors – Safety requirements and tests*

IEC TR 63040, *Guidance on clearances and creepage distances in particular for distances equal to or less than 2 mm – Test results of research on influencing parameters*

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*

ISO 21920-1:2021, *Geometrical product specifications (GPS) – Surface texture: Profile – Part 1: Indication of surface texture*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-581, IEC 60512-1, IEC 61076-1, and IEC 61076-3 apply.

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

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

### 4 Technical information

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

##### 4.1.1 Performance level

Connectors according to this document are classified by mating performance level (MPL). See 6.6.2 for details.

##### 4.1.2 Compatibility levels according to IEC 61076

###### a) Intermateability

Intermateability (level 2 of IEC 61076-1) 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 of different connectors shall be assured by compliance with the specified interface dimensions and by compliance with the requirements in 6.4 and 6.5 proven by the respective testing sequences in Clause 7.

#### 4.2 Classification into climatic categories

See 6.3.

#### 4.3 Clearance and creepage distances

See 6.4.1.

#### 4.4 Current-carrying capacity

See 6.4.4.

#### 4.5 Marking

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

#### 4.6 Safety aspects

For safety aspects, IEC 61984 shall be considered. In the sense of IEC 61984, this document covers connectors without breaking capacity (COC).

### 5 Dimensional information

#### 5.1 General

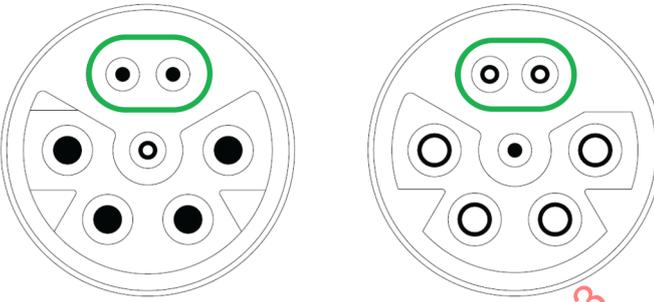
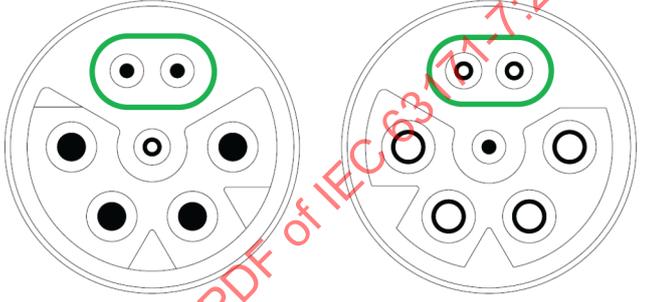
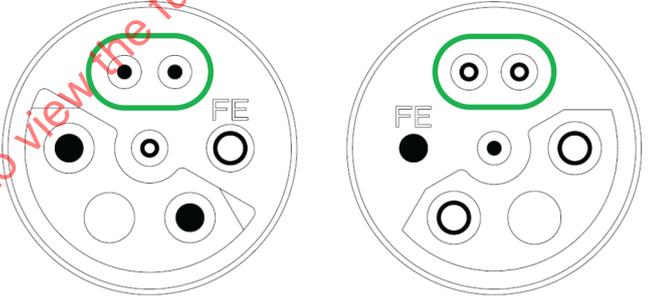
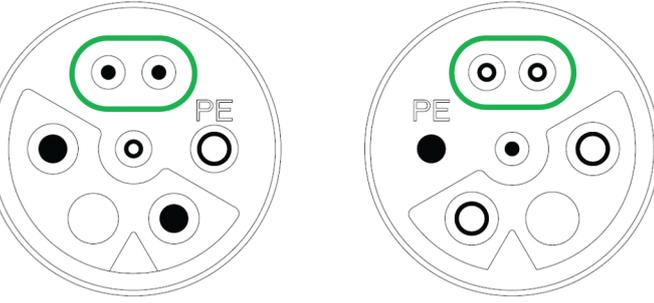
Drawings are shown in the first angle projection. The shape of connectors may deviate from those shapes given in the following figures as long as the specified dimensions are not influenced. Coordination dimensions are dimensions without tolerances which indicate the boundary or centre-line references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

#### 5.2 Codings

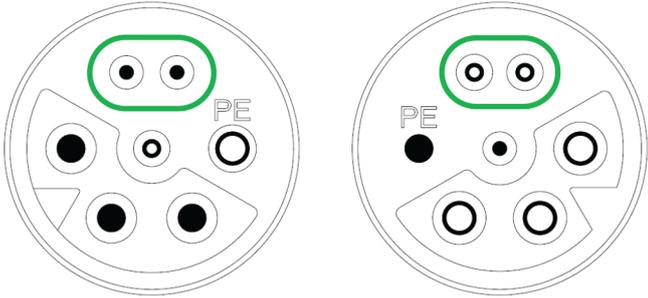
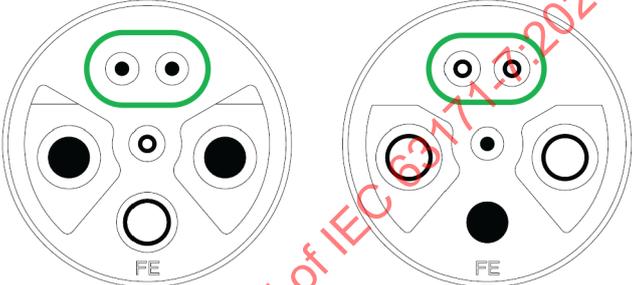
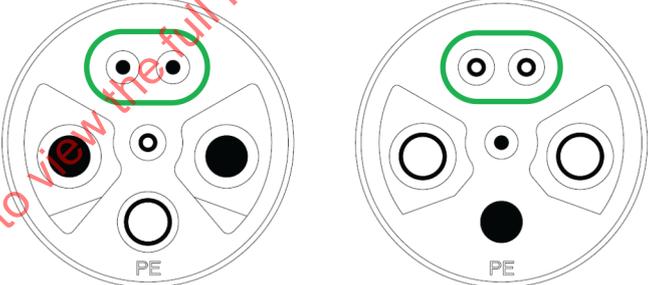
Table 1 defines the codings.

