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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

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

IEC 60947-7-4:2019-01 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document ~~IEC 60947-7-4 for PCB terminal blocks~~ 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.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

~~1 General~~

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 ~~0,05~~ 0,08 mm^2 and 300 mm^2 (AWG ~~30/~~ 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 mm^2 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;

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

1 mil = 1/1 000 inch.

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

IEC 60512-2-2:2003, *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 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 mm^2 up to 35 mm^2 (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 mm^2 up to 300 mm^2 (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 ~~given in IEC 60947-1, as well as the following,~~ 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: 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.~~

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 ~~0,05~~ 0,08 mm^2 and 35 mm^2 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);

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.

~~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.~~

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.

Other terminations and connection methods shall be tested in accordance with the relevant standards.

Table 3 – Standards for clamping units and connecting methods

Ref.	Clamping units and connecting methods	Reference standards
a)	Screw-type clamping unit	IEC 60999-1 or IEC 60999-2
b)	Screwless-type clamping unit	IEC 60999-1 or IEC 60999-2 or IEC 60352-7
c)	Wrapped connection	IEC 60352-1
d)	Crimped connection	IEC 60352-2
e)	Insulation displacement connection (accessible)	IEC 60352-3 or IEC 60998-2-3
f)	Insulation displacement connection (non accessible)	IEC 60352-4 or IEC 60998-2-3
g)	Press-in connection	IEC 60352-5
h)	Insulation piercing connection	IEC 60352-6 or IEC 60998-2-3
i)	Flat quick-connect termination	IEC 61210
j)	Soldered connection	IEC 60068-2-20 [a]
NOTE The relevant standard applies for the preconditioning of prepared conductors.		
[a] The test method selected shall be stated in the test report.		

8.1.2 Mounting and installation

PCB terminal blocks shall be so designed that safe mounting on a printed circuit board is possible by means of soldering, pressing-in, screwing, etc. The connection to the printed circuit board shall not be damaged by connecting the conductors.

Tests shall be carried out in accordance with 9.3.2.

8.1.3 Clearances and creepage distances

For PCB terminal blocks for which the manufacturer has stated values of rated impulse withstand voltage (U_{imp}) and rated insulation voltage (U_i), minimum values of clearances and creepage distances are given in Table 13 of IEC 60947-1:2007 and Table 15 of IEC 60947-1:2007/AMD1:2010.

For PCB terminal blocks for which the manufacturer has not declared a value of rated impulse withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of IEC 60947-1:2007.

Electrical requirements are given in 8.2.2.

8.1.4 Terminal identification and marking

Subclause 7.1.8.4 of IEC 60947-1:2007 applies with the following addition.

A PCB terminal block shall have provision, or at least space, for identification marks or numbers for each clamping unit or contact unit related to the circuit of which it forms a part, except when such marking is not physically possible.

~~If such marking is not possible the information shall be stated by the manufacturer, e.g. in the manufacturer's data sheet or his catalogue or on the packing unit.~~

Such provision may consist of separate marking items, such as marking tags, identification labels, etc.

8.1.5 Resistance to abnormal heat and fire

The insulation materials of PCB terminal blocks shall not be adversely affected by abnormal heat and fire.

Compliance is checked by:

a) the glow-wire test on the complete product in accordance with 9.5 or

b) verification of the insulating material in accordance with

   1) IEC 60695-2-12, method GWFI at a temperature of 850 °C, or

   2) IEC 60695-2-13, method GWIT at a temperature of 775 °C.

This verification is not necessary for small parts (see IEC 60695-2-11).

NOTE 1 The relevant test method is specified by the manufacturer.

NOTE 2 For some applications it ~~may~~ can be mandatory to check compliance by the glow-wire test on the complete product in accordance with 9.5 only. The need is either defined in the end-product standard or by agreement between the manufacturer and the users. See Clause B.1.

8.1.6 Maximum cross-section and connecting capacity

PCB terminal blocks shall be so designed that conductors of the maximum cross-section and the connecting capacity, if applicable, can be accepted.

Compliance is checked by the test described in 9.3.4.

The verification of the maximum cross-section may be performed by the special test in accordance with 9.3.5.

8.2 Performance requirements

8.2.1 Temperature-rise (current-temperature derating)

PCB terminal blocks shall be tested in accordance with 9.4.5. The sum of ambient temperature and temperature-rise of the PCB terminal block shall not exceed the upper limiting temperature ~~(ULT)~~.

8.2.2 Dielectric properties

If the manufacturer has declared a value of the rated impulse withstand voltage (U_{imp}) (see 4.3.1.3 of IEC 60947-1:2007), the requirements of 7.2.3 and 7.2.3.1 of IEC 60947-1:2007/AMD1:2010 apply. If applicable, the impulse withstand voltage test shall be carried out in accordance with 9.4.3a).

For the verification of solid insulation the power-frequency withstand voltage test shall be carried out in accordance with 9.4.3b).

The verification of sufficient clearances and creepage distances shall be made in accordance with 9.4.2. For PCB terminal blocks for which the manufacturer has not declared a value of rated impulse withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of IEC 60947-1:2007.

8.2.3 Short-time withstand current

A PCB terminal block shall be capable of withstanding the short-time withstand current which corresponds to 120 A/mm^2 for 1 s, in accordance with 9.4.6.

The test shall be performed using the smallest cross-section in the current path of the contact unit as declared by the manufacturer.

8.2.4 Contact resistance

When measured in accordance with 9.4.4, the change in contact resistance of a PCB terminal block caused by the conductor connection and the mounting on the printed circuit board shall not exceed the permissible deviations.

8.2.5 Ageing tests

8.2.5.1 Climatic sequence and corrosion test

For the verification of the resistance of connections against the influence of temperatures and corrosive atmospheres, the climatic sequence test shall be carried out for all kinds of PCB terminal blocks.

Compliance is checked by the test described in 9.4.7.1.

8.2.5.2 Ageing test for screwless-type PCB terminal blocks

For the verification of screwless-type PCB terminal blocks the ageing test shall be carried out.

Compliance is checked by the test described in 9.4.7.2 (if relevant).

For screwless-type PCB terminal blocks with contact pressure via insulating material, only the current cycling ageing test in accordance with 9.4.7.3 shall be performed.

8.2.5.3 Current cycling ageing test for PCB terminal blocks with contact pressure via insulating material

For the verification of the resistance of connections against the influence of contact pressure via insulating material, the current cycling ageing test shall be carried out.

Compliance is checked by the test described in 9.4.7.3 (if relevant).

8.3 Electromagnetic compatibility (EMC)

Subclause 7.3 of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014 applies.

9 Tests

9.1 Kinds of test

Subclause 8.1.1 of IEC 60947-1:2007 applies with the following addition.

No routine tests are specified. The verification of the maximum cross-section in accordance with 9.3.5 is a special test. All other tests are type tests.

9.2 General

Unless otherwise specified, PCB terminal blocks are tested in new and in clean condition, and installed as for normal use (see 6.3 of IEC 60947-1:2007) at an ambient temperature of (25 ±10) °C.

The tests are carried out in the order described in 9.3, 9.4 and 9.5.

Each test is carried out on new individual specimens with at least four contact units (one set) where each multipole PCB terminal block may contain the required number of contact units.

For a PCB terminal block family with the same design and comparable form, tests need only be performed on specimens representing the most unfavourable case.

The surface of the conductors shall be free of contamination and corrosion that degrades performance.

Care shall be taken when stripping conductors to avoid cutting, nicking, scraping or otherwise damaging the conductors.

In cases where the manufacturer has stated that special preparation of the end of the conductor is necessary, the test report shall indicate the method of preparation used.

The tests are carried out with the type of conductors (rigid or flexible) as stated by the manufacturer.

If one of the PCB terminal blocks does not withstand one of the tests, this test shall be repeated on a second set of PCB terminal blocks, all of which shall then comply with the repeated test. If this test is part of a test sequence, the complete test sequence shall be repeated.

9.3 Verification of mechanical characteristics

9.3.1 General

The verification of mechanical characteristics includes the following test:

- attachment of the PCB terminal block on its support (see 9.3.2);
- verification of the maximum cross-section and connecting capacity (see 9.3.4);
- verification of maximum cross-section (special test with gauges) (see 9.3.5).

9.3.2 Attachment of the PCB terminal block on its support

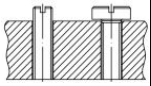
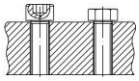
The tests shall be carried out on the smallest number of poles, preferably two poles, of a PCB terminal block, which is mounted on an appropriate support (printed circuit board) as in normal use in accordance with the manufacturer's instructions. For PCB terminal blocks to be soldered on printed circuit boards, this test shall be carried out on printed circuit boards with plated through holes, when applicable.

The wiring of the PCB terminal blocks for this test shall be carried out as shown in Figure 1 with the maximum cross-section as specified by the manufacturer.

After the verification of the contact resistance in accordance with 9.4.4, this conductor shall be connected and disconnected five times, if applicable, according to the manufacturer's instructions. For each connection, a new end of the conductor shall be used.

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 ~~of IEC 60947-1:2007~~ or, alternatively, with a higher value, as specified by the manufacturer.

Table 4 – Tightening torques for PCB terminal blocks with screw-type clamping units

Diameter of thread (mm)				Tightening torque (N·m)			
Metric standard values	Range of diameter			Ia 	Ib 	II 	III 
1,6	≤ 1,6			0,05	0,05	0,1	0,1
2,0	> 1,6	up to and including	2,0	0,1	0,1	0,2	0,2
2,5	> 2,0	up to and including	2,8	0,2	0,3	0,4	0,4
3,0	> 2,8	up to and including	3,0	0,25	0,4	0,5	0,5
–	> 3,0	up to and including	3,2	0,3	0,5	0,6	0,6
3,5	> 3,2	up to and including	3,6	0,4	0,6	0,8	0,8
4,0	> 3,6	up to and including	4,1	0,7	1,0	1,2	1,2
4,5	> 4,1	up to and including	4,7	0,8	1,2	1,8	1,8
5	> 4,7	up to and including	5,3	0,8	1,4	2,0	2,0
6	> 5,3	up to and including	6,0	1,2	1,9	2,5	3,0
8	> 6,0	up to and including	8,0	2,5	3,0	3,5	6,0
10	> 8,0	up to and including	10,0	–	–	4,0	10,0
12	> 10	up to and including	12	–	–	–	14,0
14	> 12	up to and including	15	–	–	–	19,0
16	> 15	up to and including	20	–	–	–	25,0
20	> 20	up to and including	24	–	–	–	36,0
24	> 24			–	–	–	50,0

NOTE 1 Column Ia applies to screws without heads that, when tightened, do not protrude from the hole, and to other screws that cannot be tightened by means of a screwdriver with a blade wider than the root diameter of the screw.

NOTE 2 Column Ib applies to screws with head diameters < 1,5 times the thread diameter that, when tightened, do not protrude from the hole, and to other screws that cannot be tightened by means of a screwdriver with a blade wider than the hole diameter.

NOTE 3 Column II applies to nuts and screws that are tightened by means of a screwdriver.

NOTE 4 Column III applies to nuts and screws that can be tightened by means other than a screwdriver.

At the end of the test the PCB terminal blocks shall comply with the contact resistance test in accordance with 9.4.4. After the test, the terminal assembly shall be free from damage that ~~may~~ can impair further use.

9.3.3 Vacant

9.3.4 Verification of the maximum cross-section and connecting capacity

The verification of the maximum cross-section and connecting capacity shall be carried out in accordance with the standard for clamping units to be used (see 8.1.1).

NOTE The mechanical properties of clamping units are tested in accordance with the applicable connecting methods listed in Table 3.

9.3.5 Verification of maximum cross-section (special test with gauges)

Subclause 8.2.4.5 of IEC 60947-1:2007/AMD1:2010 applies with the following addition.

The test shall be carried out on each clamping unit of one PCB terminal block.

9.4 Verification of electrical characteristics

9.4.1 General

The verification of electrical characteristics includes the following:

- verification of clearances and creepage distances (see 9.4.2);
- dielectric tests (see 9.4.3);
- verification of the contact resistance (see 9.4.4);
- temperature-rise test (see 9.4.5);
- short-time withstand current test (see 9.4.6);
- ageing tests (see 9.4.7.1, 9.4.7.2 and 9.4.7.3).

9.4.2 Verification of clearances and creepage distances

9.4.2.1 General

The verification is made between two adjacent PCB terminal blocks or mutually insulated contact units of a multipole PCB terminal block and all live parts and accessible metal parts of a PCB terminal block.

The measurement of clearances and creepage distances shall be made under the following conditions:

a) the PCB terminal blocks shall be connected with the most unfavourable conductor type(s) and conductor cross-section(s) among those declared by the manufacturer or without a conductor, if this turns out to be the most unfavourable case;

b) the conductor ends shall be stripped, if required, to a length specified by the manufacturer.

The method of measuring clearances and creepage distances is described in Annex G of IEC 60947-1:2007.

9.4.2.2 Clearances

The measured values of clearances shall be higher than the values given in Table 13 of IEC 60947-1:2007 for case B – homogeneous field (see 7.2.3.3 of IEC 60947-1:2007/AMD2:2014) based on the value of the rated impulse withstand voltage (U_{imp}) and the pollution degree stated by the manufacturer.

The impulse withstand voltage test shall be carried out in accordance with 9.4.3 a) unless the measured clearances are equal to or larger than the values given in Table 13 of IEC 60947-1:2007 for case A – inhomogeneous field [see 8.3.3.4.1, item 2), of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010].

9.4.2.3 Creepage distances

The measured creepage distances shall be not less than the values given in Table 15 of IEC 60947-1:2007/AMD1:2010 in connection with 7.2.3.4 a) and b) of IEC 60947-1:2007 based on the rated insulation voltage (U_i), the material group and the pollution degree as specified by the manufacturer.

9.4.3 Dielectric tests

a) If the manufacturer has declared a value for the rated impulse withstand voltage (U_{imp}), the impulse withstand voltage test shall be carried out in accordance with Table 5.

b) The power-frequency withstand verification of solid insulation according to IEC 60512-4-1 shall be made in accordance with the test voltages given in Table 6. For this test, the PCB terminal blocks are connected with the most unfavourable conductor (without a printed circuit board). The duration of the test is 1 min. The test voltage shall be applied between each of the poles that can assume different potentials in the application.

NOTE The relationship between nominal voltages and of the rated impulse withstand voltage (U_{imp}) are given in Annex H of IEC 60947-1:2007 (see also 8.1.3).

A voltage dip of the test voltage or a disruptive discharge or flashover is not allowed.

Table 5 – Impulse withstand test voltages

Rated impulse voltage	Impulse withstand voltage [a]	
	for a height of 2 000 m above sea level	at sea level
kV	kV (1,2/50 µs)	kV (1,2/50 µs)
0,5	0,5	0,55
0,8	0,8	0,91
1,5	1,5	1,75
2,5	2,5	2,95
4	4	4,8
6	6	7,3
8	8	9,8
12	12	14,8

[a] If the testing laboratory is situated at a height between sea level and 2 000 m, interpolation of the impulse voltage is allowed.

Table 6 – Dielectric test voltages corresponding to the rated insulation voltage

Rated insulation voltage	AC test voltage (RMS)[a]	
U_i	Overvoltage category III	Overvoltage category II
V	kV	kV
$U_i \leq 63$	0,5	0,4
$63 < U_i \leq 100$	0,8	0,5
$100 < U_i \leq 160$	1,4	0,8
$160 < U_i \leq 320$	2,2	1,4
$320 < U_i \leq 500$	3,1	2,2
$500 < U_i \leq 1\,000$	4,2	3,1

[a] RMS test voltages are based on 6.1.3.4 of IEC 60664-1:2007 and are higher than those of IEC 60947-1:2007/AMD2:2014, Table 12A in order to be in line with requirements of end-product standards.

