

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Low-voltage switchgear and controlgear –
Part 7-4: Ancillary equipment – PCB terminal blocks for copper conductors**

**Appareillage à basse tension –
Partie 7-4: Matériels accessoires – Blocs de jonction pour cartes de circuits
imprimés pour conducteurs en cuivre**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 7-4: Ancillary equipment –
PCB terminal blocks for copper conductors**

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The text of this standard is based on the following documents:

| | |
|---------------|------------------|
| FDIS | Report on voting |
| 17B/1822/FDIS | 17B/1827/RVD |

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60947 series, published under the general title *Low-voltage switchgear and controlgear*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This standard IEC 60947-7-4 for PCB terminal blocks covers not only the terminal block requirements according to IEC 60947-7 series but also takes into account the specifications of connectors according to IEC 61984 as the requirements for both components are highly similar due to equivalent applications.



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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 7-4: Ancillary equipment – PCB terminal blocks for copper conductors

1 General

1.1 Scope

This part of IEC 60947 specifies requirements for PCB terminal blocks primarily intended for industrial or similar use.

Mounting and fixing on the printed circuit board is made by soldering, press-in or equivalent methods to provide electrical and mechanical connection between copper conductors and the printed circuit board.

This standard applies to PCB terminal blocks intended to connect copper conductors, with or without special preparation, having a cross-section between 0,05 mm² and 300 mm² (AWG 30/600 kcmil), intended to be used in circuits of a rated voltage not exceeding 1 000 V a.c. up to 1 000 Hz or 1 500 V d.c.

NOTE 1 Large cross section terminal blocks are dedicated to specific design of high current PCBs. The range up to 300 mm² is kept to cover any possible application. Examples of high current PCBs and PCB terminal blocks are shown in Annex C.

NOTE 2 AWG is the abbreviation of "American Wire Gage" (Gage (US) = Gauge (UK));

kcmil = 1 000 cmil;

1 cmil = 1 circular mil = surface of a circle having a diameter of 1 mil;

1 mil = 1/1 000 inch.

This standard may be used as a guide for special types of PCB terminal blocks with components, such as disconnect units, integrated cartridge fuse-links and the like.

If applicable, in this standard the term "clamping unit" is used instead of "terminal". This is taken into account in case of references to IEC 60947-1.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60352-1, *Solderless connections – Part 1: Wrapped connections – General requirements, test methods and practical guidance*

IEC 60352-2, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*

IEC 60352-3, *Solderless connections – Part 3: Solderless accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-4, *Solderless connections – Part 4: Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-5, *Solderless connections – Part 5: Press-in connections – General requirements, test methods and practical guidance*

IEC 60352-6, *Solderless connections – Part 6: Insulation piercing connections – General requirements, test methods and practical guidance*

IEC 60352-7, *Solderless connections – Part 7: Spring clamp connections – General requirements, test methods and practical guidance*

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 60512-4-1, *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 60512-11-7, *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 11-10: Climatic tests – Test 11j: Cold*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
Amendment 1: 2010

IEC 60998-2-3, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)*

IEC 61210, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

ISO 6988, *Metallic and other non-organic coatings – Sulfur dioxide test with general condensation of moisture*

2 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60947-1, as well as the following, apply.

2.1

printed circuit board

PCB

piece of insulating material with fixed metal traces to connect electronic components

Note 1 to entry: Printed circuit boards are typically subdivided according to:

- their structure (e.g. single- and double-sided, multilayers);
- the nature of the base material (e.g. rigid, flexible).

2.2

PCB terminal block

part intended to be mounted on a printed circuit board and carrying one or more mutually insulated contact units and which provides an electrical and mechanical connection between copper conductor and printed circuit board

2.3

rated current

current value assigned by the manufacturer which the PCB terminal block can carry continuously (without interruption) and simultaneously through all its poles connected with the maximum cross-section, preferably at an ambient temperature of 40 °C, without the upper limiting temperature being exceeded

2.4

contact unit

conductive part establishing the connection between printed circuit board and connectable conductor(s)

Note 1 to entry: See Annex A.