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**Table 1 – Codings**

Coding	Description	Front views – male (left) and female (right)
Type I	2 data pins (Ø 0,5 mm) up to 4 power pins (Ø 1 mm)	
Type II	Shield pin (Ø 0,5 mm) Shield ferrule	
Type III	2 data pins (Ø 0,5 mm) 2 power pins (Ø 1 mm) Shield pin (Ø 0,5 mm) FE pin (Ø 1 mm) Shield ferrule	
Type IV	2 data pins (Ø 0,5 mm) 2 power pins (Ø 1 mm) Shield pin (Ø 0,5 mm) PE pin (Ø 1 mm) Shield ferrule	

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Coding	Description	Front views – male (left) and female (right)
Type V	2 data pins (Ø 0,5 mm) 3 power pins (Ø 1 mm) Shield pin (Ø 0,5 mm) PE pin (Ø 1 mm) Shield ferrule	 <div style="text-align: right; font-size: small;">IEC</div>
Type VI	2 data pins (Ø 0,5 mm) 2 power pins (Ø 1,5 mm) Shield pin (Ø 0,5 mm) FE pin (Ø 1,5 mm) Shield ferrule	 <div style="text-align: right; font-size: small;">IEC</div>
Type VII	2 data pins (Ø 0,5 mm) 2 power pins (Ø 1,5 mm) Shield pin (Ø 0,5 mm) PE pin (Ø 1,5 mm) Shield ferrule	 <div style="text-align: right; font-size: small;">IEC</div>

### 5.3 Styles

#### 5.3.1 Overview

Table 2 shows an overview of connector styles specified within this document.

**Table 2 – Styles**

Style <sup>a</sup>	Description	Picture
6P-P12C	PLUG <sup>b</sup> – Free connector with male contacts, size 12 <sup>c</sup> , push pull locking	
6P-M12C	PLUG <sup>b</sup> – Free connector with male contacts, size 12 <sup>c</sup> , M12 thread locking	
6J-P12C	JACK <sup>b</sup> – Fixed connector with female contacts, size 12 <sup>c</sup> , push pull locking, intended for single-hole mounting	
6J-M12C	JACK <sup>b</sup> – Identical to 6J-P12C but with M12 thread locking <u>instead</u> of push pull, intended for single-hole mounting	
6J-C12C	JACK <sup>b</sup> – Combination of 6J-P12C and 6J-M12C: With both, M12 thread <u>and</u> push pull locking, intended for single-hole mounting	
6P-P12CI	PLUG <sup>b</sup> – Free connector with female contacts, "inverse style", size 12 <sup>c</sup> , push pull locking	
6P-M12CI	PLUG <sup>b</sup> – Free connector with female contacts, "inverse style", size 12 <sup>c</sup> , M12 thread locking	
6J-P12CI	JACK <sup>b</sup> – Fixed connector with male contacts, "inverse style", size 12 <sup>c</sup> , push pull locking, intended for single hole mounting	
6J-M12CI	JACK <sup>b</sup> – Identical to 6J-P12CI but with M12 thread locking <u>instead</u> of push pull, intended for single-hole mounting	
6J-C12CI	JACK <sup>a</sup> – Combination of 6J-P12CI and 6J-M12CI: with both, M12 thread <u>and</u> push pull locking, intended for single-hole mounting	

NOTE Further information for possible constellations can be found in Annex A.

<sup>a</sup> Style name taxonomy:

6 = Indicator for IP6X protected connector system

P = plug (male connector)

J = jack (female connector)

P12 = push-pull locking size 12

M12 = M12 screw-locking

C12 = combined M12 and P12 locking

C = direct style connector

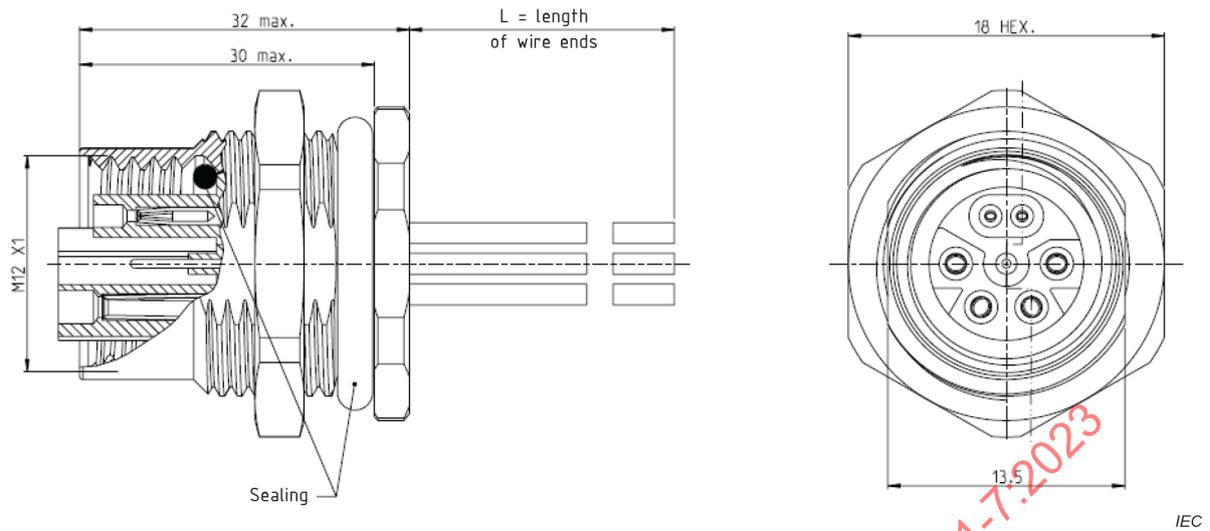
CI = inverse style connector

<sup>b</sup> The terms PLUG and JACK are used only for easier reading since they are widely used. A PLUG, either with male or female (inverse styles) contacts denotes a free connector; a JACK, either with female or male (inverse style) contacts denotes a fixed connector.

<sup>c</sup> The designation "size 12" indicates roughly the diameter of the jack in millimetres.