9.4.4 Verification of contact resistance

The contact resistance shall be verified:

a) before and after the test of attachment of the PCB terminal block on its support (see 9.3.2);

~~b) before and after the temperature rise test (see 8.4.5);~~

b) before and after the short-time withstand current test (see 9.4.6);

c) before and after the climatic sequence and corrosion test (see 9.4.7.1);

d) ~~before,~~ during and after the ageing test for screwless-type PCB terminal blocks (see 9.4.7.2).

e) during and after the additional test for clamping units, where contact pressure is transmitted through insulating materials (see 9.4.7.3).

The verification is made as specified in ~~8.3.2, 8.4.5, 8.4.6 and 8.4.7~~. 9.3.2, 9.4.6, 9.4.7.1, 9.4.7.2 (if relevant) and 9.4.7.3 (if relevant).

The contact resistance shall be measured between the connected conductor and the interconnection on the printed circuit board at each contact unit of a PCB terminal block as shown in Figure 1. ~~The measurement is carried out according to the procedure specified in IEC 60512-2-1. After the tests a), b), c) and d) the contact resistance shall not rise by more than 50 % of the initial measurement value.~~

~~If the measurement value exceeds 1,5 times the initial measurement value, the clamping units and the connecting methods may be evaluated separately.~~

For tests a), b), c), d) and e), the measurement is carried out according to the procedure specified in IEC 60512-2-2.

For tests a), b), c) and d), the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the initial measurement value. The higher value is permissible.

For test e), the measurement is carried out in accordance with the procedure specified in IEC 60512-2-2 while omitting the measurement in accordance with 4.1 c) of IEC 60512-2-2:2003 and neglecting the second paragraph of 3.2 of IEC 60512-2-2:2003. So, the contact resistance is calculated in accordance with Formula [1] below:

$$R = \frac{U_{\mathrm{m}}}{\left(\frac{1}{10}\right) * I_{\mathrm{rated}}} \qquad [1]$$

where

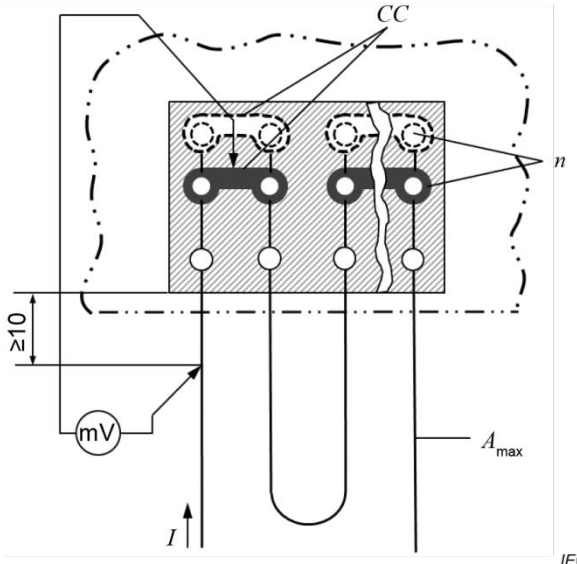
R is the resistance (mΩ);

U_{m} is the measured voltage drop (mV);

I_{rated} is the rated current (A).

After the 192nd and the 384th cycle the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value of the 24th cycle. The higher value is permissible.

Dimensions in millimetres



Key

I	Test current
mV	Voltmeter
n	Number of connections to the printed circuit board per contact unit
CC	Trace on the printed circuit board for interconnection
A_{max}	Maximum cross-section in mm^2
Cross-hatched area	Base area of the PCB terminal block

Figure 1 – Test assembly for the measurement of contact resistance and temperature-rise

9.4.5 Temperature-rise test (current-temperature derating)

This test serves to ~~evaluate the ability of the PCB terminal block to carry the rated current permanently without exceeding~~ derive a rated current for the PCB terminal block from the derating curve that does not exceed the upper limiting temperature ~~(ULT)~~. Unless otherwise specified, the test shall be carried out according to the current-temperature derating of IEC 60512-5-2 under the following test conditions.

The test is carried out on an assembly of PCB terminal blocks mounted next to each other with, preferably, four contact units per level as shown in Figure 1 and Figure 2. The PCB terminal block shall be mounted on a printed circuit board as in normal use and connected in series with insulated conductors of the maximum cross-section and conductors on the printed circuit board. The interconnections on the printed circuit board shall be made with solid bare conductors of equal cross-section or comparable means and as short as possible.

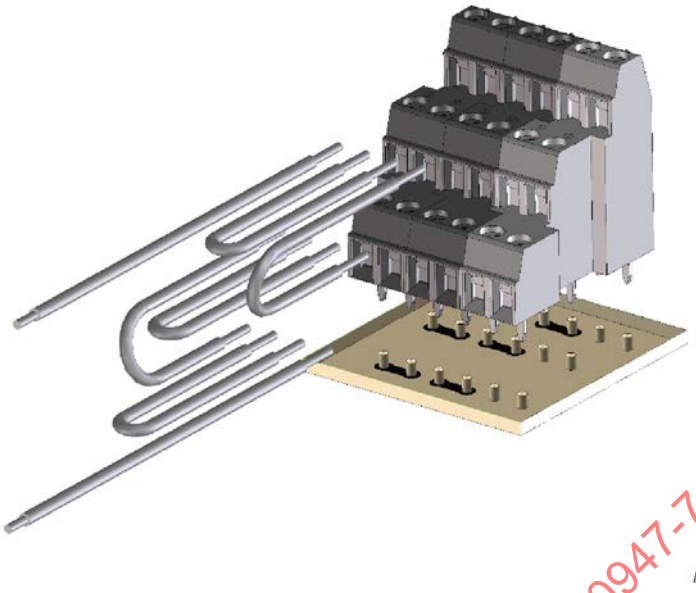


Figure 2 – Example of wiring structure of a multi-tier PCB terminal block

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 ~~of IEC 60947-1:2007~~ or, alternatively, with a higher value as specified by the manufacturer.

The length of connectable conductors and conductor loops shall be taken from Table 7.

Table 7 – Length of connectable conductors and conductor loops

Cross-section (mm^2)	Length (mm)
≤ 10	500 ± 50
16 to 35	1 000 ± 100
> 35	2 000 ± 200

For PCB terminal blocks having/providing several connections to the printed circuit board, the cross-section of interconnections A_B shall be calculated in accordance with the following Formula [2]:

$$A_B \leq \frac{A_{max}}{n} \quad [2]$$

where

A_B is the cross-section of interconnections in mm^2;

A_{max} is the maximum cross-section in mm^2; and

n is the number of connections to the printed circuit board per contact unit.

The sum of cross-sections of interconnections ($A_B \times n$) shall not exceed the cross-section of the connectable conductor. Examples are given in Table 8.

Table 8 – Examples of cross-sectional distribution of interconnections on printed circuit boards

Maximum cross-section (A_{max})	Number of connections to printed circuit board (n)			
	1	2	3	4
	Cross-section of interconnections (A_B)			
mm²	mm²			
...	...	...	...	...
2,5	2,5	1	0,75	0,5
4	4	1,5	1	1
6	6	2,5	1,5	1,5
10	10	4	2,5	2,5
...	...	...	...	...

The test assembly shall be prepared and arranged for the test procedure as shown in Figure 1 in accordance with the test conditions described in IEC 60512-5-2. Unless otherwise specified, the size of the printed circuit board shall be ~~selected so that it protrudes over~~ at least two times the base area of the PCB terminal block(s) ~~on all sides corresponding to five times the spacing of the PCB terminal block~~. The printed circuit board that is used shall be described in the test report.

~~After verification of the contact resistance as described in 8.4.4,~~ The test shall be carried out with single-phase alternating or direct current as described in IEC 60512-5-2, Test 5b. As described in IEC 60512-5-2, the measuring points for measuring the temperature shall be located on the hottest spot above the printed circuit board (component side).

Where applicable, it ~~may~~ can be necessary to determine the hottest spot by carrying out pre-tests.

The reduction factor to determine the derating curve is 0,8. ~~If this is not adhered to~~ Otherwise, the derating factor used shall be indicated in the technical documentation.

~~At the end of the test and after cooling down to ambient temperature the PCB terminal block shall comply with the contact resistance test according to 8.4.4 without modification of the assembly.~~

9.4.6 Short-time withstand current test

The purpose of this test is to verify the ability to withstand a thermal shock.

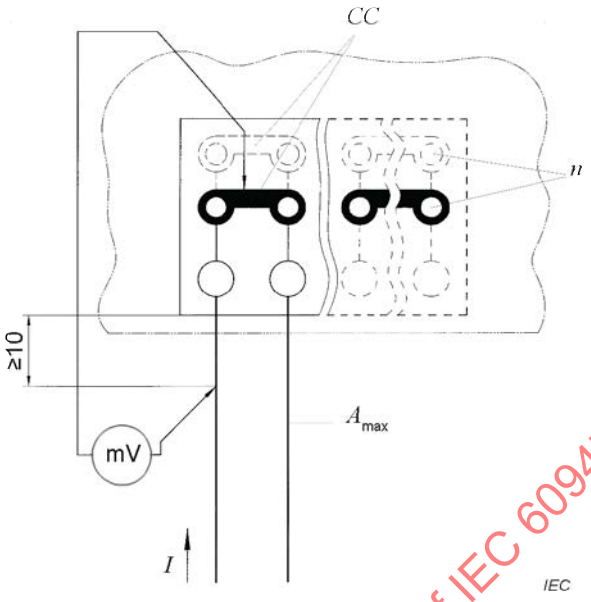
The test is carried out on two adjacent contact units with the longest and most unfavourable current paths of one PCB terminal block or two adjacent PCB terminal blocks. For this test, the PCB terminal block is mounted as in normal use in accordance with the manufacturer's instructions and connected with conductors of maximum cross-section A_{max} and interconnections A_B as determined in 9.4.5 (see Figure 3).

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 ~~of IEC 60947-1:2007~~ or, alternatively, with a higher value as specified by the manufacturer.

At the end of the test, the test (circuit) assembly shall show no interruptions and the PCB terminal blocks shall be free from cracks, ruptures or other critical damage.

After cooling down to room temperature, the contact units shall comply with the contact resistance test in 9.4.4.

Dimensions in millimetres



Key

I	Test current
mV	Voltmeter
n	Number of connections to the printed circuit board per contact unit
CC	Trace on the printed circuit board for interconnection
A_{max}	Maximum cross-section in mm^2

Figure 3 – Test assembly for the measurement of short-time withstand current

9.4.7 Ageing tests

9.4.7.1 Climatic sequence and corrosion test

The purpose of this test is to verify that clamping units and connections to the printed circuit board are able to withstand environmental conditions and ageing.

The test sequence is carried out on ~~a~~ two sets of PCB terminal blocks ~~each~~. One set is connected with conductors of the minimum cross-section and the other set is connected with the maximum cross-section. Attachment of the terminal block to the PCB shall be made in accordance with the manufacturer's instructions.

The tests are carried out on prepared specimens in the indicated test sequence in accordance with IEC 60512-11-10, IEC 60512-11-9, IEC 60512-11-7 and ISO 6988 (see Figure 4).

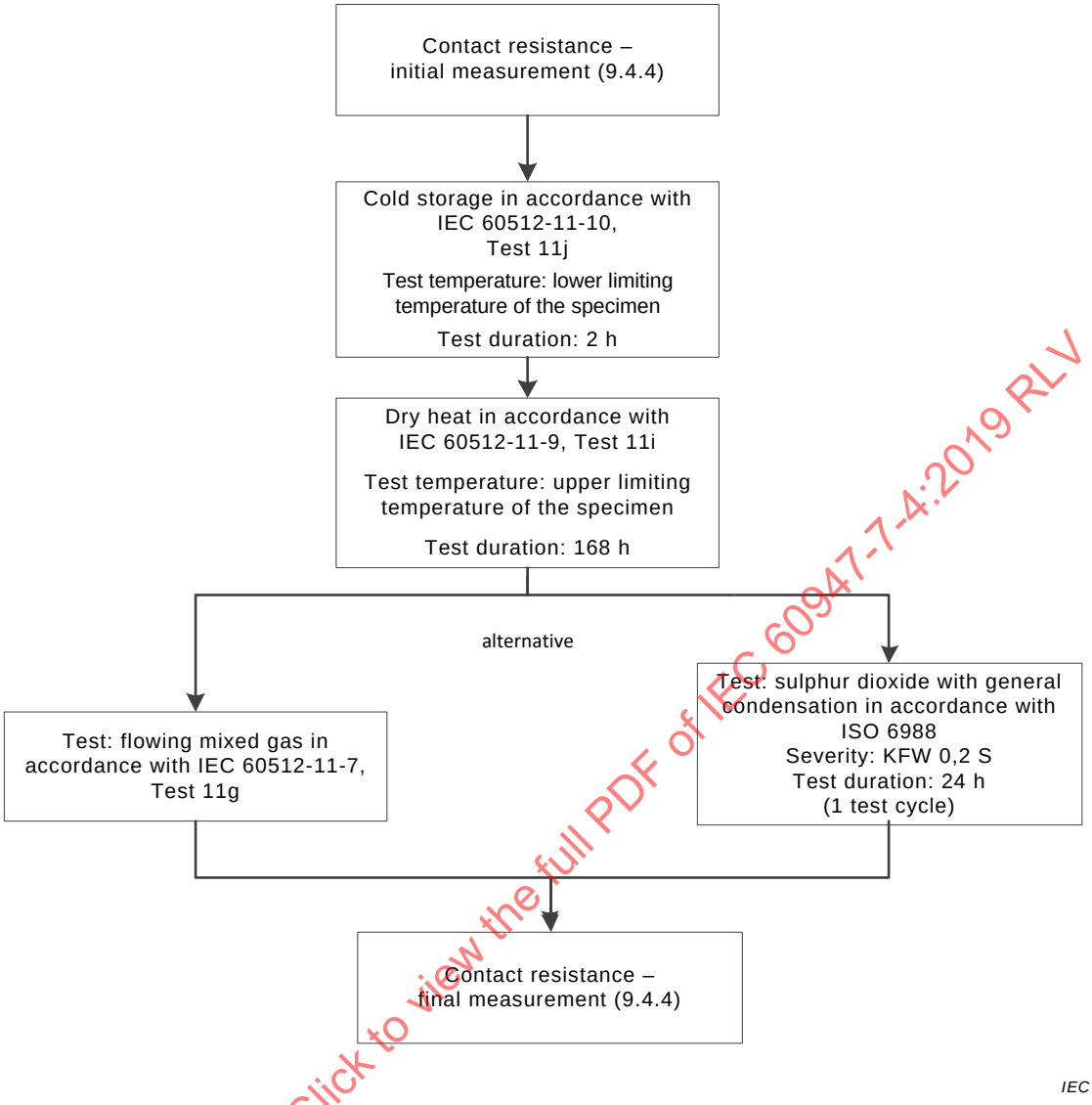


Figure 4 – Test sequence

After each test ~~step~~, except after the contact resistance measurement, the specimens shall be subjected to visual inspection where the PCB terminal blocks shall be free from cracks, ruptures or other critical damage.