2.5

upper limiting temperature

ULT

maximum temperature in the PCB terminal block as outcome (sum) of the ambient temperature and the temperature rise due to current flow, at which the PCB terminal block is intended to be still operable

Note 1 to entry: At ambient temperature = ULT the available temperature rise due to current flow is zero, thus the current carrying capacity of the PCB terminal block is zero.

2.6

lower limiting temperature

LLT

minimum temperature of a PCB terminal block assigned by the manufacturer, at which a PCB terminal block is intended to operate

3 Classification

A distinction is made between various types of PCB terminal blocks, if applicable, as follows:

- a) type of clamping unit (see 7.1.1);
- b) ability to accept prepared conductors (see 2.3.28 of IEC 60947-1:2007, Amendment 1 (2010));
- c) type of electrical contact to the printed circuit board;
- d) type of mechanical fastening to the printed circuit board;
- e) number of poles;
- f) pitch (center to center pin spacing);
- g) contact unit with identical or dissimilar clamping units;
- h) number of clamping units on each contact unit;
- i) service conditions.

4 Characteristics

4.1 Summary of characteristics

The characteristics of a PCB terminal block are as follows:

- type of PCB terminal block (see 4.2);
- rated and limiting values (see 4.3).

4.2 Type of PCB terminal block

The following shall be stated:

- type of clamping units (see 7.1.1);
- type of contacting on the printed circuit board;
- number of clamping units.

4.3 Rated and limiting values

4.3.1 Rated voltages

Subclauses 4.3.1.2 and 4.3.1.3 of IEC 60947-1:2007 apply.

4.3.2 Rated current

Verification of the rated current specified by the manufacturer is made according to 8.4.5.

If an ambient temperature other than 40 °C is used for the definition of the rated current, the manufacturer should state, in the technical documentation, the ambient temperature on which the rating is based, with reference, if appropriate, to the derating curve defined in IEC 60512-5-2, Test 5b.

The derating curve is obtained by applying a reduction factor of 0,8 according to IEC 60512-5-2, Test 5b. If another reduction factor is used, this shall be stated in the technical documentation.

4.3.3 Standard cross-sections

The standard values for cross-sections of copper conductors to be used are given in Table 1.

Table 1 – Standard cross-sections of copper conductors

| Metric size ISO | Comparison between AWG/kcmil and metric sizes | |
|-----------------|---|------------------------|
| | Size | Equivalent metric area |
| | AWG/kcmil | mm ² |
| 0,05 | 30 | 0,05 |
| 0,08 | 28 | 0,08 |
| 0,14 | 26 | 0,13 |
| 0,2 | 24 | 0,205 |
| 0,34 | 22 | 0,324 |
| 0,5 | 20 | 0,519 |
| 0,75 | 18 | 0,82 |
| 1 | – | – |
| 1,5 | 16 | 1,3 |
| 2,5 | 14 | 2,1 |
| 4 | 12 | 3,3 |
| 6 | 10 | 5,3 |
| 10 | 8 | 8,4 |
| 16 | 6 | 13,3 |
| 25 | 4 | 21,2 |
| 35 | 2 | 33,6 |
| 50 | 0 | 53,5 |
| 70 | 00 | 67,4 |
| 95 | 000 | 85 |
| + | 0000 | 107,2 |
| 120 | 250 (kcmil) | 127 |
| 150 | 300 (kcmil) | 152 |
| 185 | 350 (kcmil) | 177 |
| 240 | 500 (kcmil) | 253 |
| 300 | 600 (kcmil) | 304 |

4.3.4 Maximum cross-section

The maximum cross-section shall be selected from the standard cross-sections given in Table 1.

4.3.5 Connecting capacity

For PCB terminal blocks with a maximum cross-section between 0,05 mm² and 35 mm² inclusive, the minimum range contained in Table 2 applies. The conductors may be rigid (solid or stranded) or flexible. The manufacturer shall state the types and the maximum and minimum cross-sections of conductors that can be connected and, if applicable, the number of conductors simultaneously connectable to each clamping unit. The manufacturer shall also state any necessary preparation of the end of the conductor.