### 5.3.2 Styles 6J-P12C, 6J-M12C and 6J-C12C

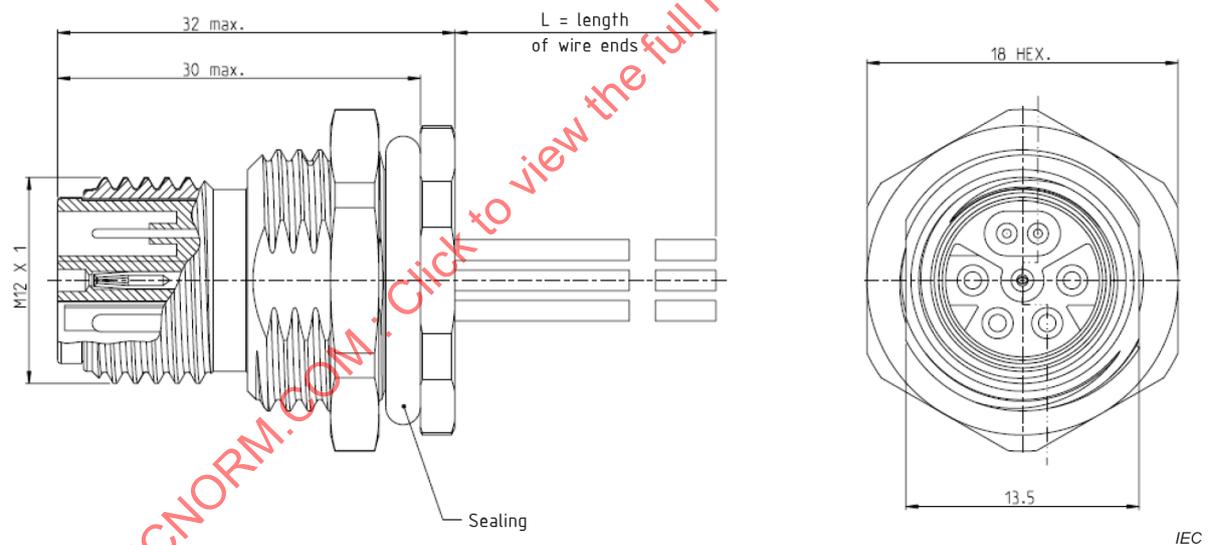
Figure 2 shows the overall dimensions of fixed connectors with female contacts, size 12, with relevant locking mechanism, intended for single-hole mounting.



**Figure 2 – Styles 6J-P12C, 6J-M12C, 6J-C12C overall dimensions**

### 5.3.3 Styles 6J-P12CI, 6J-M12CI and 6J-C12CI

Figure 3 shows the overall dimensions of fixed connectors with male contacts, "inverse style", size 12, with relevant locking mechanism, intended for single hole mounting.



**Figure 3 – Styles 6J-P12CI, 6J-M12CI and 6J-C12CI overall dimensions**

### 5.3.4 Styles 6P-P12C, 6P-M12C

Figure 4 shows the overall dimensions of free connectors with male contacts, size 12, with relevant locking mechanism.

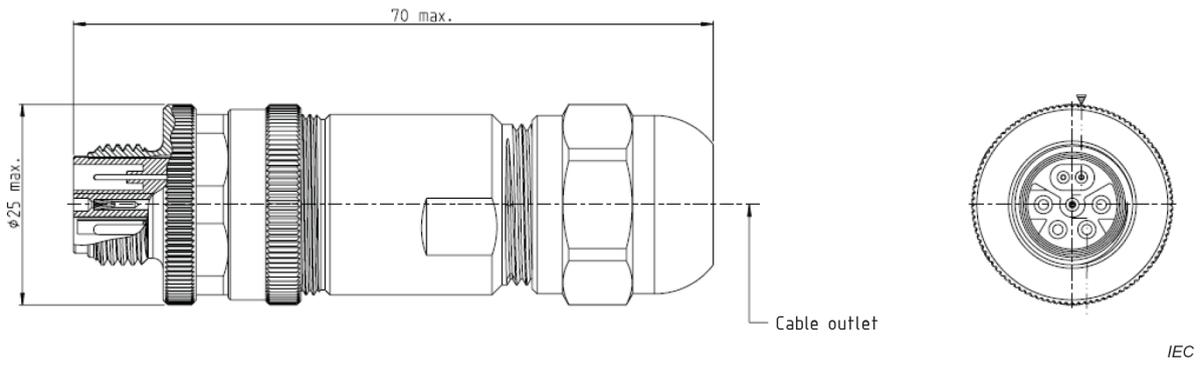


Figure 4 – Styles 6P-P12C and 6P-M12C overall dimensions

### 5.3.5 Styles 6P-P12CI and 6P-M12CI

Figure 5 shows the overall dimensions of free connectors with female contacts, "inverse style", size 12, with relevant locking mechanism.

