



UL 61810-1

STANDARD FOR SAFETY

Electromechanical Elementary Relays – Part 1: General Requirements

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UL Standard for Safety for Electromechanical Elementary Relays – Part 1: General Requirements, UL 61810-1

First Edition, Dated July 31, 2015

Summary of Topics

This revision of ANSI/UL 61810-1, dated September 3, 2020 includes the harmonization of UL 61810-1 Edition 1 with IEC 61810-1, Edition 4, Amendment 1, to correlate the revision to [Table 4](#).

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated June 26, 2020.

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Electronic Components Industry Association
UL 61810-1-2015
First Edition



Underwriters Laboratories Inc.
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Standard for Electromechanical Elementary Relays – Part 1: General Requirements

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ANSI/UL 61810-1-2020

Commitment for Amendments

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This ANSI/UL Standard for Safety consists of the First Edition including revisions through September 3, 2020. The most recent designation of ANSI/UL 61810-1 as an American National Standard (ANSI) occurred on August 5, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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Preface (UL)

This UL Standard is based on IEC Publication 61810-1: fourth edition Electromechanical elementary relays – Part 1: General and safety requirements. IEC publication 61810-1 is copyrighted by the IEC.

This edition has been issued to satisfy UL Standards policy.

Efforts have been made to synchronize the UL edition number with that of the corresponding IEC standard with which this standard is harmonized. As a result, one or more UL edition numbers have been skipped to match that of the IEC edition number.

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Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 61810-1, Electromechanical Elementary Relays – Part 1: General and safety requirements copyright 2015 are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROMECHANICAL ELEMENTARY RELAYS – Part 1: General and safety requirements

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.

9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61810-1 has been prepared by IEC technical committee 94: All-or-nothing electrical relays.

This fourth edition cancels and replaces the third edition published in 2008. This edition constitutes a technical revision.

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

– two main test procedures were introduced: procedure A, reflecting the procedure known from Edition 3 of this standard and procedure B, reflecting the assessment according to North American requirements;

– inclusion of dedicated device application tests especially relevant for applications in the North American Market (see Clause [D.1](#));

– introduction of testing under single mounting condition;

- clarification of insulation requirements after endurance testing;
- inclusion of provisions for basic safety requirements;
- update of references.

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

FDIS	Report on voting
94/380/FDIS	94/384/RVD

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

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

A list of all parts of IEC 61810 series, published under the general title *Electromechanical elementary relays* can be found on the IEC website.

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

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

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ELECTROMECHANICAL ELEMENTARY RELAYS – Part 1: General requirements

1 Scope

This part of IEC 61810 applies to electromechanical elementary relays (non-specified time all-or-nothing relays) for incorporation into low voltage equipment (circuits up to 1000 V alternate current or 1500 V direct current). It defines the basic functional and safety requirements and safety-related aspects for applications in all areas of electrical engineering or electronics, such as:

- general industrial equipment,
- electrical facilities,
- electrical machines,
- electrical appliances for household and similar use,
- information technology and business equipment,
- building automation equipment,
- automation equipment,
- electrical installation equipment,
- medical equipment,
- control equipment,
- telecommunications,
- vehicles,
- transportation (e.g. railways).

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

In case the application of a relay determines additional requirements exceeding those specified in this standard, the relay should be assessed in line with this application in accordance with the relevant IEC standard(s) (e.g. IEC 60730-1, IEC 60335-1, IEC 60950-1).

2 Normative references

The following referenced documents are indispensable for the application 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.

2DV D2 Modify Clause 2 and all subclauses as follows:

For a list of normative standards, see Annex [DVA](#), [Table DVA.1](#) and [Table DVA.2](#) for normative references. See Annex [DVB](#), [Table DVB.1](#) for a list of normative component standards.

IEC 60038: 2009,
IEC standard voltages

IEC 60050 (all parts),
International Electrotechnical Vocabulary
(available at <http://www.electropedia.org>)

IEC 60068-2-2:2007,
Environmental testing – Part 2-2: Tests – Test B: Dry heat

IEC 60068-2-17:1994,
Basic environmental testing procedures – Part 2-17: Tests – Test Q: Sealing

IEC 60068-2-20: 2008,
Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads

IEC 60079-15:2010,
Explosive atmospheres – Part 15: Equipment protection by type of protection "n"

IEC 60085: 2007,
Electrical insulation – Thermal evaluation and designation

IEC 60099-1,
Surge arresters – Part 1: Non-linear resistor type gapped surge arresters for a.c. systems¹

