IEC 61810-10

Edition 1.0 2019-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electromechanical elementary relays – Part 10: Additional functional aspects and safety requirements for high-capacity relays

Relais électromécaniques élémentaires – Partie 10: Aspects fonctionnels et exigences de sécurité supplémentaires pour les relais à grande capacité

IEC 61810-10:2019-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROMECHANICAL ELEMENTARY RELAYS –

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FOREWORD

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The International Standards of the IEC 61810 have been prepared by IEC technical committee 94: All-or-nothing electrical relays.

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

FDIS	Report on voting
94/453/FDIS	94/458/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 of IEC 61810 series, published under the general title *Electromechanical elementary relays,* can be found on the IEC website.

This International Standard is to be used in conjunction with IEC 61810-1:2015.

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- withdrawn,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.

ELECTROMECHANICAL ELEMENTARY RELAYS –

Part 10: Additional functional aspects and safety requirements for high-capacity relays

1 Scope

This part of IEC 61810, with functional and safety aspects, applies to electromechanical elementary relays (non-specified time all-or-nothing relays) with high capability requirements like breaking or short circuit capabilities and similar for incorporation into low-voltage equipment. These relays may have a specific design to extinguish the electric arc between contacts (e.g. by magnetic blow-out), or use an insulation coordination not covered by IEC 61810-1 (e.g. by gas filled contact chambers), or require safety assessments not covered by IEC 61810-1 (e.g. for higher loads).

It defines additional requirements for high-capacity relays with generic performance intended for use in applications in smart grids, electric vehicles and other applications where, for example, battery charge/discharge switching is used, such as:

- electrical energy storage (EES) systems,
- solar photovoltaic energy systems,
- electric road vehicles (EV) and electric industrial trucks,
- power electronic systems and equipment,
- secondary cells and batteries,
- road vehicles.

Compliance with the requirements of this standard is verified by the type tests indicated.

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 60028, *International standard of resistance for copper*

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

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

IEC 60068-2-17, *Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-64:2008, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 60270, *High-voltage test techniques – Partial discharge measurements*

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

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

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

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 61810-1:2015, *Electromechanical elementary relays – Part 1: General and safety requirements*

ISO 16750-1:2018, *Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 1: General*

ISO 16750-2:2012, *Road vehicles – Environmental conditions and testing for electrical and electronic equipment – Part 2: Electrical loads*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61810-1 and 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

NOTE In the text of this document, the term "relay" is used instead of "elementary relay" to improve the readability.

3.5 Terms and definitions related to contacts

Addition to IEC 61810-1:2015:

3.5.23
polarity of contact
indication of which terminal of a contact is to be connected to the positive supply and which to the negative

3.5.24
arcing time
<of a pole or a fuse> interval of time between the instant of the initiation of the arc in a pole or a fuse and the instant of final arc extinction in that pole or that fuse

[SOURCE: IEC 60050-441:1984, 441-17-37]

4 Influence quantities

Clause 4 of IEC 61810-1 is applicable.

5 Rated values

Clause 5 of IEC 61810-1 is applicable, except as follows.

5.6 Electrical endurance

Recommended number of cycles: 1; 2; 5; 10; 20; 50; 100; 200; 500; 1 000; 2 000; 3 000; 5 000; 6 000; 10 000; 20 000; 25 000; 30 000; 50 000;100 000; 200 000; 300 000; 500 000; etc.

5.7 Frequency of operation

Recommended frequencies: 180/h; 360/h; 720/h; 900/h and multiples thereof.

0,05 Hz; 0,1 Hz; 0,2 Hz; 0,25 Hz and multiples thereof.

5.8 Contact loads

a) Resistive loads, recommended values

Current: 0,1 A; 0,5 A; 1 A; 2 A; 3 A; 5 A; 6 A; 8 A; 10 A; 12 A; 16 A; 20 A; 25 A; 30 A; 35 A; 60 A; 100 A, 120 A; 150 A; 200 A; 300 A; 400 A; 600 A; 800 A; 1 000 A (AC/DC).