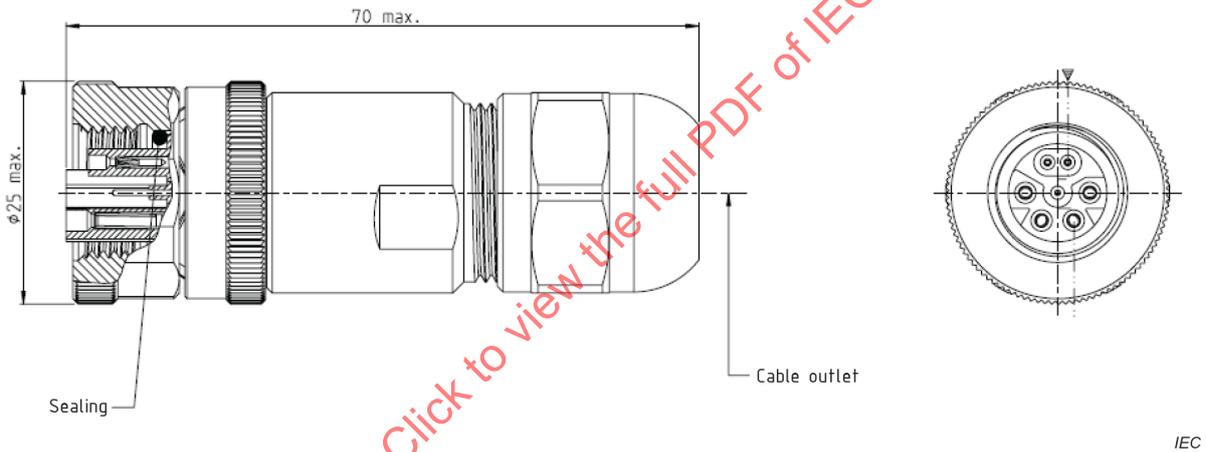
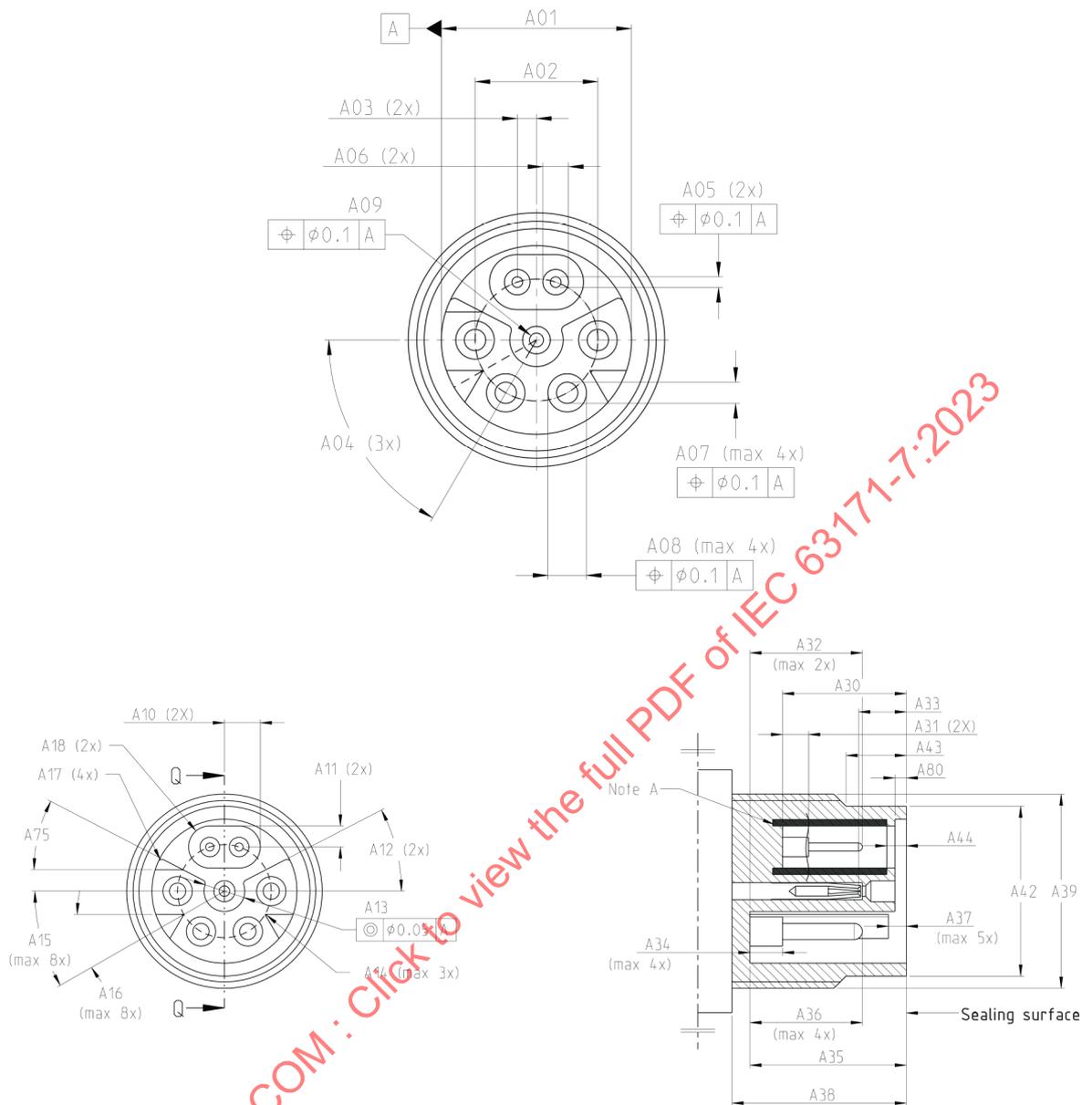


Figure 5 – Styles 6P-P12CI and 6P-M12CI overall dimensions

### 5.4 Interface dimensions

Figure 6 and Figure 7 show the mating dimensions for the codings Type I to Type V and styles with male contacts 6P-P12C, 6P-M12C, 6J-P12CI, 6J-M12CI, 6J-C12CI. See Table 3 for the dimensions.



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**Key**

A Over this distance, a 360° shielding with overlapping to the shielding of the receptacle is mandatory. This shielding shall not reduce the dimension A11.

**Figure 6 – Mating dimensions for the codings Type I to V and styles with male contacts (at the example of coding Type I)**

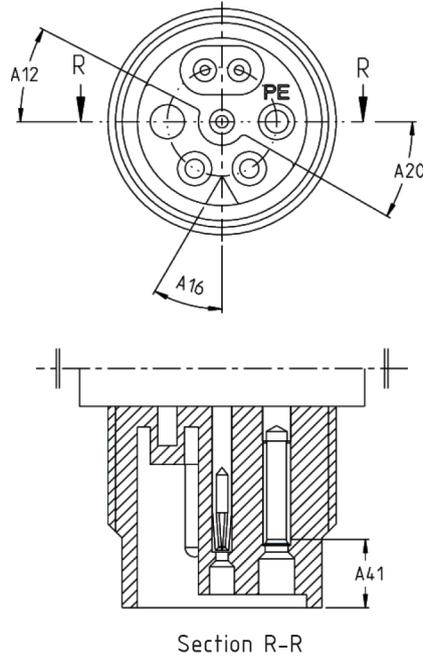


Figure 7 – Dimensions of PE pin for the codings Type I to V and styles with male contacts (at the example of coding Type IV)