9.4.7.2 Aging test for screwless-type PCB terminal blocks

The test is carried out on an assembly of PCB terminal blocks mounted next to each other with preferably four contact units per level as shown in Figure 1 and Figure 2. The PCB terminal block shall be mounted on a printed circuit board as in normal use and connected in series with insulated conductors of the maximum cross-section and conductors on the printed circuit board. The interconnections on the printed circuit board shall be made with solid bare conductors of equal cross-section or comparable means and as short as possible.

The length of connectable conductors and conductor loops shall be taken from Table 7.

The test arrangement is placed in a heating cabinet which is initially kept at a temperature of (20 ± 2) °C and then submitted to the verification of the contact resistance test.

The whole test arrangement, including the conductors, shall not be moved until the voltage drop test has been completed.

The PCB terminal blocks are submitted to 192 temperature cycles as follows.

The temperature in the heating cabinet is increased to 40 °C in accordance with 8.3.3.3.1 of IEC 60947-1:2007/AMD2:2014 or to the temperature value declared by the manufacturer for maximum service conditions.

The temperature is maintained within ± 5 °C of this value for approximately 10 min.

During this test period, the current derived from the derating curve at an ambient temperature of 40 °C is applied.

Alternatively to the current value at 40 °C, a test current declared by the manufacturer can be used. In this case, the sum of the ambient temperature and the temperature-rise shall be equal to the upper limiting temperature.

The PCB terminal blocks are then cooled down to a temperature of approximately 30 °C, forced cooling being allowed; they are kept at this temperature for approximately 10 min and, if necessary for measuring the contact resistance, further cooling to a temperature of (20 ± 5) °C is allowed.

NOTE As guidance, a value for the heating and cooling rate of the heating cabinet of approximately 1,5 °C/min can be taken as a basis.

The contact resistance on all contact units is also determined in accordance with 9.4.4 (measurement of the voltage drop and then calculating the resistance) after the 24th temperature cycle and after the 192nd temperature cycle have been completed, each time at a temperature of (20 ± 5) °C.

The contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value measured after the 24th cycle. The higher value is permissible.

If one of the contact unit does not pass the test, the test is repeated on a second set of PCB terminal blocks, all of which shall then comply with the repeated test.

After this test, a visual inspection shall show no changes impairing further use, such as cracks, deformations or the like.

9.4.7.3 Aging test sequence for PCB terminal blocks with contact pressure via insulating material

The test sequence (see Figure 5) is composed by a cold storage step, followed by a dry heat storage step, and finally a current cycling ageing test procedure. It is carried out on prepared specimens. The test assembly shall be in accordance with 9.4.5, with a minimum conductor length of 300 mm. The length of the conductor chosen has to be stated in the test report.

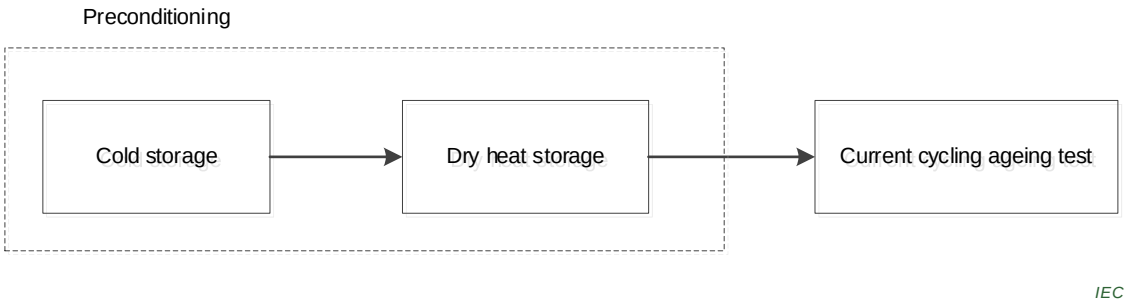


Figure 5 – Test sequence for PCB terminal blocks with contact pressure via insulating material

Cold storage (preconditioning step 1):

The first step of the sequence shall be a cold storage. It shall be performed in accordance with IEC 60512-11-10, test 11j, where the test temperature is the lower limiting temperature of the specimen. The test duration shall be 2 h.

Dry heat storage (preconditioning step 2):

The second step of the sequence shall be a dry heat storage. It shall be performed in accordance with IEC 60512-11-9, test 11i, where the test temperature is the upper limiting temperature of the specimen. The test duration shall be 168 h.

Current cycling ageing test procedure:

The third and main step of the complete test sequence is a current cycling ageing test procedure. During this test, the specimen is placed in a climate chamber and periodically heated and cooled down. The heating is performed by simultaneously heating up the chamber and by rated current flowing through the specimen.

For this step, the specimen shall be energized in cycles using the rated current (current either taken from the derating curve for an ambient temperature of 40 °C or the rated current value as specified by the manufacturer). The number of test cycles shall be 384 and the ambient temperature in a climate chamber for the test shall be increased to either 40 °C or the temperature stated by the manufacturer, with respect to the rated current derived from the derating curve.

The PCB terminal blocks are then cooled down to a temperature of approximately 30 °C, forced cooling being allowed. They are then kept at this temperature for approximately 10 min and are allowed to cool down further to a temperature of (20 ± 5) °C, if necessary, for measuring the contact resistance.

NOTE 1 The procedure has been derived from 8.4.7 of IEC 60947-7-1:2009 (ageing test for screwless-type terminal blocks).

NOTE 2 As guidance, a value for the heating and cooling rate of the heating cabinet of approximately 1,5 °C/min can be taken as a basis.

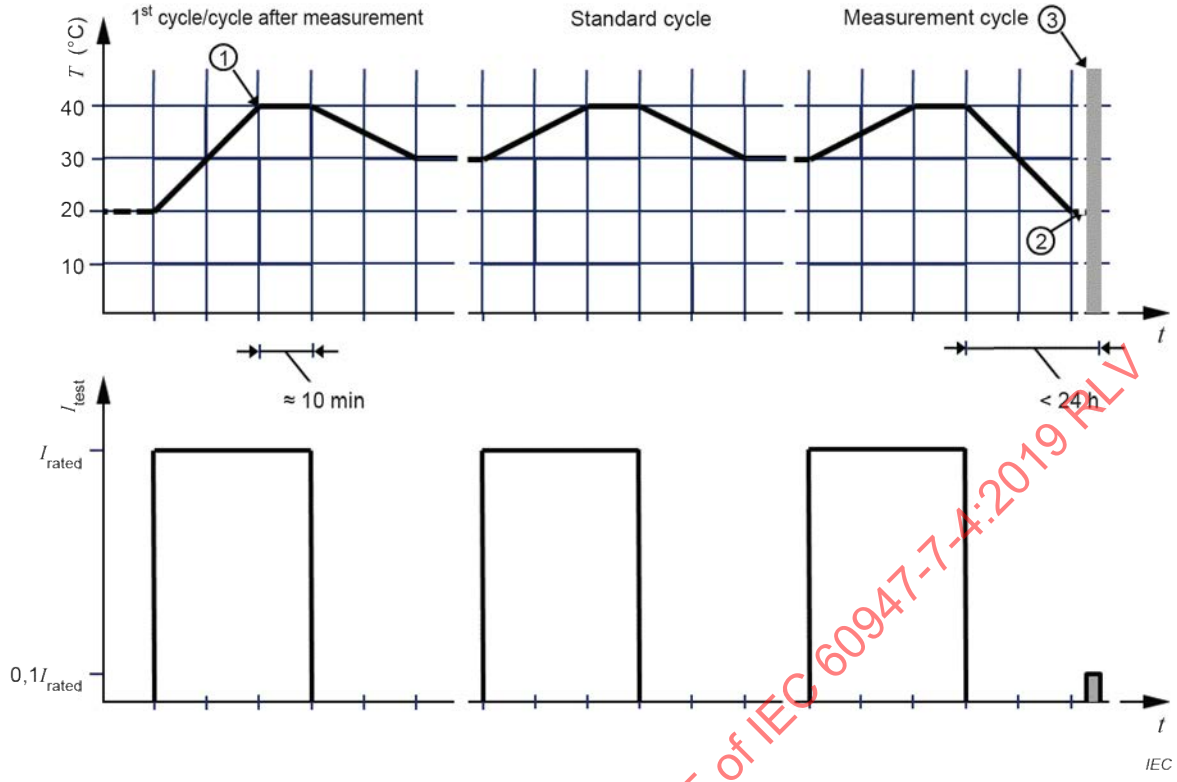
The contact resistance is derived from the voltage drop measurement in accordance with the requirements of IEC 60512-2-2. The voltage drop measurement shall be made as near as possible to the area of contact on the PCB terminal block. If the measuring points cannot be positioned closely to the contact, the voltage drop within the part of the conductor between the ideal and the actual measuring points shall be deducted from the voltage drop measured.

After the 24th and the 192nd cycles of the ageing cycle test and after the test procedure (after the 384th cycle), the resistance over the contact area of the terminal block shall be verified following the procedure described in 9.4.4 with a measurement current of 1/10 of the current (either derived from the given derating curve at 40 °C or the rated current as specified by the manufacturer).

The values of the contact resistance shall be calculated with Formula [1] given in 9.4.4.

The whole test arrangement, including the conductors, shall not be moved until the contact resistance measurement has been completed. Each of these measurements has to be performed after cooling down the specimen to 20 °C, but within 24 h after the last rated current flow through the specimen.

The current cycling ageing test is illustrated in Figure 6.



Key

1 Upper temperature in the chamber (40 °C or assigned ambient temperature)

2 Ambient temperature of 20 °C in the chamber for cycles with voltage drop measurement only

3 Time slot for voltage drop measurement (24th, 192th and 384th cycle) within 24 h after the last rated current flow through the specimen

Figure 6 – Current cycling ageing test procedure

The test is passed if the contact resistances (calculated from the voltage drop measurement) do not exceed the defined limits. After the 192nd cycle and after the 384th cycle of the current cycling ageing test, the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value measured after the 24th cycle. The higher value is permissible.

9.5 Verification of thermal characteristics

The thermal characteristics are checked by the glow wire test.

NOTE The tests are not carried out on parts of ceramic material.

The test is carried out in accordance with the procedure described in IEC 60695-2-11 with the test arrangement specified in IEC 60695-2-10 under following conditions:

– on parts of insulating materials necessary to retain current-carrying parts in position and on parts of the protective conductor circuit at a test temperature of 850 °C;

– on parts of insulating materials necessary for the proper functioning of the PCB terminal block at a test temperature of 650 °C.

If the tests are to be made at more than one place on the same sample, it shall be ensured that any deterioration caused by previous tests does not affect the test to be carried out.

The test is carried out on a single specimen. In case of doubt, the test shall be repeated on two other specimens that shall then comply with the repeated test.

The test is carried out by applying the glow-wire for one time for $5\,^{+1}_{0}$ s ~~with a tolerance of – 0/+1 s~~.

During the test, the specimen shall be placed in the most unfavourable position of normal use, with the surface to be tested in the vertical position. The tip of the glow-wire shall be applied to the specified surface of the specimen, taking account of the conditions of normal use, under which a heated or glowing object ~~may~~ can be in contact with the specimen.

The test specimen is considered to have passed the glow-wire test if there is no flaming or glowing, or if ~~all of~~ the following situations apply:

a) if flames or glowing of the test specimen extinguish within 30 s after removal of the glow-wire, i.e. $t_e \leq t_a + 30$ s; and

b) when the specified layer of wrapping tissue is used, there shall be no ignition of the wrapping tissue.

9.6 Verification of EMC characteristics

9.6.1 General

Subclause 8.4 of IEC 60947-1:2007/AMD2:2014 applies with the addition of 9.6.2 and 9.6.3.

9.6.2 Immunity

PCB terminal blocks within the scope of this document are not sensitive to electromagnetic disturbances and, therefore, no immunity tests are necessary.

9.6.3 Emission

PCB terminal blocks within the scope of this document do not generate electromagnetic disturbances and, therefore, no emission tests are necessary.

Annex A
(informative)

Structure of a PCB terminal block

The structure of a PCB terminal block consists of an insulation body and one or more contact units (see also Figure A.1).

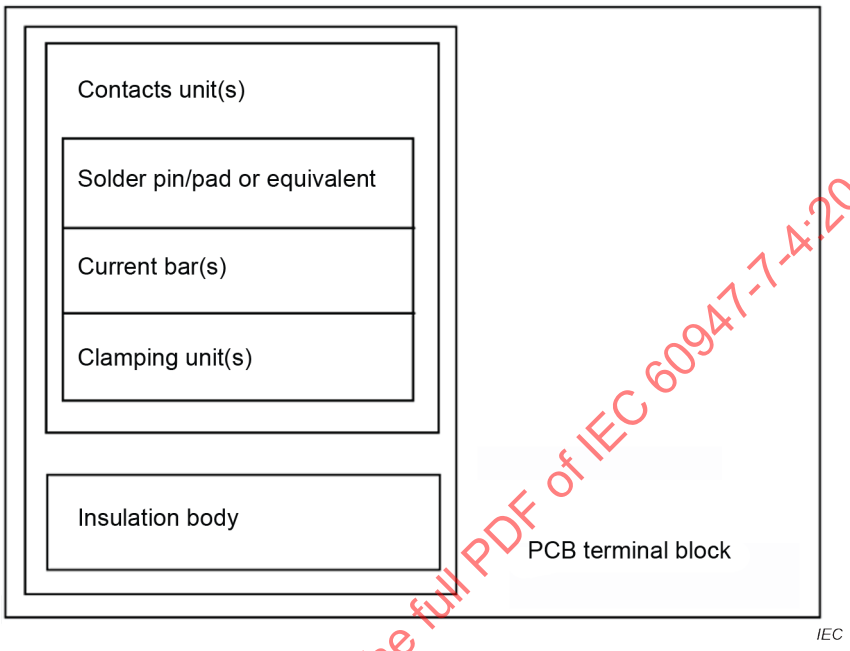


Figure A.1 – Structure of a PCB terminal block

Annex B
(informative)

Additional information to be specified between the manufacturer and the user

B.1 Additional information available on request of the user

In addition to the product information as described in Clause 6, the following items are subject to agreement between manufacturer and user:

– additional derating curves in accordance with IEC 60512-5-2;
– glow-wire flammability test method for end-products in accordance with IEC 60695-2-11;
– glow-wire flammability index (GWFI) of PCB terminal block materials in accordance with IEC 60695-2-12;
– needle flame test in accordance with IEC 60695-11-5;
– ball pressure test in accordance with IEC 60695-10-2.

NOTE For the purpose of this annex, the word “agreement” is used in a very wide sense and the word “user” includes testing stations.

B.2 Information for testing in addition to those mentioned above

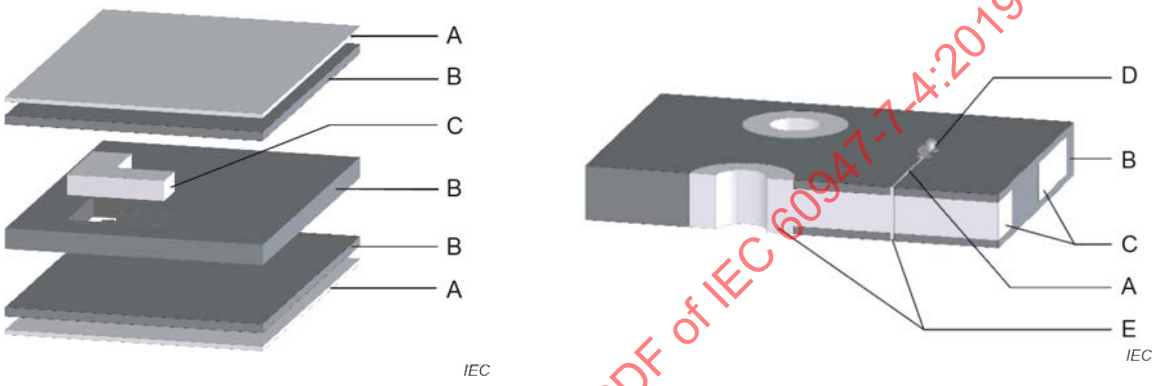
– Insulating material group (CTI value) of the insulating material.
It is recommended to check the insulating material group by the PTI value;
– Relevant detail specification, if available, for example, loaded temperature in accordance with IEC 60512-9-5;
– Tests for *T*-classified PCB terminal blocks in accordance with Clause 12 of IEC 60998-1:2002.

