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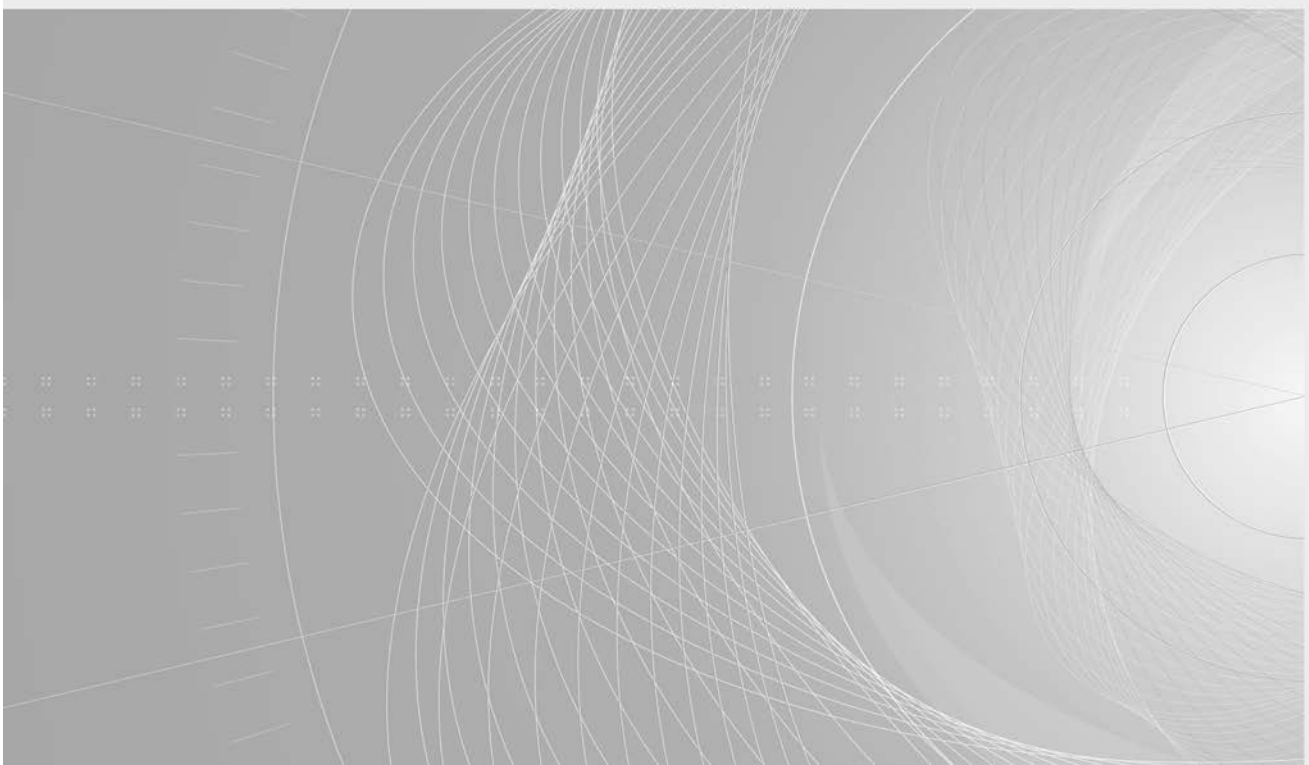


Low-voltage switchgear and controlgear –
Part 7-4: Ancillary equipment – PCB terminal blocks for copper conductors

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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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

FOREWORD

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International Standard IEC 60947-7-4 has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

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

- a) additional test for PCB terminal blocks with clamping units, where contact pressure is transmitted through insulating materials;
- b) tightening torques for screws now given in Table 4 of this document (previously given in Table 4 of IEC 60947-1:2007); tightening torques added for an additional type of screw;
- c) new criteria for verification of contact resistance introduced;

- d) clarification in the description of the temperature-rise test (current-temperature derating); corrections in the test sequence according to Figure 4.