Table 3 – Dimensions for Figure 6 and Figure 7

Dimensions in millimetres

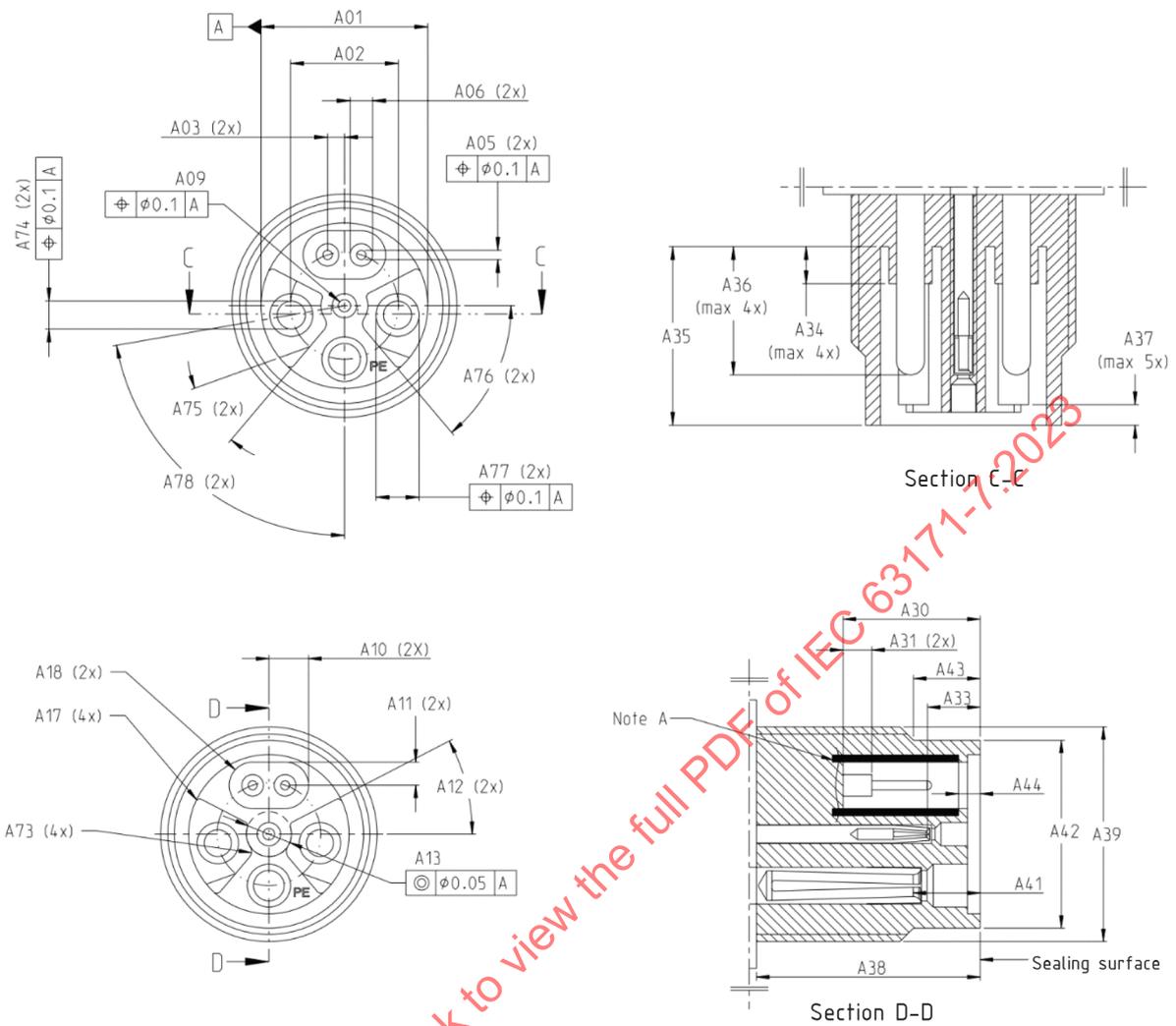
Dimension	Min	Nom	Max
A01	Ø8,8	Ø8,90	Ø8,90
A02	-	5,75	-
A03	-	0,90	-
A04	-	60°	-
A05	Ø0,47	Ø0,50	Ø0,53
A06	Ø1,17	Ø1,20	Ø1,23
A07	Ø0,97	Ø1,00	Ø1,03
A08	Ø1,77	Ø1,80	Ø1,83
A09	Ø0,60	Ø0,65	Ø0,70
A10	2,20	2,20	2,30
A11	1,30	1,30	1,40
A12	27,5°	27,5°	29,5°
A13	Ø2,40	Ø2,50	Ø2,50
A14	R0,1	R0,1	R0,15
A15	29,5°	30,0°	30,5°
A16	29°	30°	30°
A17	-	-	R0,25
A18	-	-	R1,30
A20	28°	30°	30°
A30	7,7	7,9	8,0
A31	1,9	1,9	2,0
A32	7,00	7,20	7,40

Dimensions in millimetres

Dimension	Min	Nom	Max
A33	3,00	3,20	3,40
A34	3,00	3,00	3,10
A35	9,70	9,90	9,90
A36	7,00	7,20	7,40
A37	1,10	1,10	1,20
A38	10,70	-	-
A39	-	M12 x 1	-
A41	1,70	1,80	1,90
A42	Ø10,20	Ø10,50	Ø10,50
A43	1,5	-	3,60
A44	1,10	1,20	1,30
A75	26,5°	27,5°	27,5°
A80	0,70	0,70	0,80

Figure 8 shows the mating dimensions for the codings Type VI and Type VII and styles with male contacts 6P-P12C, 6P-M12C, 6J-P12CI, 6J-M12CI, 6J-C12CI. See Table 4 for the dimensions.

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**Key**

A Over this distance, a 360° shielding with overlapping to the shielding of the receptacle is mandatory. This shielding shall not reduce the dimension A11.