Annex C
(informative)

Examples of PCBs and PCB terminal blocks for high-current application

C.1 Layout of high-current PCBs (schematic diagram)

The PCB terminal blocks for high-current applications are commonly used in combination with suitable high-current printed circuit boards [see Figures C.1 a) and b)]. Possible connection methods to the PCB are soldering and screwing (see Figure C.2 and Figure C.3).



a) General view

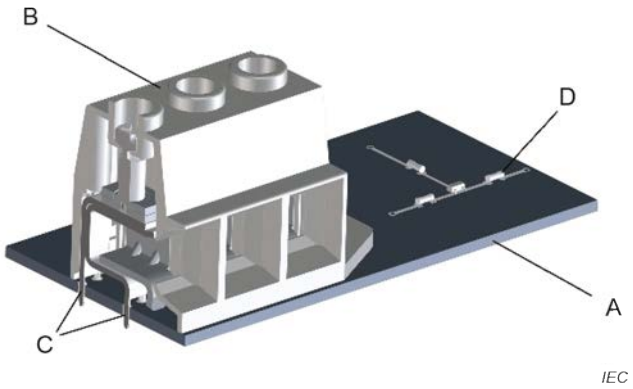
b) Detail of through connection

Key

A conductive layer
B base material
C conductive inlay
D SMD component
E through connection

Figure C.1 – Structure of a high current PCB

C.2 High-current PCB terminal blocks



Key

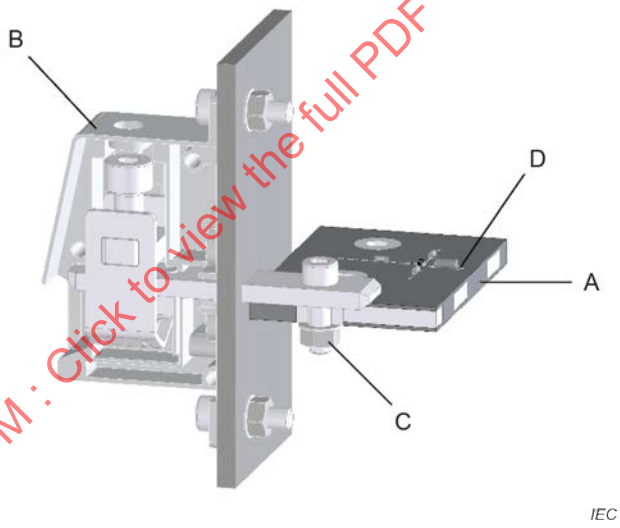
A PCB

B PCB terminal block

C connection in accordance with 8.1.2

D SMD component

Figure C.2 – PCB terminal block with soldered connection to the PCB



Key

A PCB

B PCB terminal block

C connection in accordance with 8.1.2

D SMD component

Figure C.3 – PCB terminal block with screwed connection to the PCB

Bibliography

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 60512-5-1, *Connectors for electronic equipment – Tests and measurements – Part 5-1: Current-carrying capacity tests – Test 5a: Temperature rise*

IEC 60512-9-5:2010, *Connectors for electronic equipment – Tests and measurements – Part 9-5: Endurance tests – Test 9e: Current loading, cyclic*

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

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60947-7-1:2009, *Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors*

IEC 60998-1:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 61984, *Connectors – Safety requirements and tests*

IEC 60947-7-4

Edition 2.0 2019-01

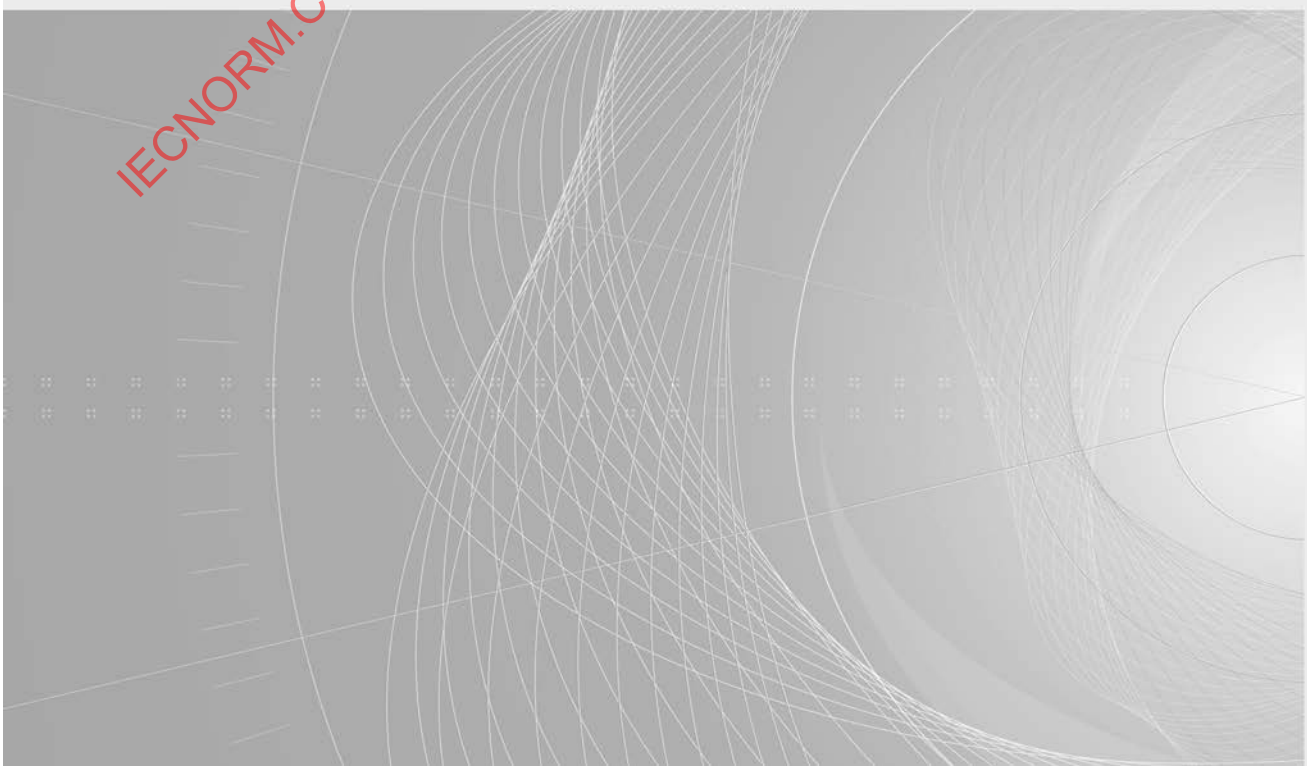
INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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



IEC 60947-7-4:2019-01(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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.

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 mm^2 and 300 mm^2 (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 mm^2 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;

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

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 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 mm^2 up to 35 mm^2 (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 mm^2 up to 300 mm^2 (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 mm^2 and 35 mm^2 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);

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.

Other terminations and connection methods shall be tested in accordance with the relevant standards.

Table 3 – Standards for clamping units and connecting methods

Ref.	Clamping units and connecting methods	Reference standards
a)	Screw-type clamping unit	IEC 60999-1 or IEC 60999-2
b)	Screwless-type clamping unit	IEC 60999-1 or IEC 60999-2 or IEC 60352-7
c)	Wrapped connection	IEC 60352-1
d)	Crimped connection	IEC 60352-2
e)	Insulation displacement connection (accessible)	IEC 60352-3 or IEC 60998-2-3
f)	Insulation displacement connection (non accessible)	IEC 60352-4 or IEC 60998-2-3
g)	Press-in connection	IEC 60352-5
h)	Insulation piercing connection	IEC 60352-6 or IEC 60998-2-3
i)	Flat quick-connect termination	IEC 61210
j)	Soldered connection	IEC 60068-2-20 [a]

NOTE The relevant standard applies for the preconditioning of prepared conductors.

[a] The test method selected shall be stated in the test report.

8.1.2 Mounting and installation

PCB terminal blocks shall be so designed that safe mounting on a printed circuit board is possible by means of soldering, pressing-in, screwing, etc. The connection to the printed circuit board shall not be damaged by connecting the conductors.

Tests shall be carried out in accordance with 9.3.2.

8.1.3 Clearances and creepage distances

For PCB terminal blocks for which the manufacturer has stated values of rated impulse withstand voltage (U_{imp}) and rated insulation voltage (U_i), minimum values of clearances and creepage distances are given in Table 13 of IEC 60947-1:2007 and Table 15 of IEC 60947-1:2007/AMD1:2010.

For PCB terminal blocks for which the manufacturer has not declared a value of rated impulse withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of IEC 60947-1:2007.

Electrical requirements are given in 8.2.2.

8.1.4 Terminal identification and marking

Subclause 7.1.8.4 of IEC 60947-1:2007 applies with the following addition.

A PCB terminal block shall have provision, or at least space, for identification marks or numbers for each clamping unit or contact unit related to the circuit of which it forms a part, except when such marking is not physically possible.

Such provision may consist of separate marking items, such as marking tags, identification labels, etc.

8.1.5 Resistance to abnormal heat and fire

The insulation materials of PCB terminal blocks shall not be adversely affected by abnormal heat and fire.

Compliance is checked by:

a) the glow-wire test on the complete product in accordance with 9.5 or

b) verification of the insulating material in accordance with

   1) IEC 60695-2-12, method GWFI at a temperature of 850 °C, or

   2) IEC 60695-2-13, method GWIT at a temperature of 775 °C.

This verification is not necessary for small parts (see IEC 60695-2-11).

NOTE 1 The relevant test method is specified by the manufacturer.

NOTE 2 For some applications it can be mandatory to check compliance by the glow-wire test on the complete product in accordance with 9.5 only. The need is either defined in the end-product standard or by agreement between the manufacturer and the users. See Clause B.1.

8.1.6 Maximum cross-section and connecting capacity

PCB terminal blocks shall be so designed that conductors of the maximum cross-section and the connecting capacity, if applicable, can be accepted.

Compliance is checked by the test described in 9.3.4.

The verification of the maximum cross-section may be performed by the special test in accordance with 9.3.5.

8.2 Performance requirements

8.2.1 Temperature-rise (current-temperature derating)

PCB terminal blocks shall be tested in accordance with 9.4.5. The sum of ambient temperature and temperature-rise of the PCB terminal block shall not exceed the upper limiting temperature.

8.2.2 Dielectric properties

If the manufacturer has declared a value of the rated impulse withstand voltage (U_{imp}) (see 4.3.1.3 of IEC 60947-1:2007), the requirements of 7.2.3 and 7.2.3.1 of IEC 60947-1:2007/AMD1:2010 apply. If applicable, the impulse withstand voltage test shall be carried out in accordance with 9.4.3a).

For the verification of solid insulation the power-frequency withstand voltage test shall be carried out in accordance with 9.4.3b).

The verification of sufficient clearances and creepage distances shall be made in accordance with 9.4.2. For PCB terminal blocks for which the manufacturer has not declared a value of rated impulse withstand voltage (U_{imp}), guidance for minimum values is given in Annex H of IEC 60947-1:2007.

8.2.3 Short-time withstand current

A PCB terminal block shall be capable of withstanding the short-time withstand current which corresponds to 120 A/mm^2 for 1 s, in accordance with 9.4.6.

The test shall be performed using the smallest cross-section in the current path of the contact unit as declared by the manufacturer.

8.2.4 Contact resistance

When measured in accordance with 9.4.4, the change in contact resistance of a PCB terminal block caused by the conductor connection and the mounting on the printed circuit board shall not exceed the permissible deviations.

8.2.5 Ageing tests

8.2.5.1 Climatic sequence and corrosion test

For the verification of the resistance of connections against the influence of temperatures and corrosive atmospheres, the climatic sequence test shall be carried out for all kinds of PCB terminal blocks.

Compliance is checked by the test described in 9.4.7.1.

8.2.5.2 Ageing test for screwless-type PCB terminal blocks

For the verification of screwless-type PCB terminal blocks the ageing test shall be carried out.

Compliance is checked by the test described in 9.4.7.2 (if relevant).

For screwless-type PCB terminal blocks with contact pressure via insulating material, only the current cycling ageing test in accordance with 9.4.7.3 shall be performed.

8.2.5.3 Current cycling ageing test for PCB terminal blocks with contact pressure via insulating material

For the verification of the resistance of connections against the influence of contact pressure via insulating material, the current cycling ageing test shall be carried out.

Compliance is checked by the test described in 9.4.7.3 (if relevant).

8.3 Electromagnetic compatibility (EMC)

Subclause 7.3 of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010 and IEC 60947-1:2007/AMD2:2014 applies.

9 Tests

9.1 Kinds of test

Subclause 8.1.1 of IEC 60947-1:2007 applies with the following addition.

No routine tests are specified. The verification of the maximum cross-section in accordance with 9.3.5 is a special test. All other tests are type tests.

9.2 General

Unless otherwise specified, PCB terminal blocks are tested in new and in clean condition, and installed as for normal use (see 6.3 of IEC 60947-1:2007) at an ambient temperature of (25 ±10) °C.

The tests are carried out in the order described in 9.3, 9.4 and 9.5.

Each test is carried out on new individual specimens with at least four contact units (one set) where each multipole PCB terminal block may contain the required number of contact units.

For a PCB terminal block family with the same design and comparable form, tests need only be performed on specimens representing the most unfavourable case.

The surface of the conductors shall be free of contamination and corrosion that degrades performance.

Care shall be taken when stripping conductors to avoid cutting, nicking, scraping or otherwise damaging the conductors.

In cases where the manufacturer has stated that special preparation of the end of the conductor is necessary, the test report shall indicate the method of preparation used.

The tests are carried out with the type of conductors (rigid or flexible) as stated by the manufacturer.

If one of the PCB terminal blocks does not withstand one of the tests, this test shall be repeated on a second set of PCB terminal blocks, all of which shall then comply with the repeated test. If this test is part of a test sequence, the complete test sequence shall be repeated.

9.3 Verification of mechanical characteristics

9.3.1 General

The verification of mechanical characteristics includes the following test:

- attachment of the PCB terminal block on its support (see 9.3.2);
- verification of the maximum cross-section and connecting capacity (see 9.3.4);
- verification of maximum cross-section (special test with gauges) (see 9.3.5).

9.3.2 Attachment of the PCB terminal block on its support

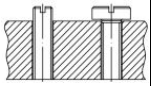
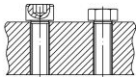
The tests shall be carried out on the smallest number of poles, preferably two poles, of a PCB terminal block, which is mounted on an appropriate support (printed circuit board) as in normal use in accordance with the manufacturer's instructions. For PCB terminal blocks to be soldered on printed circuit boards, this test shall be carried out on printed circuit boards with plated through holes, when applicable.