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

FDIS	Report on voting
121A/255/FDIS	121A/265/RVD

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

This document 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 document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

This document covers not only the terminal block requirements in accordance with the IEC 60947-7 series but also takes into account the specifications of connectors in accordance with IEC 61984 as the requirements for both components are highly similar owing to equivalent applications.

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

1 Scope

This part of IEC 60947-7 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 document applies to PCB terminal blocks intended to connect copper conductors, with or without special preparation, having a cross-section between 0,08 mm² and 300 mm² (AWG 28-600 kcmil), intended to be used in circuits of a rated voltage not exceeding 1 000 V AC up to 1 000 Hz or 1 500 V DC.

NOTE 1 Large-cross-section terminal blocks are dedicated to the 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)).

1 kcmil = 1 000 cmil;

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

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1 mil = 1/1 000 inch.

This document can 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 or with other dimensions of conductors.

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

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 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 60512-2-2:2003, *Connectors for electronic equipment – Tests and measurements – Part 2-2: Electrical continuity and contact resistance tests – Test 2b: Contact resistance – Specified test current method*

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

IEC 60512-5-2:2002, *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 60947-7-4:2019](#)

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 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

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

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*

IEC 60947-1:2007/AMD1:2010

IEC 60947-1:2007/AMD2:2014

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*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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>

3.1

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).

Note 2 to entry: This note applies to the French language only.

3.2

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

3.3

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

3.4

contact unit

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

Note 1 to entry: See Annex A for description of the structure of a PCB terminal block.

3.5**upper limiting temperature****ULT**

maximum temperature assigned by the manufacturer 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: This note applies to the French language only.

3.6**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

Note 1 to entry: This note applies to the French language only.

4 Classification

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

- a) type of clamping unit (see 8.1.1);
- b) ability to accept prepared conductors (see 2.3.28 of IEC 60947-1:2007/AMD1:2010);
- 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 (centre to centre pin spacing);
- g) contact unit with identical or dissimilar clamping units;
- h) number of clamping units on each contact unit;
- i) service conditions.

5 Characteristics**5.1 Summary of characteristics**

The characteristics of a PCB terminal block are as follows:

- type of PCB terminal block (see 5.2);
- rated and limiting values (see 5.3).

5.2 Type of PCB terminal block

The following shall be stated:

- type of clamping units (see 8.1.1);
- type of contacting on the printed circuit board;
- number of clamping units.

5.3 Rated and limiting values**5.3.1 Rated voltages**

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

5.3.2 Rated current

Verification of the rated current specified by the manufacturer is carried out in accordance with 9.4.5.

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.

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

5.3.3 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
mm ²	AWG/kcmil	mm ²
0,05 ^a	30 ^a	0,05 ^a
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

^a Outside the scope of this document and included for information only.

5.3.4 Maximum cross-section

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

5.3.5 Connecting capacity

For PCB terminal blocks with a maximum cross-section between 0,08 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 ^a	30 ^a	0,05 ^a		30 ^a	
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	

^a Outside the scope of this document and included for information only.

6 Product information

6.1 Marking

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

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

Very small PCB terminal blocks with a surface that cannot be marked shall be marked only in accordance with a). In those cases, all specified information shall be marked on the smallest packing unit.

6.2 Additional information

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

- a) IEC 60947-7-4, if the manufacturer claims compliance with this document;
- 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); [IEC 60947-7-4:2019](https://standards.iteh.ai/catalog/standards/sist/01851b5e-35ee-4f2d-b4c9-766973154imcc-60947-7-4-2019)
- f) the rated impulse withstand voltage (U_{imp}), when determined;
- g) service conditions, if different from those stated in Clause 7;
- h) special preparation of the end of the conductor;
- i) additional information to be specified stated in Annex B, if applicable.

7 Normal service, mounting and transport conditions

Clause 6 of IEC 60947-1:2007/AMD2:2014 applies.

8 Constructional and performance requirements

8.1 Constructional requirements

8.1.1 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.

In addition, the test described in 9.4.7.3 shall be performed if contact pressure of the clamping unit is transmitted through insulating material. If this contact pressure is transmitted purely via ceramic or pure mica, the test according to 9.4.7.3 is not deemed necessary.

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

Additional requirements are given in this document.