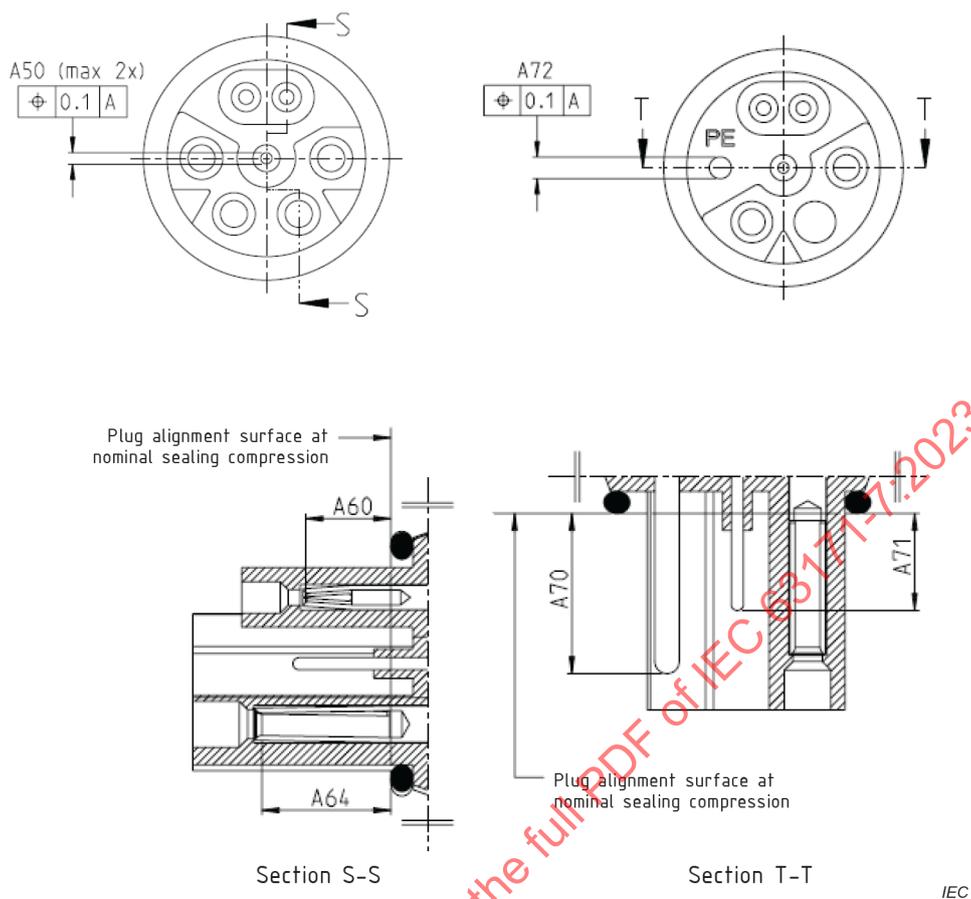
**Figure 8 – Mating dimensions for the codings Type VI and Type VII and styles with male contacts (at the example of coding Type VII)**

**Table 4 – Dimensions for Figure 8**

*Dimension in millimeters*

Dimension	Min	Nom	Max
A73	-	-	R0,50
A74	Ø1,47	Ø1,50	Ø1,53
A75	26,5°	27,5°	27,5°
A76	50°	50°	52°
A77	Ø2,27	Ø2,30	Ø2,33
A78	-	80°	-
A79	Ø1,65	Ø1,70	Ø1,75

Figure 9 shows the mating dimensions for the styles with female contacts 6J-P12C, 6J-M12C, 6JC12C, 6P-P12CI, 6P-M12CI. See Table 5 for the dimensions.



**Figure 9 – Mating dimensions for the styles with female contacts  
(at the example of codings Type I and Type IV)**

**Table 5 – Dimensions for Figure 9**

Dimension in millimetres

Dimension	Min	Nom	Max
A50	Ø0,47	Ø0,50	Ø0,53
A60	3,82	4,02	4,22
A64	4,82	5,02	5,22
A70	6,6	6,9	7,0
A71	4,5	4,7	4,9
A72	Ø0,97	Ø1,00	Ø1,03

## 5.5 Gauges

Material: tool steel, hardened



= Surface (clean and free of grease) roughness according to ISO 21920-1:2021:

$$Ra_{\max} = 0,25 \mu\text{m}; Ra_{\min} = 0,15 \mu\text{m}$$

Figure 10 and Table 6 show the gauge dimensions and requirements.

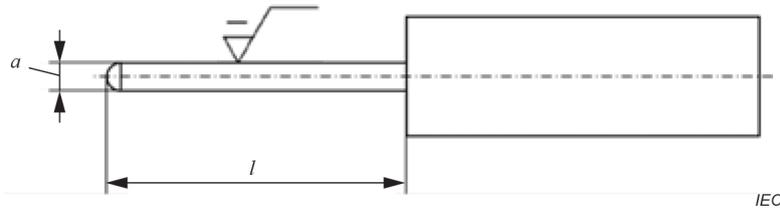


Figure 10 – Gauge dimensions

Table 6 – Gauges

Nom. pin $\varnothing$	Application	Mass g	$\varnothing a$ mm	$l$ min. mm
0,5	Sizing	-	$0,52^{+0,01}_0$	10
	Retention force	10	$0,48^0_{-0,01}$	10
1,0	Sizing	-	$1,02^{+0,01}_0$	10
	Retention force	20	$0,98^0_{-0,01}$	10
1,5	Sizing	-	$1,52^{+0,01}_0$	10
	Retention force	25	$1,48^0_{-0,01}$	10