The wiring of the PCB terminal blocks for this test shall be carried out as shown in Figure 1 with the maximum cross-section as specified by the manufacturer.

After the verification of the contact resistance in accordance with 9.4.4, this conductor shall be connected and disconnected five times, if applicable, according to the manufacturer's instructions. For each connection, a new end of the conductor shall be used.

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 or, alternatively, with a higher value, as specified by the manufacturer.

Table 4 – Tightening torques for PCB terminal blocks with screw-type clamping units

Diameter of thread (mm)				Tightening torque (N·m)			
Metric standard values	Range of diameter			Ia 	Ib 	II 	III 
1,6	≤ 1,6			0,05	0,05	0,1	0,1
2,0	> 1,6	up to and including	2,0	0,1	0,1	0,2	0,2
2,5	> 2,0	up to and including	2,8	0,2	0,3	0,4	0,4
3,0	> 2,8	up to and including	3,0	0,25	0,4	0,5	0,5
–	> 3,0	up to and including	3,2	0,3	0,5	0,6	0,6
3,5	> 3,2	up to and including	3,6	0,4	0,6	0,8	0,8
4,0	> 3,6	up to and including	4,1	0,7	1,0	1,2	1,2
4,5	> 4,1	up to and including	4,7	0,8	1,2	1,8	1,8
5	> 4,7	up to and including	5,3	0,8	1,4	2,0	2,0
6	> 5,3	up to and including	6,0	1,2	1,9	2,5	3,0
8	> 6,0	up to and including	8,0	2,5	3,0	3,5	6,0
10	> 8,0	up to and including	10,0	–	–	4,0	10,0
12	> 10	up to and including	12	–	–	–	14,0
14	> 12	up to and including	15	–	–	–	19,0
16	> 15	up to and including	20	–	–	–	25,0
20	> 20	up to and including	24	–	–	–	36,0
24	> 24			–	–	–	50,0

NOTE 1 Column Ia applies to screws without heads that, when tightened, do not protrude from the hole, and to other screws that cannot be tightened by means of a screwdriver with a blade wider than the root diameter of the screw.

NOTE 2 Column Ib applies to screws with head diameters < 1,5 times the thread diameter that, when tightened, do not protrude from the hole, and to other screws that cannot be tightened by means of a screwdriver with a blade wider than the hole diameter.

NOTE 3 Column II applies to nuts and screws that are tightened by means of a screwdriver.

NOTE 4 Column III applies to nuts and screws that can be tightened by means other than a screwdriver.

At the end of the test the PCB terminal blocks shall comply with the contact resistance test in accordance with 9.4.4. After the test, the terminal assembly shall be free from damage that can impair further use.

9.3.3 Vacant

9.3.4 Verification of the maximum cross-section and connecting capacity

The verification of the maximum cross-section and connecting capacity shall be carried out in accordance with the standard for clamping units to be used (see 8.1.1).

NOTE The mechanical properties of clamping units are tested in accordance with the applicable connecting methods listed in Table 3.

9.3.5 Verification of maximum cross-section (special test with gauges)

Subclause 8.2.4.5 of IEC 60947-1:2007/AMD1:2010 applies with the following addition.

The test shall be carried out on each clamping unit of one PCB terminal block.

9.4 Verification of electrical characteristics

9.4.1 General

The verification of electrical characteristics includes the following:

- verification of clearances and creepage distances (see 9.4.2);
- dielectric tests (see 9.4.3);
- verification of the contact resistance (see 9.4.4);
- temperature-rise test (see 9.4.5);
- short-time withstand current test (see 9.4.6);
- ageing tests (see 9.4.7.1, 9.4.7.2 and 9.4.7.3).

9.4.2 Verification of clearances and creepage distances

9.4.2.1 General

The verification is made between two adjacent PCB terminal blocks or mutually insulated contact units of a multipole PCB terminal block and all live parts and accessible metal parts of a PCB terminal block.

The measurement of clearances and creepage distances shall be made under the following conditions:

a) the PCB terminal blocks shall be connected with the most unfavourable conductor type(s) and conductor cross-section(s) among those declared by the manufacturer or without a conductor, if this turns out to be the most unfavourable case;

b) the conductor ends shall be stripped, if required, to a length specified by the manufacturer.

The method of measuring clearances and creepage distances is described in Annex G of IEC 60947-1:2007.

9.4.2.2 Clearances

The measured values of clearances shall be higher than the values given in Table 13 of IEC 60947-1:2007 for case B – homogeneous field (see 7.2.3.3 of IEC 60947-1:2007/AMD2:2014) based on the value of the rated impulse withstand voltage (U_{imp}) and the pollution degree stated by the manufacturer.

The impulse withstand voltage test shall be carried out in accordance with 9.4.3 a) unless the measured clearances are equal to or larger than the values given in Table 13 of IEC 60947-1:2007 for case A – inhomogeneous field [see 8.3.3.4.1, item 2), of IEC 60947-1:2007, IEC 60947-1:2007/AMD1:2010].

9.4.2.3 Creepage distances

The measured creepage distances shall be not less than the values given in Table 15 of IEC 60947-1:2007/AMD1:2010 in connection with 7.2.3.4 a) and b) of IEC 60947-1:2007 based on the rated insulation voltage (U_i), the material group and the pollution degree as specified by the manufacturer.

9.4.3 Dielectric tests

a) If the manufacturer has declared a value for the rated impulse withstand voltage (U_{imp}), the impulse withstand voltage test shall be carried out in accordance with Table 5.

b) The power-frequency withstand verification of solid insulation according to IEC 60512-4-1 shall be made in accordance with the test voltages given in Table 6. For this test, the PCB terminal blocks are connected with the most unfavourable conductor (without a printed circuit board). The duration of the test is 1 min. The test voltage shall be applied between each of the poles that can assume different potentials in the application.

NOTE The relationship between nominal voltages and of the rated impulse withstand voltage (U_{imp}) are given in Annex H of IEC 60947-1:2007 (see also 8.1.3).

A voltage dip of the test voltage or a disruptive discharge or flashover is not allowed.

Table 5 – Impulse withstand test voltages

Rated impulse voltage	Impulse withstand voltage [a]	
	for a height of 2 000 m above sea level	at sea level
kV	kV (1,2/50 µs)	kV (1,2/50 µs)
0,5	0,5	0,55
0,8	0,8	0,91
1,5	1,5	1,75
2,5	2,5	2,95
4	4	4,8
6	6	7,3
8	8	9,8
12	12	14,8

[a] If the testing laboratory is situated at a height between sea level and 2 000 m, interpolation of the impulse voltage is allowed.

Table 6 – Dielectric test voltages corresponding to the rated insulation voltage

Rated insulation voltage	AC test voltage (RMS)[a]	
U_i	Overvoltage category III	Overvoltage category II
V	kV	kV
$U_i \leq 63$	0,5	0,4
$63 < U_i \leq 100$	0,8	0,5
$100 < U_i \leq 160$	1,4	0,8
$160 < U_i \leq 320$	2,2	1,4
$320 < U_i \leq 500$	3,1	2,2
$500 < U_i \leq 1\,000$	4,2	3,1

[a] RMS test voltages are based on 6.1.3.4 of IEC 60664-1:2007 and are higher than those of IEC 60947-1:2007/AMD2:2014, Table 12A in order to be in line with requirements of end-product standards.

9.4.4 Verification of contact resistance

The contact resistance shall be verified:

a) before and after the test of attachment of the PCB terminal block on its support (see 9.3.2);

b) before and after the short-time withstand current test (see 9.4.6);

c) before and after the climatic sequence and corrosion test (see 9.4.7.1);

d) during and after the ageing test for screwless-type PCB terminal blocks (see 9.4.7.2);

e) during and after the additional test for clamping units, where contact pressure is transmitted through insulating materials (see 9.4.7.3).

The verification is made as specified in 9.3.2, 9.4.6, 9.4.7.1, 9.4.7.2 (if relevant) and 9.4.7.3 (if relevant).

The contact resistance shall be measured between the connected conductor and the interconnection on the printed circuit board at each contact unit of a PCB terminal block as shown in Figure 1.

For tests a), b), c), d) and e), the measurement is carried out according to the procedure specified in IEC 60512-2-2.

For tests a), b), c) and d), the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the initial measurement value. The higher value is permissible.

For test e), the measurement is carried out in accordance with the procedure specified in IEC 60512-2-2 while omitting the measurement in accordance with 4.1 c) of IEC 60512-2-2:2003 and neglecting the second paragraph of 3.2 of IEC 60512-2-2:2003. So, the contact resistance is calculated in accordance with Formula [1] below:

$$R = \frac{U_{\mathrm{m}}}{\left(\frac{1}{10}\right) * I_{\mathrm{rated}}} \qquad [1]$$

where

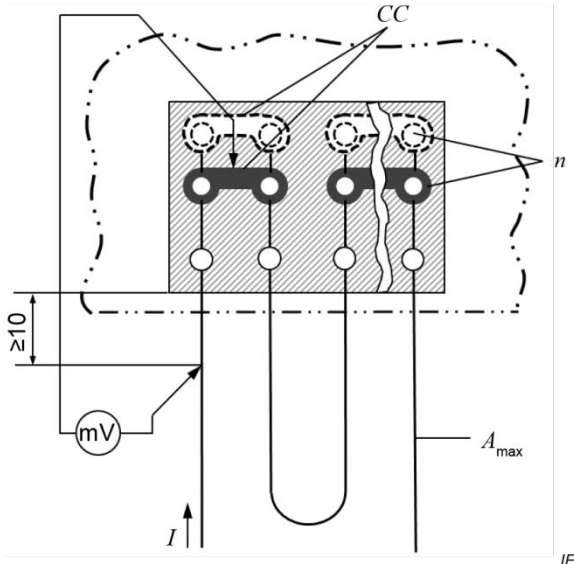
R is the resistance (mΩ);

U_{m} is the measured voltage drop (mV);

I_{rated} is the rated current (A).

After the 192nd and the 384th cycle the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value of the 24th cycle. The higher value is permissible.

Dimensions in millimetres



Key

I	Test current
mV	Voltmeter
n	Number of connections to the printed circuit board per contact unit
CC	Trace on the printed circuit board for interconnection
A_{max}	Maximum cross-section in mm^2
Cross-hatched area	Base area of the PCB terminal block

Figure 1 – Test assembly for the measurement of contact resistance and temperature-rise

9.4.5 Temperature-rise test (current-temperature derating)

This test serves to derive a rated current for the PCB terminal block from the derating curve that does not exceed the upper limiting temperature. Unless otherwise specified, the test shall be carried out according to the current-temperature derating of IEC 60512-5-2 under the following test conditions.

The test is carried out on an assembly of PCB terminal blocks mounted next to each other with, preferably, four contact units per level as shown in Figure 1 and Figure 2. The PCB terminal block shall be mounted on a printed circuit board as in normal use and connected in series with insulated conductors of the maximum cross-section and conductors on the printed circuit board. The interconnections on the printed circuit board shall be made with solid bare conductors of equal cross-section or comparable means and as short as possible.

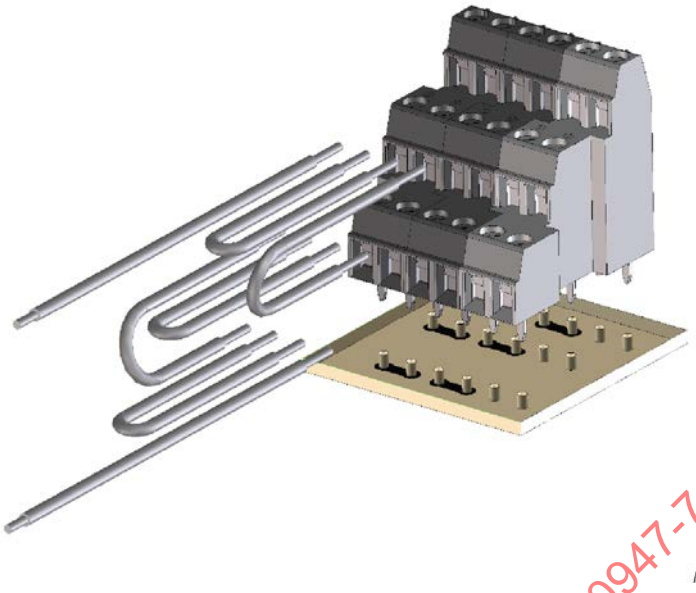


Figure 2 – Example of wiring structure of a multi-tier PCB terminal block

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 or, alternatively, with a higher value as specified by the manufacturer.

The length of connectable conductors and conductor loops shall be taken from Table 7.

Table 7 – Length of connectable conductors and conductor loops

Cross-section (mm^2)	Length (mm)
≤ 10	500 ± 50
16 to 35	1 000 ± 100
> 35	2 000 ± 200

For PCB terminal blocks having/providing several connections to the printed circuit board, the cross-section of interconnections A_B shall be calculated in accordance with the following Formula [2]:

$$A_B \leq \frac{A_{max}}{n} \quad [2]$$

where

A_B is the cross-section of interconnections in mm^2;

A_{max} is the maximum cross-section in mm^2; and

n is the number of connections to the printed circuit board per contact unit.

The sum of cross-sections of interconnections ($A_B \times n$) shall not exceed the cross-section of the connectable conductor. Examples are given in Table 8.

Table 8 – Examples of cross-sectional distribution of interconnections on printed circuit boards

Maximum cross-section (A_{max})	Number of connections to printed circuit board (n)			
	1	2	3	4
	Cross-section of interconnections (A_B)			
mm^2	mm^2			
...	...	...	...	...
2,5	2,5	1	0,75	0,5
4	4	1,5	1	1
6	6	2,5	1,5	1,5
10	10	4	2,5	2,5
...	...	...	...	...

The test assembly shall be prepared and arranged for the test procedure as shown in Figure 1 in accordance with the test conditions described in IEC 60512-5-2. Unless otherwise specified, the size of the printed circuit board shall be at least two times the base area of the PCB terminal block(s). The printed circuit board that is used shall be described in the test report.

The test shall be carried out with single-phase alternating or direct current as described in IEC 60512-5-2, Test 5b. As described in IEC 60512-5-2, the measuring points for measuring the temperature shall be located on the hottest spot above the printed circuit board (component side).

Where applicable, it can be necessary to determine the hottest spot by carrying out pre-tests.

The reduction factor to determine the derating curve is 0,8. Otherwise, the derating factor used shall be indicated in the technical documentation.

9.4.6 Short-time withstand current test

The purpose of this test is to verify the ability to withstand a thermal shock.

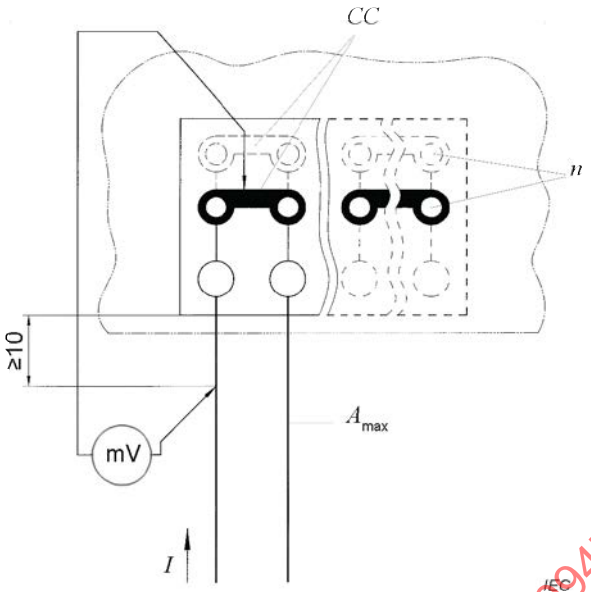
The test is carried out on two adjacent contact units with the longest and most unfavourable current paths of one PCB terminal block or two adjacent PCB terminal blocks. For this test, the PCB terminal block is mounted as in normal use in accordance with the manufacturer's instructions and connected with conductors of maximum cross-section A_{max} and interconnections A_B as determined in 9.4.5 (see Figure 3).