Voltage: 4,5 V; 5 V; 12 V; 24 V; 36 V; 42 V; 48 V; 110 V; 125 V; 230 V; 250 V; 300 V; 380 V; 400 V; 480 V; 500 V; 575 V; 600 V; 690 V; 1 000 V (AC/DC); 1 200 V DC; 1 500 V DC.

b) Recommended inductive loads: see Annex B.

c) Recommended capacitive loads: see Annex D of IEC 61810-1:2015.

6 General provisions for testing

Clause 6 of IEC 61810-1 is applicable, except as follows.

Deviating from IEC 61810-1, the specimens shall be grouped in 8 inspection lots, and the related tests shall be taken from Table 1 of this document.

Table 1 of this document replaces Table 3 of IEC 61810-1:2015.

Table 1 – Type testing

Inspection lot	Tests	Clause	Additional references
1	Marking and documentation	7	IEC 60417
	Heating (all coil voltages)	8	IEC 60085
	Basic operating function (all coil voltages)	9	
2	Dielectric strength	10	
3	Electrical endurance (per contact load and contact material)	11	
4	Mechanical endurance	12	
5	Clearances, creepage distances and distances through solid insulation	13	IEC 60664-1
6	Insulation coordination evaluation as a system (if applicable)	13.6	IEC 60060-1
	Screw type terminals and screwless terminals (if applicable)	14.2	IEC 60999-1
	Flat quick-connect terminations (if applicable)	14.3	IEC 61210
	Solder terminals (if applicable)	14.4	IEC 60068-2-20
	Sockets (if applicable)	14.5	IEC 61984
	Alternative termination types (if applicable)	14.6	
	Sealing (if applicable)	15	IEC 60068-2-17
7	Heat and fire resistance	16	IEC 60695-2-10
8	Leaking test (sealed relay only)	Annex Q	IEC 60068-2-14 IEC 60068-2-17
NOTE The number of coil voltages in inspection lot 1 to be tested can be reduced under certain conditions explained in Clauses 8 and 9. Beside the defined minimum requirements, deviations of test conditions and procedures could be specified by the manufacturer in the inspection lot 8.			

7 Documentation and marking

Clause 7 of IEC 61810-1:2015 is applicable with the additions given in Table 2 of this document.

Table 2 – Required relay data

N°	Data	Notes	Place of indication
2d	Coil polarity	N/A in case of non-polarized coil	Relay and/or catalogue or instruction sheet
3h	Classification of load and polarity of contacts	For DC only use:+, - For AC/DC use: +/⁓, -/⁓, ⁓	Relay and/or catalogue or instruction sheet
5l	Limited short circuit capacity	Specify the fuses or current limiting device (if applicable)	Catalogue or instruction sheet

8 Heating

Clause 8 of IEC 61810-1:2015 is applicable with the following changes/additions.

8.4.4 Screw and screwless type terminals

The electrical interconnections between the relays are made with bare rigid conductors (= default, however the usage of flexible conductors is allowed if defined from the manufacturer; this shall be stated in the documentation and in the test report) in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A. The connections of the relay to the voltage or current source(s) are realized with flexible conductors in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A. The electrical interconnections between the relays are made with copper bars in accordance with Table 4 with a maximum of 1 000 A. Any fixture to hold the flexible-connected test samples in place is not allowed to have any impact on the results.

The temperature rise at the terminals shall not exceed 45 K. This may be verified without the temperature rise influence of the relay contacts and the coil (e.g. bridged or short-circuited or soldered relay contacts).

8.4.5 Alternative termination types

The electrical interconnections between the relays are made with bare rigid conductors in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A. The connections of the relay to the voltage or current source(s) are realized with flexible conductors in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A. The electrical interconnections between the relays are made with copper bars in accordance with Table 4 with a maximum of 1 000 A.

The temperature rise at the terminals shall not exceed 45 K. This may be verified without the temperature rise influence of the relay contacts and the coil (e.g. bridged or short-circuited or soldered relay contacts).

8.4.6 Sockets

The maximum steady-state temperature limits permissible for the connections between relay and socket as well as for the insulating materials of both relay and socket adjacent to the connection shall not be exceeded.