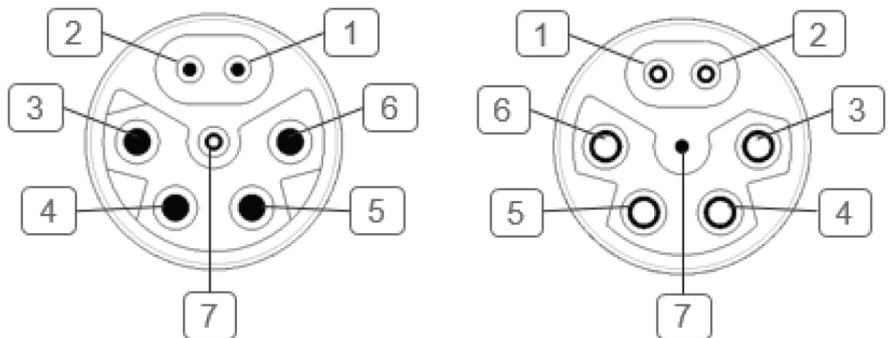
## 6 Characteristics

### 6.1 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.

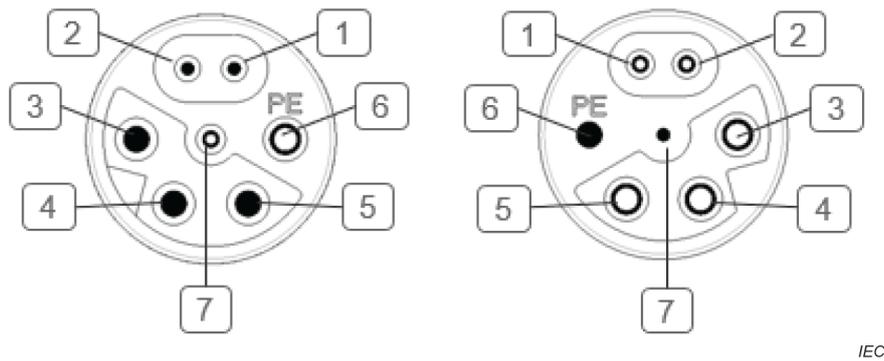
### 6.2 Pin assignment

Figure 11 to Figure 13 and Table 7 specify the connector pin assignments for differential data transmission and separate power supply for the Type I, Type II, Type III, Type IV and Type V codings.



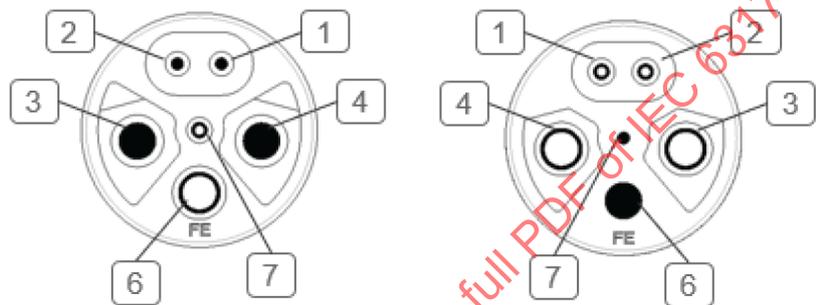
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Figure 11 – Pin assignments, front views, Types I and II



(Type V shown)

Figure 12 – Pin assignments, front views, M12, Types III, IV and V



(Type VI shown)

Figure 13 – Pin assignments, front views, M12, Types VI and VII

Table 7 – Pin assignments

Pin No.	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII
1 <sup>a</sup>	Data	Data	Data	Data	Data	Data	Data
2 <sup>b</sup>	Data	Data	Data	Data	Data	Data	Data
3	Power	Power	Power	Power	Power	Power	Power
4	Power	Power	Power	---	Power	Power	Power
5	Power	Power	Power	Power	Power	---	---
6	Power	Power	FE	PE	PE	FE	PE
7	Shield	Shield	Shield	Shield	Shield	Shield	Shield

<sup>a</sup> Signal BI\_DA+ and PoDL +

<sup>b</sup> Signal: BI\_DA- and PoDL -

### 6.3 Classification into climatic category

The lowest and highest temperatures and the duration of the damp-heat steady-state test should be selected from the preferred values stated in IEC 61076-1:2006, 2.3. 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 8.

**Table 8 – Climatic category**

Climatic category	Category temperature		Damp heat steady state		Days
	Lower	Upper	Temperature	Relative humidity	
	°C	°C	°C	%	
40/090/21	-40	+90	40	93	21

**6.4 Electrical characteristics**

**6.4.1 Creepage and clearance distances**

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

In general, for minimum values of clearances and creepage distances, IEC 60664-1 shall apply based on the assigned voltage ratings as specified in 6.4.3. See Table 9 for minimum creepage and clearance distances.

**Table 9 – Creepage and clearance distances**

Dimension in millimetres

Contact	Coding	Minimum creepage distance <sup>a</sup>		Minimum clearance distance	
		Contact-to-contact	Contact-to-shield	Contact-to-contact <sup>b</sup>	Contact-to-shield <sup>c</sup>
Data	All	1,25 <sup>d</sup>	1,25 <sup>d</sup>	0,5	1,7
Power	Type I	1,25 <sup>e</sup>	2,5 <sup>e, f</sup>	0,5	1,5 <sup>f</sup>
	Type II				
	Type III				
	Type IV	6,0 <sup>e</sup>	12,0 <sup>e, f</sup>	5,5	8,0 <sup>f</sup>
	Type V	4,8 <sup>e</sup>	9,6 <sup>e, f</sup>	3,0	5,5 <sup>f</sup>
	Type VI	1,25 <sup>e</sup>	2,5 <sup>e, f</sup>	0,5	1,5 <sup>f</sup>
	Type VII	6 <sup>e</sup>	12,0 <sup>e, f</sup>	5,5	8,0 <sup>f</sup>

<sup>a</sup> Per IEC 61984:2008, 6.19.2.3, the insulating parts inside the enclosure for the connectors with IP65 or higher specified in this document are dimensioned for pollution degree 2.

<sup>b</sup> Contact-to-contact clearances are based on overvoltage category III.

<sup>c</sup> Contact-to-shield clearances are based on overvoltage category IV.

<sup>d</sup> Creepage distances for data contacts are based on material group III.

<sup>e</sup> Creepage distances for power contacts are based on material group III.

<sup>f</sup> Contact-to-shield creepage and clearance distances for power contacts also apply to the spacings between power contact and shield ferrule and between power contact and shield pin.

NOTE As indicated in IEC 60664-1, IEC TR 63040 provides an alternative and more precise dimensioning procedure for clearances equal to or less than 2 mm.

The creepage and clearance distances that cover performance requirements in IEC 60664-1 may be reduced, based on IEC TR 63040.

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

Furthermore, in practice, based on the conductive pattern of the printed board or the wiring used, reductions in creepage or clearance distances are permitted.