The tightening torque for PCB terminal blocks with screw-type clamping units shall be in accordance with Table 4 or, alternatively, with a higher value as specified by the manufacturer.

At the end of the test, the test (circuit) assembly shall show no interruptions and the PCB terminal blocks shall be free from cracks, ruptures or other critical damage.

After cooling down to room temperature, the contact units shall comply with the contact resistance test in 9.4.4.

Dimensions in millimetres



Key

I	Test current
mV	Voltmeter
n	Number of connections to the printed circuit board per contact unit
CC	Trace on the printed circuit board for interconnection
A_{max}	Maximum cross-section in mm^2

Figure 3 – Test assembly for the measurement of short-time withstand current

9.4.7 Ageing tests

9.4.7.1 Climatic sequence and corrosion test

The purpose of this test is to verify that clamping units and connections to the printed circuit board are able to withstand environmental conditions and ageing.

The test sequence is carried out on two sets of PCB terminal blocks. One set is connected with conductors of the minimum cross-section and the other set is connected with the maximum cross-section. Attachment of the terminal block to the PCB shall be made in accordance with the manufacturer's instructions.

The tests are carried out on prepared specimens in the indicated test sequence in accordance with IEC 60512-11-10, IEC 60512-11-9, IEC 60512-11-7 and ISO 6988 (see Figure 4).

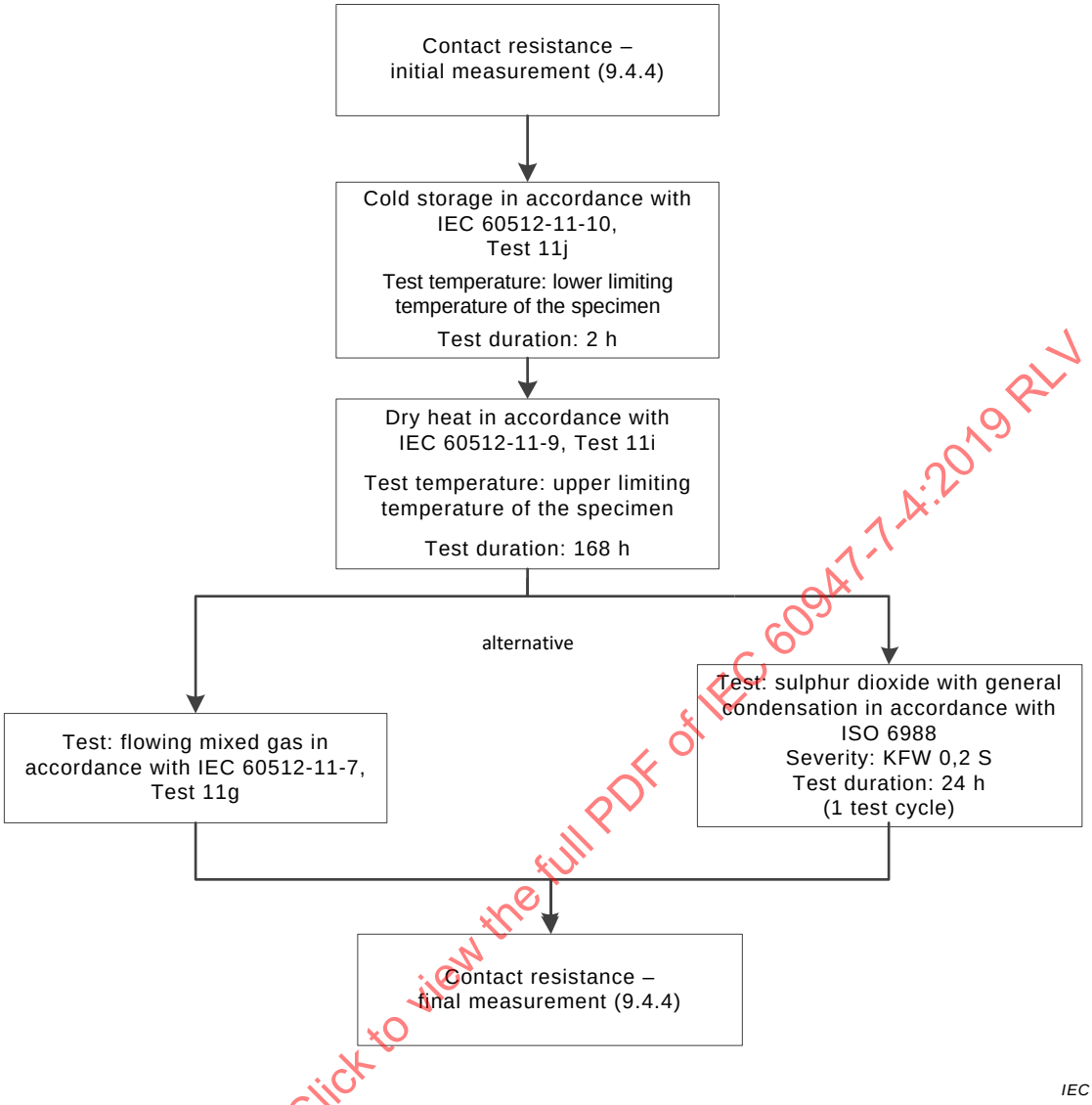


Figure 4 – Test sequence

After each test, except after the contact resistance measurement, the specimens shall be subjected to visual inspection where the PCB terminal blocks shall be free from cracks, ruptures or other critical damage.

9.4.7.2 Aging test for screwless-type PCB terminal blocks

The test is carried out on an assembly of PCB terminal blocks mounted next to each other with preferably four contact units per level as shown in Figure 1 and Figure 2. The PCB terminal block shall be mounted on a printed circuit board as in normal use and connected in series with insulated conductors of the maximum cross-section and conductors on the printed circuit board. The interconnections on the printed circuit board shall be made with solid bare conductors of equal cross-section or comparable means and as short as possible.

The length of connectable conductors and conductor loops shall be taken from Table 7.

The test arrangement is placed in a heating cabinet which is initially kept at a temperature of (20 ± 2) °C and then submitted to the verification of the contact resistance test.

The whole test arrangement, including the conductors, shall not be moved until the voltage drop test has been completed.

The PCB terminal blocks are submitted to 192 temperature cycles as follows.

The temperature in the heating cabinet is increased to 40 °C in accordance with 8.3.3.3.1 of IEC 60947-1:2007/AMD2:2014 or to the temperature value declared by the manufacturer for maximum service conditions.

The temperature is maintained within ± 5 °C of this value for approximately 10 min.

During this test period, the current derived from the derating curve at an ambient temperature of 40 °C is applied.

Alternatively to the current value at 40 °C, a test current declared by the manufacturer can be used. In this case, the sum of the ambient temperature and the temperature-rise shall be equal to the upper limiting temperature.

The PCB terminal blocks are then cooled down to a temperature of approximately 30 °C, forced cooling being allowed; they are kept at this temperature for approximately 10 min and, if necessary for measuring the contact resistance, further cooling to a temperature of (20 ± 5) °C is allowed.

NOTE As guidance, a value for the heating and cooling rate of the heating cabinet of approximately 1,5 °C/min can be taken as a basis.

The contact resistance on all contact units is also determined in accordance with 9.4.4 (measurement of the voltage drop and then calculating the resistance) after the 24th temperature cycle and after the 192nd temperature cycle have been completed, each time at a temperature of (20 ± 5) °C.

The contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value measured after the 24th cycle. The higher value is permissible.

If one of the contact unit does not pass the test, the test is repeated on a second set of PCB terminal blocks, all of which shall then comply with the repeated test.

After this test, a visual inspection shall show no changes impairing further use, such as cracks, deformations or the like.

9.4.7.3 Aging test sequence for PCB terminal blocks with contact pressure via insulating material

The test sequence (see Figure 5) is composed by a cold storage step, followed by a dry heat storage step, and finally a current cycling ageing test procedure. It is carried out on prepared specimens. The test assembly shall be in accordance with 9.4.5, with a minimum conductor length of 300 mm. The length of the conductor chosen has to be stated in the test report.

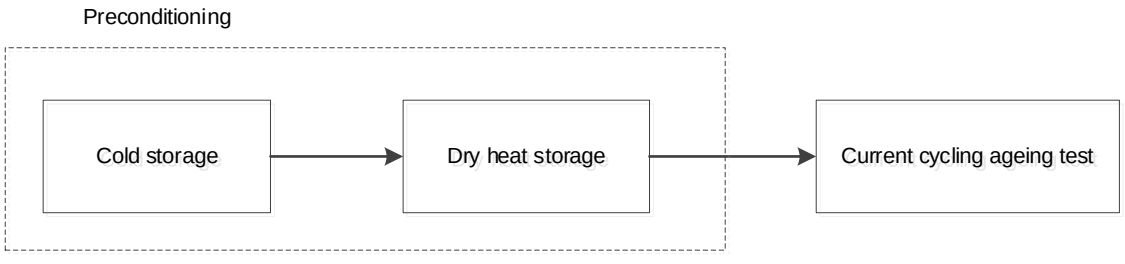


Figure 5 – Test sequence for PCB terminal blocks with contact pressure via insulating material

Cold storage (preconditioning step 1):

The first step of the sequence shall be a cold storage. It shall be performed in accordance with IEC 60512-11-10, test 11j, where the test temperature is the lower limiting temperature of the specimen. The test duration shall be 2 h.

Dry heat storage (preconditioning step 2):

The second step of the sequence shall be a dry heat storage. It shall be performed in accordance with IEC 60512-11-9, test 11i, where the test temperature is the upper limiting temperature of the specimen. The test duration shall be 168 h.

Current cycling ageing test procedure:

The third and main step of the complete test sequence is a current cycling ageing test procedure. During this test, the specimen is placed in a climate chamber and periodically heated and cooled down. The heating is performed by simultaneously heating up the chamber and by rated current flowing through the specimen.

For this step, the specimen shall be energized in cycles using the rated current (current either taken from the derating curve for an ambient temperature of 40 °C or the rated current value as specified by the manufacturer). The number of test cycles shall be 384 and the ambient temperature in a climate chamber for the test shall be increased to either 40 °C or the temperature stated by the manufacturer, with respect to the rated current derived from the derating curve.

The PCB terminal blocks are then cooled down to a temperature of approximately 30 °C, forced cooling being allowed. They are then kept at this temperature for approximately 10 min and are allowed to cool down further to a temperature of (20 ± 5) °C, if necessary, for measuring the contact resistance.

NOTE 1 The procedure has been derived from 8.4.7 of IEC 60947-7-1:2009 (ageing test for screwless-type terminal blocks).

NOTE 2 As guidance, a value for the heating and cooling rate of the heating cabinet of approximately 1,5 °C/min can be taken as a basis.

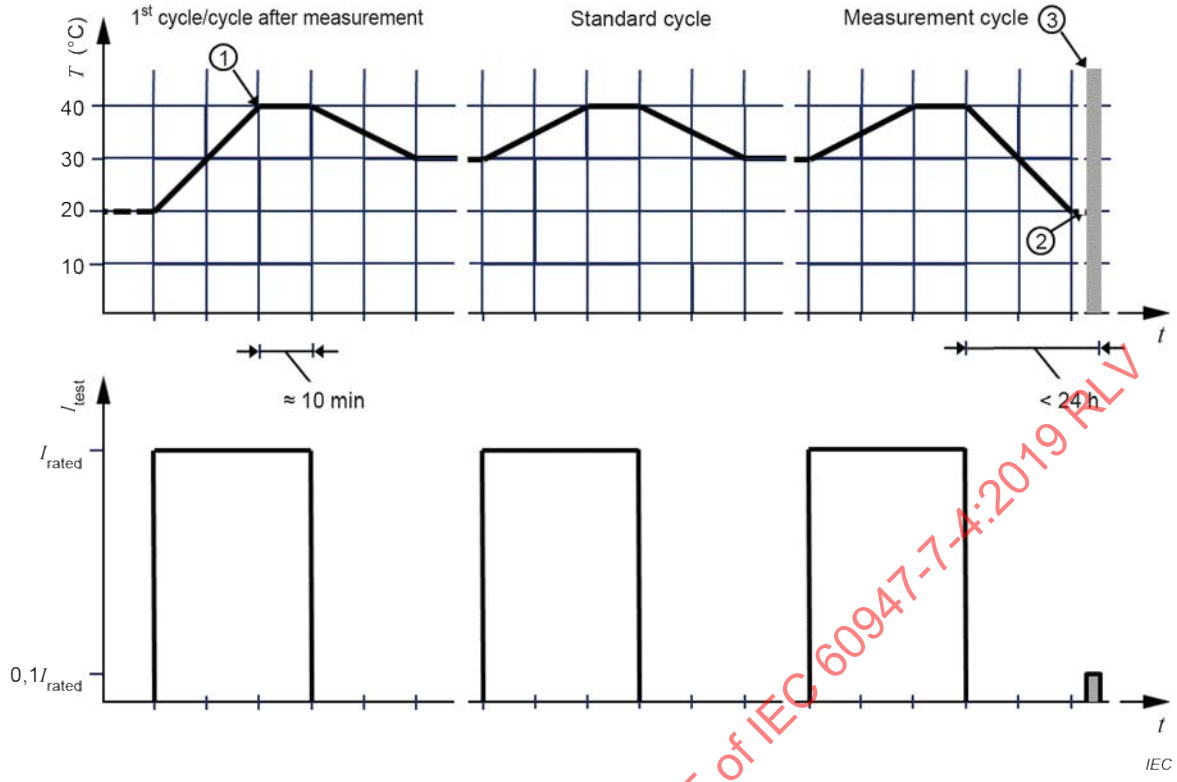
The contact resistance is derived from the voltage drop measurement in accordance with the requirements of IEC 60512-2-2. The voltage drop measurement shall be made as near as possible to the area of contact on the PCB terminal block. If the measuring points cannot be positioned closely to the contact, the voltage drop within the part of the conductor between the ideal and the actual measuring points shall be deducted from the voltage drop measured.

After the 24th and the 192nd cycles of the ageing cycle test and after the test procedure (after the 384th cycle), the resistance over the contact area of the terminal block shall be verified following the procedure described in 9.4.4 with a measurement current of 1/10 of the current (either derived from the given derating curve at 40 °C or the rated current as specified by the manufacturer).

The values of the contact resistance shall be calculated with Formula [1] given in 9.4.4.

The whole test arrangement, including the conductors, shall not be moved until the contact resistance measurement has been completed. Each of these measurements has to be performed after cooling down the specimen to 20 °C, but within 24 h after the last rated current flow through the specimen.

The current cycling ageing test is illustrated in Figure 6.



Key

1 Upper temperature in the chamber (40 °C or assigned ambient temperature)

2 Ambient temperature of 20 °C in the chamber for cycles with voltage drop measurement only

3 Time slot for voltage drop measurement (24th, 192th and 384th cycle) within 24 h after the last rated current flow through the specimen

Figure 6 – Current cycling ageing test procedure

The test is passed if the contact resistances (calculated from the voltage drop measurement) do not exceed the defined limits. After the 192nd cycle and after the 384th cycle of the current cycling ageing test, the contact resistance shall not exceed 2,5 mΩ or shall not rise by more than 50 % of the value measured after the 24th cycle. The higher value is permissible.