Table 2 – Relationship between maximum cross-section and connecting capacity of PCB terminal blocks

| Maximum cross-section | | Connecting capacity | |
|-----------------------|-----------|---------------------|------------------|
| mm ² | AWG/kcmil | mm ² | AWG |
| 0,05 | 30 | 0,05 | 30 |
| 0,08 | 28 | 0,05 – 0,08 | 30 – 28 |
| 0,14 | 26 | 0,05 – 0,08 – 0,14 | 30 – 28 – 26 |
| 0,2 | 24 | 0,08 – 0,14 – 0,2 | 28 – 26 – 24 |
| 0,34 | 22 | 0,14 – 0,2 – 0,34 | 26 – 24 – 22 |
| 0,5 | 20 | 0,2 – 0,34 – 0,5 | 24 – 22 – 20 |
| 0,75 | 18 | 0,34 – 0,5 – 0,75 | 22 – 20 – 18 |
| 1 | – | 0,5 – 0,75 – 1 | – |
| 1,5 | 16 | 0,75 – 1 – 1,5 | 20 – 18 – 16 |
| 2,5 | 14 | 1 – 1,5 – 2,5 | 18 – 16 – 14 |
| 4 | 12 | 1,5 – 2,5 – 4 | 16 – 14 – 12 |
| 6 | 10 | 2,5 – 4 – 6 | 14 – 12 – 10 |
| 10 | 8 | 4 – 6 – 10 | 12 – 10 – 8 |
| 16 | 6 | 6 – 10 – 16 | 10 – 8 – 6 |
| 25 | 4 | 10 – 16 – 25 | 8 – 6 – 4 |
| 35 | 2 | 16 – 25 – 35 | 6 – 4 – 2 |
| 50 | 0 | 25 – 35 – 50 | 4 – 2 – 0 |
| 70 | 00 | 35 – 50 – 70 | 2 – 0 – 00 |
| 95 | 000 | 50 – 70 – 95 | 0 – 00 – 000 |
| – | 0000 | – | 00 – 000 – 0000 |
| 120 | 250 | 70 – 95 – 120 | 000 – 0000 – 250 |
| 150 | 300 | 95 – 120 – 150 | 0000 – 250 – 300 |
| 185 | 350 | 120 – 150 – 185 | 250 – 300 – 350 |
| – | 400 | – | 300 – 350 – 400 |
| 240 | 500 | 150 – 185 – 240 | 350 – 400 – 500 |
| 300 | 600 | 185 – 240 – 300 | 400 – 500 – 600 |

5 Product information

5.1 Marking

A PCB terminal block shall be marked in a durable and legible manner with the following:

- the name of the manufacturer or a trade mark by which the manufacturer can be readily identified;
- a type reference permitting its identification in order to obtain relevant information from the manufacturer or his catalogue.

Very small PCB terminal blocks with a surface which cannot be marked shall be marked only according to a). In those cases all specified information shall be marked on the smallest packing unit.

5.2 Additional information

The following information shall be stated by the manufacturer, if applicable, e.g. in the manufacturer's data sheet or his catalogue or on the packing unit:

- a) IEC 60947-7-4, if the manufacturer claims compliance with this standard;
- b) the maximum cross-section;
- c) the connecting capacity, if different from Table 2, including the number of conductors simultaneously connectable;
- d) the rated current and the reduction factor to determine the derating curve if different from 0,8;

NOTE Unless otherwise specified, the rated current is preferably determined on four-pole contact units.

- e) the rated insulation voltage (U_i);
- f) the rated impulse withstand voltage (U_{imp}), when determined;
- g) service conditions, if different from those in Clause 6;
- h) special preparation of the end of the conductor.

6 Normal service, mounting and transport conditions

Clause 6 of IEC 60947-1:2007 applies.

7 Constructional and performance requirements

7.1 Constructional requirements

7.1.1 Clamping units

The clamping units shall allow the conductors to be connected by means ensuring that a reliable mechanical linkage and electrical contact is properly maintained.

No contact pressure shall be transmitted through insulating materials other than ceramic, or other material with characteristics not less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage of the insulating material.

The corresponding test is under consideration.

Clamping units and connecting methods listed in Table 3 fulfil the requirements of this standard.