IEC 60112:2003,
Method for the determination of the proof and the comparative tracking indices of solid insulating materials

IEC 60364-4-44:2007,
Low voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances

IEC 60417,
Graphical symbols for use on equipment
(available at <http://www.graphical-symbols.info/equipment>)

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

IEC 60664-3:2003,
Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution

IEC 60664-4:2005,
Insulation coordination for equipment within low-voltage systems – Part 4: Consideration of high-frequency voltage stress

IEC 60664-5:2007,
Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm

IEC 60695-2-10: 2013,
Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure

IEC 60695-2-11:2000,
Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products

IEC 60695-2-12: 2010,
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: 2010,
Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials

IEC 60695-10-2:2003,
Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test

IEC 60721-3-3:1994,
Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 3: Stationary use at weatherprotected locations
Amendment 1 (1995)
Amendment 2 (1996)

IEC 60999-1:1999,
Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)

IEC 61140:2001,
Protection against electric shock – Common aspects for installation and equipment

IEC 61210:2010,
Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements

IEC 61760-1:2006,
Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)

IEC 61984: 2008,
Connectors – Safety requirements and tests

¹ This publication was withdrawn.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-444 and the following apply.

An alphabetical list of terms can be found at the end of this standard.

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

3.1 Definitions related to general terms

3.1.1 **marking** identification of a relay which, when completely given to the manufacturer of this relay, allows the unambiguous indication of its electrical, mechanical, dimensional and functional parameters

EXAMPLE Through the indication of the trade mark and the type designation on the relay, all relay-specific data can be derived from the type code.

3.1.2 **intended use** use of a relay for the purpose for which it was made, and in the manner intended by the manufacturer

3.1.3 **relay technology categories** categories of relays, based upon environmental protection

Note 1 to entry: Six categories are in use (RT 0 to RT V).

[SOURCE: IEC 60050-444:2002, 444-01-11]

3.1.4 **pulse width modulation PWM** pulse time modulation in which the pulse duration varies in accordance with a given function of the value of the modulating signal

[SOURCE: IEC 60050-702:1992, 702-06-57]

3.1.5 **existing design** design which was already approved by the preceding Edition of this standard

3.1.6 **Hazard** potential source of harm

Note 1 to entry: Relevant hazards taken into account in this standard are heating, electrical shock, ignition and foreseeable misuse before the end of life.

3.1.7 **Type test** test of one or more devices made to a certain design to show that the design meets certain specifications

3.1.8 **Routine test** test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

3.1.9 **Sampling test** test on a number of devices taken at random from a batch

3.2 Terms and definitions of relay types

3.2.1 **electrical relay** device designed to produce sudden and predetermined changes in one or more output circuits when certain conditions are fulfilled in the electric input circuits controlling the device

Note 1 to entry: For the purpose of this standard, output circuits are contact circuits.

Note 2 to entry: For the purpose of this standard, the term "coil" is used to denote "input circuit", although other types of input circuits are possible.

[SOURCE: IEC 60050-444:2002, 444-01-01]

3.2.2 **all-or-nothing relay** electrical relay, which is intended to be energized by a quantity, the value of which is either within its operative range or effectively zero

Note 1 to entry: "All-or-nothing relays" include both "elementary relays" and "time relays".

[SOURCE: IEC 60050-444:2002, 444-01-02]

3.2.3 elementary relay all-or-nothing relay which operates and releases without any intentional time delay

[SOURCE: IEC 60050-444:2002, 444-01-03]

3.2.4 electromechanical relay electrical relay in which the intended response results mainly from the movement of mechanical elements

[SOURCE: IEC 60050-444:2002, 444-01-04]

3.2.5 monostable relay electrical relay which, having responded to an energizing quantity and having changed its condition, returns to its previous condition when that quantity is removed

[SOURCE: IEC 60050-444:2002, 444-01-07]

3.2.6 bistable relay electrical relay which, having responded to an energizing quantity and having changed its condition, remains in that condition after the quantity has been removed; a further appropriate energization is required to make it change its condition

SOURCE: IEC 60050-444:2002,444-01-08

Note 1 to entry: Bistable relays are also called latching relays.

3.3 Terms and definitions related to conditions and operations

3.3.1 release condition for a monostable relay, specified condition of the relay when it is not energized; for a bistable relay, one of the specified conditions, as declared by the manufacturer

Note 1 to entry: See [Figure A.1](#).