### 6.4.2 Voltage proof

Conditions:

- IEC 60512-4-1, Test 4a, Method A
- Standard atmospheric conditions
- Mated connectors

See Table 10 for the voltage proof test values.

**Table 10 – Voltage proof**

AC voltages are given as RMS

Contact	Coding according to Table 1	Contact to contact	All contacts connected together to shield
Data	All types	1 000 V DC <sup>b</sup>	2 250 V DC <sup>b</sup>
Power <sup>a</sup>	Type I	0,84 kV AC	0,84 kV AC
	Type II		
	Type III		
	Type IV	3,31 kV AC	3,31 kV AC
	Type V	2,21 kV AC	2,21 kV AC
	Type VI	0,84 kV AC	0,84 kV AC
	Type VII	3,31 kV AC	3,31 kV AC

<sup>a</sup> For the power contacts, test voltages are specified according to IEC 61984:2008, Table 8.  
<sup>b</sup> Voltage proof according to IEC 63171:2021, 5.4.2

### 6.4.3 Voltage rating

Table 11 defines the voltage ratings for the individual codings.

**Table 11 – Voltage ratings**

AC voltages are given as RMS

Contact	Coding	Voltage rating
Data	All	< 50 V AC ≤ 63 V DC
Power	Type I	< 50 V AC ≤ 63 V DC
	Type II	
	Type III	
	Type IV	≤ 600 V AC ≤ 600 V DC
	Type V	≤ 480 V AC
	Type VI	< 50 V AC ≤ 63 V DC
	Type VII	≤ 600 V AC ≤ 600 V DC

**6.4.4 Current-temperature derating**

Conditions:

- IEC 60512-5-2, Test 5b
- Standard atmospheric conditions
- Mated connectors
- The current-carrying capacity of the 0,5 mm data pins shall comply with the derating values of Level I as defined in IEC 63171, when all connector contacts (except PE and FE) are loaded concurrently – the curves thus represent the "worst case" condition of all power and data contacts simultaneously loaded.

NOTE The power pins are specified through current rating only; see 6.4.5.

**6.4.5 Current rating**

The rated current specifications are given in Table 12.

**Table 12 – Current ratings of connectors**

Contacts	Pin diameter mm	Rated current <sup>a</sup> A
Data	0,5	2 <sup>b</sup>
Power	1	8 <sup>c, d</sup>
	1,5	16 <sup>c</sup>
<sup>a</sup> Values at ambient temperature up to and including 60 °C, with all data and power poles concurrently loaded. <sup>b</sup> Current-carrying capacity according to derating curve. <sup>c</sup> Testing shall be carried out with the minimum supported wire size. <sup>d</sup> Value shall be reduced by 25 % (to 6 A per pin) if two pins are combined.		

**6.4.6 Interface contact resistance**

The maximum initial contact resistance and the maximum permitted rise are given in Table 13.

**Table 13 – Interface contact resistance**

Contacts	Initial	Maximum rise
Data	according to IEC 63171:2021, 5.4.4	20 mΩ
Power	5 mΩ	10 mΩ

The maximum allowable shielding resistance is 100 mΩ.

**6.4.7 Input to output DC resistance**

According to IEC 63171:2021, 5.4.5 for the data contacts.

**6.4.8 Input to output DC resistance unbalance**

According to IEC 63171:2021, 5.4.6 for the data contacts.

#### 6.4.9 Insulation resistance

The minimum insulation resistance is given in Table 14.

**Table 14 – Insulation resistance**

Contacts	Minimum insulation resistance
Data	100 MΩ
Power	100 MΩ

#### 6.4.10 Impedance

The nominal characteristic impedance of the data pair of these connectors is 100 Ω.

### 6.5 Transmission performance

#### 6.5.1 General

Compliance to this document, in respect to transmission characteristics, shall be determined according to specific test methods described in test group FP as defined in IEC 63171.

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 provisions of the following subclauses 6.5.2 to 6.5.10 apply to the data contacts only.

#### 6.5.2 Insertion loss

According to Category B of IEC 63171:2021, 5.5.2.

#### 6.5.3 Return loss

According to Category B of IEC 63171:2021, 5.5.3.

#### 6.5.4 Propagation delay

According to IEC 63171:2021, 5.5.4.

#### 6.5.5 Transverse conversion loss

According to Category B of IEC 63171:2021, 5.5.5.

#### 6.5.6 Transverse conversion transfer loss

According to Category B of IEC 63171:2021, 5.5.6.

#### 6.5.7 Transfer impedance

According to IEC 63171:2021, 5.5.7.

#### 6.5.8 Coupling attenuation

According to IEC 63171:2021, 5.5.8.

**6.5.9 Power sum alien (exogenous) NEXT**

According to Category B of IEC 63171:2021, 5.5.9.

**6.5.10 Power sum alien (exogenous) FEXT**

According to Category B of IEC 63171:2021, 5.5.10.

**6.6 Mechanical characteristics**

**6.6.1 IP degree of protection**

IP65 and IP67 (IP65/IP67), according to IEC 60529, for connectors in mated and locked position.

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

Styles 6P-P12CI and 6P-M12CI: finger-proof when unmated (IPXXB per IEC 60529).

**6.6.2 Mechanical operation**

According to mating performance level MPL100 of IEC 63171:2021, 5.6.1.

**6.6.3 Effectiveness of connector coupling devices**

According to the definitions for M12 and Push-Pull IP65/67 in IEC 63171:2021, 5.6.2.

**6.6.4 Insertion and withdrawal forces**

Conditions:

- IEC 60512-13-2, Test 13b
- Standard atmospheric conditions
- Speed: 50 mm/min

Table 15 shows insertion and withdrawal forces.

**Table 15 – Insertion and withdrawal forces**

Total insertion force	Total withdrawal force
N	N
45 max.	45 max.

**6.6.5 Polarizing and keying method**

According to IEC 63171:2021, 5.6.4.

**6.6.6 Dynamic stress**

According to IEC 63171:2021, 5.6.5.

**7 Tests and test schedule**

**7.1 General**

According to IEC 63171:2021, Clause 6.