9.5 Verification of thermal characteristics

The thermal characteristics are checked by the glow wire test.

NOTE The tests are not carried out on parts of ceramic material.

The test is carried out in accordance with the procedure described in IEC 60695-2-11 with the test arrangement specified in IEC 60695-2-10 under following conditions:

– on parts of insulating materials necessary to retain current-carrying parts in position and on parts of the protective conductor circuit at a test temperature of 850 °C;

– on parts of insulating materials necessary for the proper functioning of the PCB terminal block at a test temperature of 650 °C.

If the tests are to be made at more than one place on the same sample, it shall be ensured that any deterioration caused by previous tests does not affect the test to be carried out.

The test is carried out on a single specimen. In case of doubt, the test shall be repeated on two other specimens that shall then comply with the repeated test.

The test is carried out by applying the glow-wire for one time for $5\ ^{+1}_{0}$ s.

During the test, the specimen shall be placed in the most unfavourable position of normal use, with the surface to be tested in the vertical position. The tip of the glow-wire shall be applied to the specified surface of the specimen, taking account of the conditions of normal use, under which a heated or glowing object can be in contact with the specimen.

The test specimen is considered to have passed the glow-wire test if there is no flaming or glowing, or if the following situations apply:

a) if flames or glowing of the test specimen extinguish within 30 s after removal of the glow-wire, i.e. $t_e \leq t_a + 30$ s; and

b) when the specified layer of wrapping tissue is used, there shall be no ignition of the wrapping tissue.

9.6 Verification of EMC characteristics

9.6.1 General

Subclause 8.4 of IEC 60947-1:2007/AMD2:2014 applies with the addition of 9.6.2 and 9.6.3.

9.6.2 Immunity

PCB terminal blocks within the scope of this document are not sensitive to electromagnetic disturbances and, therefore, no immunity tests are necessary.

9.6.3 Emission

PCB terminal blocks within the scope of this document do not generate electromagnetic disturbances and, therefore, no emission tests are necessary.

Annex A
(informative)

Structure of a PCB terminal block

The structure of a PCB terminal block consists of an insulation body and one or more contact units (see also Figure A.1).

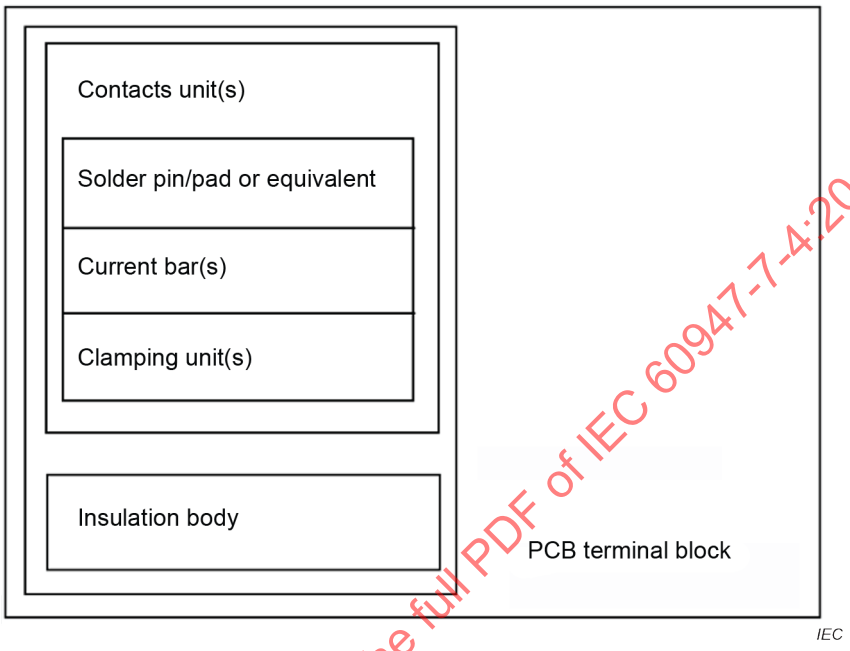


Figure A.1 – Structure of a PCB terminal block

Annex B
(informative)

Additional information to be specified between the manufacturer and the user

B.1 Additional information available on request of the user

In addition to the product information as described in Clause 6, the following items are subject to agreement between manufacturer and user:

– additional derating curves in accordance with IEC 60512-5-2;

– glow-wire flammability test method for end-products in accordance with IEC 60695-2-11;

– glow-wire flammability index (GWFI) of PCB terminal block materials in accordance with IEC 60695-2-12;

– needle flame test in accordance with IEC 60695-11-5;

– ball pressure test in accordance with IEC 60695-10-2.

NOTE For the purpose of this annex, the word “agreement” is used in a very wide sense and the word “user” includes testing stations.

B.2 Information for testing in addition to those mentioned above

– Insulating material group (CTI value) of the insulating material.
It is recommended to check the insulating material group by the PTI value;

– Relevant detail specification, if available, for example, loaded temperature in accordance with IEC 60512-9-5;

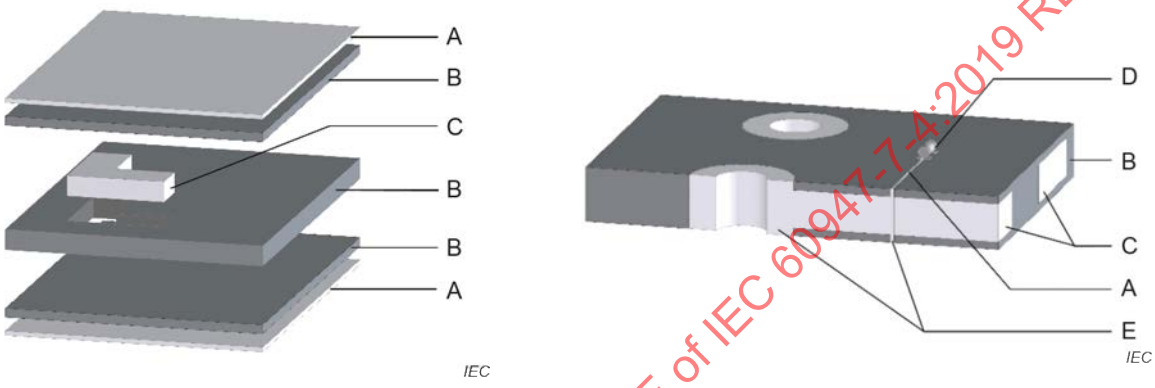
– Tests for *T*-classified PCB terminal blocks in accordance with Clause 12 of IEC 60998-1:2002.

Annex C
(informative)

Examples of PCBs and PCB terminal blocks for high-current application

C.1 Layout of high-current PCBs (schematic diagram)

The PCB terminal blocks for high-current applications are commonly used in combination with suitable high-current printed circuit boards [see Figures C.1 a) and b)]. Possible connection methods to the PCB are soldering and screwing (see Figure C.2 and Figure C.3).



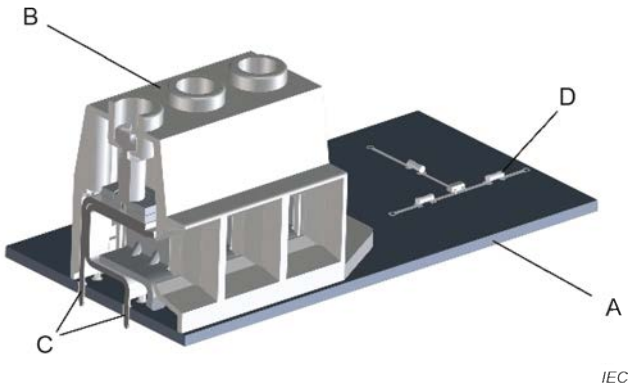
a) General view **b) Detail of through connection**

Key

A conductive layer
B base material
C conductive inlay
D SMD component
E through connection

Figure C.1 – Structure of a high current PCB

C.2 High-current PCB terminal blocks



Key

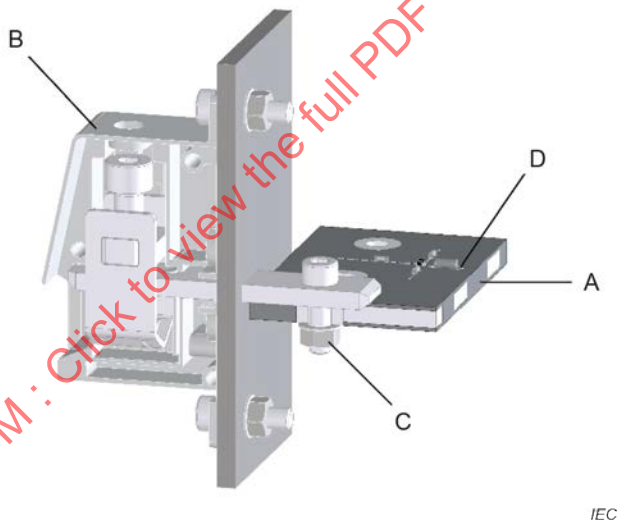
A PCB

B PCB terminal block

C connection in accordance with 8.1.2

D SMD component

Figure C.2 – PCB terminal block with soldered connection to the PCB



Key

A PCB

B PCB terminal block

C connection in accordance with 8.1.2

D SMD component

Figure C.3 – PCB terminal block with screwed connection to the PCB

Bibliography

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 60512-5-1, *Connectors for electronic equipment – Tests and measurements – Part 5-1: Current-carrying capacity tests – Test 5a: Temperature rise*

IEC 60512-9-5:2010, *Connectors for electronic equipment – Tests and measurements – Part 9-5: Endurance tests – Test 9e: Current loading, cyclic*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test*

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60947-7-1:2009, *Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors*

IEC 60998-1:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 61984, *Connectors – Safety requirements and tests*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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APPAREILLAGE À BASSE TENSION –

Partie 7-4: Matériels accessoires – Blocs de jonction pour cartes de circuits imprimés pour conducteurs en cuivre

AVANT-PROPOS

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La Norme internationale IEC 60947-7-4 a été établie par le sous-comité 121A: Appareillage à basse tension, du comité d'études 121 de l'IEC: Appareillages et ensembles d'appareillages basse tension.

Cette deuxième édition annule et remplace la première édition parue en 2013. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) essai complémentaire pour les blocs de jonction pour cartes de circuits imprimés à organes de serrage pour lesquels la pression de contact est transmise par des matériaux isolants;

b) les couples de serrage des vis sont désormais présentés dans le Tableau 4 du présent document (ils étaient précédemment donnés dans le Tableau 4 de l'IEC 60947-1:2007); les couples de serrage sont donnés pour un type supplémentaire de vis;

c) ajout de nouveaux critères pour la vérification de la résistance de contact;

d) clarification de la description de l'essai d'échauffement (taux de réduction de l'intensité en fonction de la température); corrections de la séquence d'essais conformément à la Figure 4.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
121A/255/FDIS	121A/265/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60947, publiées sous le titre général *Appareillage à basse tension*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. À cette date, le document sera

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- amendé.

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INTRODUCTION

Le présent document couvre non seulement les exigences relatives aux blocs de jonction selon la série IEC 60947-7, mais tient également compte des spécifications des connecteurs selon l'IEC 61984, dans la mesure où les exigences concernant ces deux composants sont fortement similaires en raison des applications équivalentes.

APPAREILLAGE À BASSE TENSION –

Partie 7-4: Matériels accessoires – Blocs de jonction pour cartes de circuits imprimés pour conducteurs en cuivre

1 Domaine d'application

La présente partie de l'IEC 60947-7 spécifie les exigences concernant les blocs de jonction pour cartes de circuits imprimés destinés principalement à un usage industriel ou similaire.

Le montage et la fixation sur la carte de circuits imprimés s'effectuent par brasage, insertion à force ou par des méthodes équivalentes afin d'assurer une connexion électrique et mécanique entre les conducteurs en cuivre et la carte de circuits imprimés.

Le présent document s'applique aux blocs de jonction pour cartes de circuits imprimés destinés à connecter les conducteurs en cuivre, avec ou sans préparation spéciale, dont la section est comprise entre 0,08 mm^2 et 300 mm^2 (AWG 28-600 kcmil), destinés à être utilisés dans les circuits dont la tension assignée ne dépasse pas 1 000 V en courant alternatif jusqu'à 1 000 Hz ou 1 500 V en courant continu au maximum.

NOTE 1 Les blocs de jonction de section importante sont dédiés à une conception spécifique de cartes de circuits imprimés haute intensité. La plage couvrant jusqu'à 300 mm^2 au maximum est conservée pour couvrir toute application potentielle. Des exemples de cartes de circuits imprimés et de blocs de jonction haute intensité pour lesdites cartes sont présentés à l'Annexe C.

NOTE 2 AWG est l'abréviation de "American Wire Gage" (Gage (US) = Gauge (UK ou RU)) (calibrage américain normalisé des fils);

1 kcmil = 1 000 cmil;

1 cmil = 1 mil circulaire = surface d'un cercle ayant un diamètre de 1 mil;

1 mil = 1/1 000 pouce.

Le présent document peut servir de guide pour les types spéciaux de blocs de jonction pour cartes de circuits imprimés comportant des composants tels que des unités de déconnexion, des éléments de remplacement à cartouche intégrés et analogues, ou dont les conducteurs ont des dimensions différentes.

Dans le présent document, le terme "organe de serrage" est utilisé, le cas échéant, en lieu et place du terme "borne". Cela est pris en compte en cas de référence à l'IEC 60947-1.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-20, *Essais d'environnement – Partie 2-20: Essais – Essai T: Méthodes d'essai de la brasabilité et de la résistance à la chaleur de brasage des dispositifs à broches*

IEC 60352-1, *Connexions sans soudure – Partie 1: Connexions enroulées – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-2, *Connexions sans soudure – Partie 2: Connexions serties – Exigences générales, méthodes d'essai et guide pratique*

IEC 60352-3, *Connexions sans soudure – Partie 3: Connexions autodénudantes accessibles sans soudure – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-4, *Connexions sans soudure – Partie 4: Connexions autodénudantes, non accessibles sans soudure – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-5, *Connexions sans soudure – Partie 5: Connexions insérées à force – Exigences générales, méthodes d'essai et guide pratique*

IEC 60352-6, *Connexions sans soudure – Partie 6: Connexions à percement d'isolant – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-7, *Connexions sans soudure – Partie 7: Connexions à ressort – Règles générales, méthodes d'essai et guide pratique*

IEC 60512-2-2:2003, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 2-2: Essais de continuité électrique et de résistance de contact – Essai 2b: Résistance de contact – Méthode du courant d'essai spécifié*

IEC 60512-4-1, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 4-1: Essais de contrainte diélectrique – Essai 4a: Tension de tenue*

IEC 60512-5-2:2002, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 5-2: Essais de courant limite – Essai 5b: Taux de réduction de l'intensité en fonction de la température*

IEC 60512-11-7, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 11-7: Essais climatiques – Essai 11g: Essai de corrosion dans un flux de mélange de gaz*

IEC 60512-11-9, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 11-9: Essais climatiques – Essai 11i: Chaleur sèche*

IEC 60512-11-10, *Connecteurs pour équipements électroniques – Essais et mesures – Partie 11-10: Essais climatiques – Essai 11j: Froid*

IEC 60695-2-10, *Essais relatifs aux risques du feu – Partie 2-10: Essais au fil incandescent/chauffant – Appareillage et méthode commune d'essai*

IEC 60695-2-11, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-2-12, *Essais relatifs aux risques du feu – Partie 2-12: Essais au fil incandescent/chauffant – Méthode d'essai d'indice d'inflammabilité au fil incandescent (GWFI) pour matériaux*

IEC 60695-2-13, *Essais relatifs aux risques du feu – Partie 2-13: Essais au fil incandescent/chauffant – Méthode d'essai de température d'allumabilité au fil incandescent (GWIT) pour matériaux*

IEC 60947-1:2007, *Appareillage à basse tension – Partie 1: Règles générales*
IEC 60947-1:2007/AMD1:2010
IEC 60947-1:2007/AMD2:2014

IEC 60998-2-3, *Dispositifs de connexion pour circuits basse tension pour usage domestique et analogue – Partie 2-3: Règles particulières pour dispositifs de connexion en tant que parties séparées avec organes de serrage à perçage d'isolant*

IEC 60999-1, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm^2 à 35 mm^2 (inclus)*

IEC 60999-2, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 2: Prescriptions particulières pour les organes de serrage pour conducteurs au-dessus de 35 mm^2 et jusqu'à 300 mm^2 (inclus)*

IEC 61210, *Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité*

ISO 6988, *Revêtements métalliques et autres revêtements non organiques – Essai au dioxyde de soufre avec condensation générale de l'humidité*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
carte de circuits imprimés
PCB
pièce de matériau isolant comportant des pistes métalliques fixes permettant la connexion des composants électroniques

Note 1 à l'article: Les cartes de circuits imprimés sont généralement sous-divisées selon:

- leur structure (par exemple simple et double faces, multicouche);
- la nature du matériau de base (par exemple rigide, souple).