[SOURCE: IEC 60050-444:2002, 444-02-01]

3.3.2 operate condition for a monostable relay, specified condition of the relay when it is energized by the specified energizing quantity and has responded to that quantity; for a bistable relay, the condition other than the release condition as declared by the manufacturer

Note 1 to entry: See [Figure A.1](#).

[SOURCE: IEC 60050-444:2002, 444-02-02]

3.3.3 operate (verb) change from the release condition to the operate condition

Note 1 to entry: See [Figure A.1](#).

[SOURCE: IEC 60050-444:2002, 444-02-04]

3.3.4 release (verb) for a monostable relay, change from the operate condition to the release condition

Note 1 to entry: See [Figure A.1](#).

[SOURCE: IEC 60050-444:2002, 444-02-05]

3.3.5 **reset (verb)** for a bistable relay, change from the operate condition to the release condition

[SOURCE: IEC 60050-444:2002, 444-02-06]

3.3.6 **cycle** operation and subsequent release/reset

[SOURCE: IEC 60050-444:2002, 444-02-11]

3.3.7 **frequency of operation** number of cycles per unit of time

[SOURCE: IEC 60050-444:2002, 444-02-12]

3.3.8 **continuous duty** duty in which the relay remains energized for a period long enough to reach thermal equilibrium

[SOURCE: IEC 60050-444:2002, 444-02-13]

3.3.9 **intermittent duty** duty in which the relay performs a series of identical cycles, the durations in the energized and unenergized conditions being specified; the duration of energization of the relay is such as will not permit the relay to reach thermal equilibrium

[SOURCE: IEC 60050-444:2002, 444-02-14, modified – modification of the definition]

3.3.10 **temporary duty** duty in which the relay remains energized for insufficient duration to reach thermal equilibrium, the time intervals of energization being separated by unenergized time intervals of duration sufficient to restore equality of temperature between the relay and the surrounding medium

[SOURCE: IEC 60050-444:2002, 444-02-16]

3.3.11 **duty factor** ratio of the duration of energization to the total period in which intermittent or continuous or temporary duty takes place

Note 1 to entry: The duty factor can be expressed as a percentage of the total period.

[SOURCE: IEC 60050-444:2002, 444-02-15]

3.3.12 **ambient temperature** temperature(s) prescribed for the air surrounding the relay under certain conditions, when the relay is mounted as indicated by the manufacturer

[SOURCE: IEC 60050-444:2002, 444-03-18, modified – modification of the definition and addition of a new note]

3.3.13 **thermal equilibrium** variation of less than 1 K between any two out of three consecutive measurements made at an interval of 5 min

3.3.14 **rated value** value of a quantity used for specification purposes, established for a specific set of operating conditions

[SOURCE: IEC 60050-444:2002, 444-02-18, modified – modification of the definition]

3.3.15 **test value** value of a quantity for which the relay shall comply with a specified action during a test

[SOURCE: IEC 60050-444:2002, 444-02-20]

3.3.16 **mechanical endurance** number of cycles under specified conditions with unloaded contact(s)

[SOURCE: IEC 60050-444:2002, 444-07-10, modified – modification of the definition]

3.4 Terms and definitions of operating values

3.4.1 **energizing quantity** electrical quantity which, when applied to the coil (s) of a relay under specified conditions, enables it to fulfil its purpose

Note 1 to entry: For relays, the energizing quantity is usually a voltage. Therefore, the input voltage as energizing quantity is used in the definitions given in 3.4. Where a relay is energized by a given current instead, the respective terms and definitions apply with "current" used instead of "voltage".

[SOURCE: IEC 60050-444:2002, 444-03-01, modified – modification of the definition]

3.4.2 **operate voltage – set voltage** value of the coil voltage at which a relay operates

Note 1 to entry: "Set voltage" applies to bistable relays only.

[SOURCE: IEC 60050-444:2002, 444-03-06, modified – modification of the term and the definition]

3.4.3 **operate voltage U_1** value of the coil voltage at which a relay operates, having previously been energized at that same voltage

Note 1 to entry: Thermal equilibrium has to be achieved.

3.4.4 **limiting voltage U_2** value of the coil voltage, taking into account the effect of heating due to the power dissipated by the coil (s), which when exceeded may result in a relay failure caused by thermal overload

Note 1 to entry: Thermal equilibrium has to be achieved.