The electrical interconnections between the sockets are made with conductors in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A. The connections of the sockets to the voltage or current source(s) are realized with flexible conductors in accordance with Table 10 of IEC 61810-1:2015 with a maximum of 400 A, and in accordance with Table 3 with a maximum of 800 A.

The electrical interconnections between the sockets are made with copper bars in accordance with Table 4 with a maximum of 1 000 A.

The mounting distance between sockets shall be specified by the manufacturer.

Table 3 – Test conductor for test current above 400 A and up to 800 A inclusive dependent on the current carried by the terminal

Current carried by the terminal[a] A		Conductor[b,c,d,e]			
Above	Up to and including	Number	Size mm^2	Number	Size kcmil
400	500	2	150	2	250
500	630	2	185	2	350
630	800	2	240	3	300

[a] The value of test current shall be greater than the first value in the first column and less than or equal to the second value in that column

[b] For convenience of testing and with the manufacturer's consent, smaller conductors than those given for a stated test current may be used.

[c] The tables give alternative sizes for conductors in the metric and AWG/kcmil system and for bars in millimetres and inches. Comparison between AWG/kcmil and metric sizes is given in Table 1 of IEC 60947-1:2007.

[d] Either of the two conductors specified for a given test current range may be used.

[e] When a dimension of a wire is not available, the next smallest available standard wire size shall be used.

[f] Minimum conductor length for testing is 1 400 mm .

NOTE This table is based on Table 10 of IEC 60947-1:2007.

Table 4 – Test copper bars for test current above 400 A and up to 1 000 A inclusive dependent on the current carried by the terminal

Current carried by the terminal[a] A		2 set copper bars[b,c,d,e]		
Above	Up to and including	Number	Dimension mm^2	Dimension inches
400	500	2	30 × 5	1 × 0,250
500	630	2	40 × 5	1,25 × 0,250
630	800	2	50 × 5	1,5 × 0,250
800	1 000	2	60 × 5	2 × 0,250

[a] The value of test current shall be greater than the first value in the first column and less than or equal to the second value in that column

[b] For convenience of testing and with the manufacturer's consent, smaller conductors than those given for a stated test current may be used.

[c] Either of the two conductors specified for a given test current range may be used.

[d] Bars are assumed to be arranged with their long faces vertical. Arrangements with long faces horizontal may be used if specified by the manufacturer.

[e] Minimum conductor length for testing is 1 400 mm (including the length of flexible conductors).

[f] The tables give alternative sizes for bars in millimetres and inches.

NOTE This table is based on Table 11 of IEC 60947-1:2007.

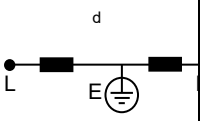
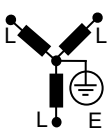
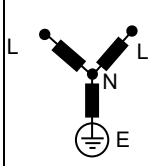
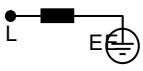
9 Basic operating function

Clause 9 of IEC 61810-1:2015 is applicable.

10 Dielectric strength

Clause 10 of IEC 61810-1:2015 is applicable with the following changes/additions: Table 5 and Table 6 of this document replace Table 13 and Table 14 of IEC 61810-1:2015.

Table 5 – Dielectric strength – AC

Insulation or disconnection to be tested[g]	**Test voltage**[a] [b] **depending on the rated voltage of the circuit** (RMS values)								
	[c] **Up to and including 50 V**	**50 V to 120 V**	**100 V to 200 V** **120 V to 240 V** **125 V to 250 V**		**230 V / 400 V** **277 V / 480 V**		**400 V / 400/ $\sqrt{3}$ V** **480 V / 480/ $\sqrt{3}$ V**		**> 480 V**
			[d] 		[e] 		[f] 		
	L – E	L – E	L – E	L – L	L – E	L – L	L – E	L – L	L – E
	V	V	V		V		V		
Functional insulation[h]	500	1 300	1 300	1 500	1 500	1 700	1 700	1 700	U_n + 1 200 V (rounded)
Basic insulation[i]	500	1 300	1 300	---	1 500	---	1 700	---	U_n + 1 200 V (rounded)
Basic insulation (Test procedure B)	500	1 000 + 2 times rated voltage							
Supplementary insulation[i]	---	1 300	1 300	---	1 500	---	1 700	---	U_n + 1 200 V (rounded)
Reinforced or double insulation[i]	500	2 600	2 600	---	3 000	---	3 400	---	2 × (U_n + 1 200 V) (rounded)
Micro-disconnection[j]	400	400	400	500	500	700	700	700	U_n + 250V
Full-disconnection	500	1 300	1 300	1 500	1 500	1 700	1 700	1 700	U_n + 1 200 V (rounded)