Note 2 à l'article: Le terme abrégé "PCB" est dérivé du terme anglais développé correspondant "printed circuit board".

3.2
bloc de jonction pour cartes de circuits imprimés
partie destinée à être montée sur une carte de circuits imprimés et supportant une ou plusieurs unités de contact isolées entre elles, et qui fournit une connexion électrique et mécanique entre le conducteur en cuivre et la carte de circuits imprimés

3.3
courant assigné
valeur du courant assignée par le fabricant, que le bloc de jonction pour carte de circuits imprimés peut supporter en continu (sans interruption) et simultanément à travers tous ses contacts (pôles) connectés avec la section maximale, de préférence à une température ambiante de 40 °C, sans que la température limite supérieure ne soit dépassée

3.4
unité de contact
partie conductrice qui établit la connexion entre la carte de circuits imprimés et le(s) conducteur(s) raccordable(s)

Note 1 à l'article: Voir l'Annexe A pour une description de la structure d'un bloc de jonction pour carte de circuits imprimés.

3.5
température limite supérieure
ULT
température maximale assignée par le fabricant dans le bloc de jonction pour carte de circuits imprimés comme résultat (somme) de la température ambiante et de l'échauffement dû à la circulation de courant, à laquelle le bloc de jonction pour carte de circuits imprimés est prévu pour encore fonctionner

Note 1 à l'article: Le terme abrégé "ULT" est dérivé du terme anglais développé correspondant "upper limiting temperature".

3.6
température limite inférieure
LLT
température minimale d'un bloc de jonction pour carte de circuits imprimés, assignée par le fabricant, à laquelle le bloc de jonction pour carte de circuits imprimés est prévu pour fonctionner

Note 1 à l'article: Le terme abrégé "LLT" est dérivé du terme anglais développé correspondant "lower limiting temperature".

4 Classification

Une distinction entre les différents types de blocs de jonction pour cartes de circuits imprimés est faite, le cas échéant, selon

a) le type de l'organe de serrage (voir 8.1.1);
b) la possibilité d'accepter des conducteurs préparés (voir 2.3.28 de l'IEC 60947-1:2007/AMD1:2010);
c) le type de contact électrique avec la carte de circuits imprimés;
d) le type de fixation mécanique avec la carte de circuits imprimés;
e) le nombre de pôles;
f) le pas (entraxe des broches);
g) l'unité de contact avec des organes de serrage identiques ou différents;
h) le nombre d'organes de serrage sur chaque unité de contact;
i) les conditions de service.

5 Caractéristiques

5.1 Énumération des caractéristiques

Les caractéristiques d'un bloc de jonction pour carte de circuits imprimés sont celles qui suivent:

- le type du bloc de jonction pour carte de circuits imprimés (voir 5.2);
- les valeurs assignées et les valeurs limites (voir 5.3).

5.2 Type du bloc de jonction pour carte de circuits imprimés

Les informations suivantes doivent être indiquées:

- le type d'organes de serrage (voir 8.1.1);
- le type de contact sur la carte de circuits imprimés;
- le nombre d'organes de serrage.

5.3 Valeurs assignées et valeurs limites

5.3.1 Tensions assignées

Les 4.3.1.2 et 4.3.1.3 de l'IEC 60947-1:2007 s'appliquent.

5.3.2 Courant assigné

La vérification du courant assigné spécifié par le fabricant est effectuée conformément à 9.4.5.

Lorsqu'une température ambiante autre qu'une température de 40 °C est utilisée pour la définition du courant assigné, il convient que le fabricant indique, dans la documentation technique, la température ambiante sur laquelle le classement est établi, avec référence, le cas échéant, à la courbe avec taux de réduction définie dans l'IEC 60512-5-2.

La courbe avec taux de réduction est obtenue par application d'un facteur de réduction de 0,8 conformément à l'IEC 60512-5-2. La documentation technique doit indiquer toute utilisation d'un autre facteur de réduction.

5.3.3 Sections normales

Les valeurs normales des sections de conducteurs en cuivre à utiliser sont données dans le Tableau 1.

Tableau 1 – Sections normales des conducteurs en cuivre

Dimension du système métrique ISO	Comparaison entre les dimensions AWG/kcmil et celles du système métrique	
	Dimension	Section métrique équivalente
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] Ne relève pas du domaine d'application du présent document et n'est inclus qu'à titre d'information.

5.3.4 Section maximale

La section maximale doit être choisie parmi les sections normales données dans le Tableau 1.

5.3.5 Capacité de raccordement

La plage minimale du Tableau 2 s'applique aux blocs de jonction pour cartes de circuits imprimés, de section maximale comprise entre 0,08 mm^2 et 35 mm^2 inclus. Les conducteurs peuvent être rigides (à âme massive ou à âme câblée) ou souples. Le fabricant doit indiquer les types et les sections maximales et minimales des conducteurs qui peuvent être raccordés ainsi que, le cas échéant, le nombre de conducteurs simultanément raccordables à chaque organe de serrage. Il doit aussi indiquer toute préparation qu'il serait nécessaire de faire subir à l'extrémité du conducteur.

Tableau 2 – Relation entre la section maximale et la capacité de raccordement des blocs de jonction pour cartes de circuits imprimés

Section maximale		Capacité de raccordement	
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] Ne relève pas du domaine d'application du présent document et n'est inclus qu'à titre d'information.

6 Informations sur le produit

6.1 Marquage

Un bloc de jonction pour carte de circuits imprimés doit porter, de manière durable et lisible, ce qui suit:

a) le nom du fabricant ou une marque de fabrique au moyen de laquelle le fabricant peut être immédiatement identifié;

b) une référence de type permettant son identification dans le but d'obtenir tout renseignement correspondant auprès du fabricant ou dans son catalogue.

Les blocs de jonction pour cartes de circuits imprimés de très petites dimensions, dont la surface ne peut porter de marquage, doivent être marqués uniquement selon a). Dans ce type de cas, toutes les informations spécifiées doivent être marquées sur la plus petite unité de conditionnement.

6.2 Informations complémentaires

Les informations suivantes doivent être indiquées par le fabricant, le cas échéant, par exemple, dans la fiche technique du fabricant ou dans son catalogue ou sur l'emballage:

a) IEC 60947-7-4, si le fabricant déclare la conformité au présent document;

b) la section maximale;

c) la capacité de raccordement si elle diffère de celle du Tableau 2, ainsi que le nombre de conducteurs simultanément raccordables;

d) le courant assigné et le facteur de réduction permettant de déterminer la courbe avec taux de réduction s'il est différent de 0,8;

NOTE Sauf spécification contraire, le courant assigné est déterminé de préférence sur les unités de contact à 4 pôles.

e) la tension assignée d'isolement (U_i);

f) la tension assignée de tenue aux chocs (U_{imp}), lorsqu'elle est déterminée;

g) les conditions de service, si elles diffèrent de celles indiquées dans l'Article 7;

h) la préparation spéciale de l'extrémité du conducteur;

i) les informations complémentaires à spécifier de l'Annexe B, le cas échéant.

7 Conditions normales de service, de montage et de transport

L'Article 6 de l'IEC 60947-1:2007/AMD2:2014 s'applique.

8 Exigences relatives à la construction et au fonctionnement

8.1 Exigences relatives à la construction

8.1.1 Organes de serrage

Les organes de serrage doivent permettre de raccorder les conducteurs par des moyens assurant qu'un contact mécanique et électrique fiable est correctement maintenu.

En outre, l'essai décrit en 9.4.7.3 doit être effectué si la pression de contact de l'organe de serrage est transmise par un matériau isolant. Si cette pression de contact est uniquement transmise par de la céramique ou du mica pur, l'essai de 9.4.7.3 n'est pas considéré comme étant nécessaire.

Les organes de serrage et méthodes de connexion énumérés dans le Tableau 3 satisfont aux exigences mécaniques du présent document.

Des exigences complémentaires sont données dans le présent document.

Les autres organes de serrage et méthodes de connexion doivent être soumis à l'essai conformément aux normes applicables.

Tableau 3 – Normes pour les organes de serrage et les méthodes de connexion

Réf.	Organes de serrage et méthodes de connexion	Normes de référence
a)	Organe de serrage à vis	IEC 60999-1 ou IEC 60999-2
b)	Organe de serrage sans vis	IEC 60999-1 ou IEC 60999-2 ou IEC 60352-7
c)	Connexion enroulée	IEC 60352-1
d)	Connexion sertie	IEC 60352-2
e)	Connexion autodénudante (accessible)	IEC 60352-3 ou IEC 60998-2-3
f)	Connexion autodénudante (non accessible)	IEC 60352-4 ou IEC 60998-2-3
g)	Connexion insérée à force	IEC 60352-5
h)	Connexion à perçage d'isolant	IEC 60352-6 ou IEC 60998-2-3
i)	Borne plate à connexion rapide	IEC 61210
j)	Connexion brasée	IEC 60068-2-20 [a]
NOTE La norme appropriée s'applique au préconditionnement des conducteurs préparés. [a] La méthode d'essai sélectionnée doit être mentionnée dans le rapport d'essai.		

8.1.2 Montage et installation

Les blocs de jonction pour cartes de circuits imprimés doivent être conçus de manière que leur montage en toute sécurité soit possible sur une carte de circuits imprimés par brasage, insertion à force, vissage, etc. La connexion à la carte de circuits imprimés ne doit pas être endommagée par l'opération de raccordement des conducteurs.

Les essais doivent être effectués conformément à 9.3.2.

8.1.3 Distances d'isolement et lignes de fuite

Pour les blocs de jonction pour cartes de circuits imprimés dont le fabricant a déclaré des valeurs de tension assignée de tenue aux chocs (U_{imp}) et de tension assignée d'isolement (U_i), les valeurs minimales des distances d'isolement et des lignes de fuite sont données dans le Tableau 13 de l'IEC 60947-1:2007 et le Tableau 15 de l'IEC 60947-1:2007/AMD1:2010.

Pour les blocs de jonction pour cartes de circuits imprimés dont le fabricant n'a pas déclaré de valeur de tension assignée de tenue aux chocs (U_{imp}), l'Annexe H de l'IEC 60947-1:2007 donne des recommandations pour les valeurs minimales.

Les exigences électriques sont données en 8.2.2.

8.1.4 Identification et marquage des bornes

Le 7.1.8.4 de l'IEC 60947-1:2007 s'applique avec l'ajout suivant.

Un bloc de jonction pour carte de circuits imprimés doit être prévu pour porter des marques ou des nombres de repérage pour chaque organe de serrage ou unité de contact selon le circuit dont il fait partie, ou au moins comporter l'espace nécessaire à cet effet, sauf lorsque l'apposition d'un tel marquage n'est pas physiquement réalisable.

Ceci peut être effectué au moyen de marques séparées telles que des languettes de marquage, des étiquettes d'identification, etc.

8.1.5 Résistance à la chaleur anormale et au feu

Les matériaux isolants des blocs de jonction pour cartes de circuits imprimés ne doivent pas être altérés par une chaleur anormale et par le feu.

La conformité est vérifiée par:

a) l'essai au fil incandescent effectué sur le produit complet conformément à 9.5, ou

b) la vérification du matériau isolant conformément à

   1) l'IEC 60695-2-12, méthode GWFI à une température de 850 °C, ou

   2) l'IEC 60695-2-13, méthode GWIT à une température de 775 °C.

Cette vérification n'est pas nécessaire pour les petites pièces (voir l'IEC 60695-2-11).

NOTE 1 La méthode d'essai appropriée est spécifiée par le fabricant.

NOTE 2 Pour certaines applications, il peut être obligatoire de vérifier la conformité par l'essai au fil incandescent sur le produit complet conformément à 9.5 uniquement. Ce besoin est défini soit dans la norme applicable au produit fini soit par accord entre le fabricant et les utilisateurs. Voir l'Article B.1.

8.1.6 Section maximale et capacité de raccordement

Les blocs de jonction pour cartes de circuits imprimés doivent être conçus de telle façon que des conducteurs de la section maximale et de la capacité de raccordement, le cas échéant, puissent être acceptés.

La conformité est vérifiée par l'essai décrit au 9.3.4.

La vérification de la section maximale peut être effectuée par l'essai spécial conformément à 9.3.5.

8.2 Exigences relatives au fonctionnement

8.2.1 Échauffement (taux de réduction de l'intensité en fonction de la température)

Les blocs de jonction pour cartes de circuits imprimés doivent être soumis à l'essai conformément à 9.4.5. La somme de la température ambiante et de l'échauffement du bloc de jonction pour carte de circuits imprimés ne doit pas dépasser la température limite supérieure.

8.2.2 Propriétés diélectriques

Si le fabricant a déclaré une valeur de tension assignée de tenue aux chocs (U_{imp}) (voir 4.3.1.3 de l'IEC 60947-1:2007), les exigences de 7.2.3 et 7.2.3.1 de l'IEC 60947-1:2007/AMD1:2010 s'appliquent. Le cas échéant, l'essai de tension de tenue aux chocs doit être effectué conformément à 9.4.3a).

Pour la vérification de l'isolation solide, l'essai de tension de tenue à la fréquence industrielle doit être effectué conformément à 9.4.3b).

La vérification des distances d'isolement et des lignes de fuite suffisantes doit être effectuée conformément à 9.4.2. Pour les blocs de jonction pour cartes de circuits imprimés dont le fabricant n'a pas déclaré de valeur de tension assignée de tenue aux chocs (U_{imp}), l'Annexe H de l'IEC 60947-1:2007 donne des recommandations pour les valeurs minimales.

8.2.3 Courant de courte durée admissible

Un bloc de jonction pour carte de circuits imprimés doit être capable de résister au courant de courte durée admissible qui correspond à 120 A/mm^2 pendant 1 s conformément à 9.4.6.

L'essai doit être effectué en utilisant la section la plus petite du cheminement du courant de l'unité de contact, comme déclaré par le fabricant.