3.4.5 **operative range** range of values of coil voltage for which a relay is able to perform its specified function

[SOURCE: IEC 60050-444:2002, 444-03-05, modified – modification of the term and the definition]

3.4.6 **release voltage** value of the coil voltage at which a monostable relay releases

[SOURCE: IEC 60050-444:2002, 444-03-08, modified – modification of the definition]

3.5 Terms and definitions related to contacts

For a.c., r.m.s. values for voltage and current are specified, unless otherwise indicated.

3.5.1 **contact** arrangement of contact members, with their insulation, which close or open their contact circuit by their relative movement

Note 1 to entry: See [Figure A.2](#)

[SOURCE: IEC 60050-444:2002, 444-04-03]

3.5.2 **contact set** combination of contacts within a relay, separated by their insulation

Note 1 to entry: See [Figure A.2](#)

[SOURCE: IEC 60050-444:2002, 444-04-04]

3.5.3 **contact gap** gap between the contact points when the contact circuit is open

[SOURCE: IEC 60050-444:2002, 444-04-09]

3.5.4 **make contact** contact which is closed when the relay is in its operate condition and which is open when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-17]

3.5.5 **break contact** contact which is open when the relay is in its operate condition and which is closed when the relay is in its release condition

[SOURCE: IEC 60050-444:2002, 444-04-18]

3.5.6 **change-over contact** combination of two contact circuits with three contact members, one of which is common to the two contact circuits; such that when one of these contact circuits is open, the other is closed

[SOURCE: IEC 60050-444:2002, 444-04-19]

3.5.7 **switching voltage** voltage between the contact members before closing or after opening of a relay contact

Note 1 to entry: The term “contact voltage” (see IEC 60050-444:2002, 444-04-25) has been replaced by “switching voltage”. The definition remains unchanged, however.

3.5.8 **contact current** electric current which a relay contact carries before opening or after closing

[SOURCE: IEC 60050-444:2002, 444-04-26]

3.5.9 **switching current** electric current which a relay contact makes and/or breaks

[SOURCE: IEC 60050-444:2002, 444-04-27]

3.5.10 **limiting continuous current** greatest value of electric current which a closed contact is capable of carrying continuously under specified conditions

[SOURCE: IEC 60050-444:2002, 444-04-28, modified]

3.5.11 **micro-interruption** interruption of a circuit by contact separation which does not provide full-disconnection or micro-disconnection

Note 1 to entry: There are no dielectric strength or dimensional requirements for the contact gap.

[SOURCE: IEC 60730-1, 2.4.4, modified— modification of the definition]

3.5.12 **micro-disconnection** adequate contact separation in at least one contact so as to provide functional security

Note 1 to entry: There is a requirement for the dielectric strength of the contact gap but no dimensional requirement.

[SOURCE: IEC 60730-1:2013, 2.4.3, modified – modification of the term and definition]

3.5.13 **full-disconnection** contact separation for the disconnection of conductors so as to provide the equivalent of basic insulation between those parts intended to be disconnected

Note 1 to entry: There are dielectric strength and dimensional requirements.

[SOURCE: IEC 60730-1:2013, 2.4.2, modified – modification of the term and definition]

3.5.14 **failure** termination of the ability of an item to perform a required function as defined in the failure criteria.

Note 1 to entry: For the purpose of this standard, items are elementary relays.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.5.15 **failure criteria** specified conditions to judge if a fault or malfunction is a failure

3.5.16 **malfunction** single event when an item does not perform an expected function

3.5.17 **fault** deviation of the existing condition from the expected condition

3.5.18 **contact failure** occurrence of break and/or make malfunctions of a contact under test, exceeding a specified number

3.5.19 **failure to break** current flows although it should not

Note 1 to entry: This could be a contact welding/sticking as well as a delayed contact operate or release.

3.5.20 **failure to make** no sufficient contact is ensured

Note 1 to entry: This could be a not acceptable or excessive contact resistance as well as a bouncing of the contact due to the lost of overtravel.

3.5.21 **electrical endurance** number of cycles without contact failure under specified conditions, with loaded contacts

3.5.22 **end of life** the point at which the physical relay conditions for operate and release can no longer be ensured after an unspecified number of cycles

Note 1 to entry: The intended use of electromechanical relays is to switch loads depending on the control circuit. The relay will follow this request until the mechanical and/or electrical breakdown of the relay (the relay is per definition a wear device).

Note 2 to entry: Using relays after end of life could cause hazards.

3.6 Terms and definitions related to accessories

3.6.1 **manual operation** manual movement of the actuating member of the relay