[a] The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 3 mA. Care shall be taken to ensure that the RMS value of the test voltage is measured within ±3 %.

[b] For functional, basic and supplementary insulation as well as for full disconnection, the values are derived from the formula U_n + 1 200 V (rounded). The reinforced level from 50 V up is consequently two times higher.

For micro-disconnection, the values are derived from the formula U_n + 250 V (rounded), with U_n being the nominal voltage of the supply system.

[c] Up to and including 50 V: not to be connected direct to the supply mains. No temporary overvoltages in accordance with IEC 60364-4-44 are expected to occur.

[d] Single-phase system, mid-point earthed.

[e] Three-phase system, mid-point earthed.

[f] Three-phase system, one phase earthed.

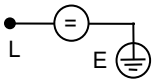
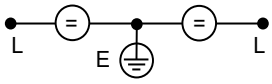
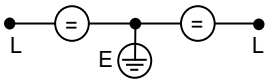
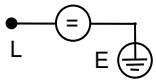
[g] Special components which might render the test impractical such as light emitting diodes, free-running diodes, varistors are disconnected at one pole, or bridged, or removed, as appropriate to the insulation being tested.

[h] An example is the insulation between contacts necessary for proper function only.

[i] For the test of basic, supplementary and reinforced insulation, all live parts are connected together and care shall be taken to ensure that all moving parts are in the most unfavourable position.

[j] Contact gap ensuring proper function of the contact (covers also micro-interruption).

Table 6 – Dielectric strength – DC

Insulation or disconnection to be tested [d]	Test voltage [a] [b] depending on the rated voltage of the circuit						
	[c] Up to and including 50 V	Above 50 V up to including 120 V	120 V to 250 V 125 V to 250 V		240 V to 480 V		> 480V
							
	L – E	L – E	L – E	L – L	L – E	L – L	L – E
	V		V		V		
Functional insulation [e]	500	1 300	1 300	1 500	1 500	1 700	U_n + 1 200 V (rounded)
Basic insulation [f]	500	1 300	1 300	---	1 500	---	U_n + 1 200 V (rounded)
Basic insulation (Test procedure B)	500	1 000 + 2 times rated voltage					
Supplementary insulation [f]	---	1 300	1 300	---	1 500	---	U_n + 1 200 V (rounded)
Reinforced or double insulation [f]	500	2 600	2 600	---	3 000	---	2 × (U_n + 1 200 V) (rounded)
Micro-disconnection [g]	400	400	400	500	500	700	U_n + 250 V
Full-disconnection	500	1 300	1 300	1 500	1 500	1 700	U_n + 1 200 V (rounded)

[a] The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 3 mA. Care shall be taken that the value of the test voltage is measured within ±3 %.

[b] For functional, basic and supplementary insulation, as well as for full disconnection, the values are derived from the formula U_n + 1 200 V (rounded). The reinforced level from 50 V up is consequently two times higher.

For micro-disconnection, the values are derived from the formula U_n + 250 V (rounded), with U_n being the nominal voltage of the supply system.

[c] Up to and including 50 V: Not to be connected direct to the supply mains. No temporary overvoltages according to IEC 60364-4-44 are expected to occur.

[d] Special components which might render the test impractical such as light emitting diodes, free-running diodes, varistors are disconnected at one pole, or bridged, or removed, as appropriate to the insulation being tested.

[e] An example is the insulation between contacts necessary for proper function only.

[f] For the test of basic, supplementary and reinforced insulation, all live parts are connected together and care shall be taken to ensure that all moving parts are in the most unfavourable position.

[g] Contact gap ensuring proper function of the contact (covers also micro-interruption).