
**Niskonapetostne stikalne in krmilne naprave – 4-3. del: Kontaktorji in
motorski zaganjalniki, polprevodniški krmilniki in kontaktorji na izmenični tok
za nemotorske obremenitve**

Low-voltage switchgear and controlgear - Part 4-3: Contactors and motor-starters
AC semiconductor controllers and contactors for non-motor loads

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English version

**Low-voltage switchgear and controlgear
Part 4-3: Contactors and motor-starters
AC semiconductor controllers and contactors for non-motor loads
(IEC 60947-4-3:1999)**

Appareillage à basse tension
Partie 4-3: Contacteurs et démarreurs
de moteurs
Gradateurs et contacteurs à
semiconducteurs pour charges, autres
que des moteurs, à courant alternatif
(CEI 60947-4-3:1999)

Niederspannungsschaltgeräte
Teil 4-3: Schütze und Motorstarter
Halbleiter-Steuergeräte und -Schütze
für nichtmotorische Lasten für
Wechselspannung
(IEC 60947-4-3:1999)

This European Standard was approved by CENELEC on 1999-12-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 17B/1000/FDIS, future edition 1 of IEC 60947-4-3, prepared by SC 17B, Low-voltage switchgear and controlgear, of IEC TC 17, Switchgear and controlgear, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60947-4-3 on 1999-12-01.

This European Standard, together with EN 60947-4-2:2000, supersedes HD 419.2 S1:1987.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2000-09-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2002-12-01

This standard is to be used in conjunction with EN 60947-1:1999.

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes A, D and ZA are normative and annexes B, E, F, G and H are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60947-4-3:1999 was approved by CENELEC as a European Standard without any modification.

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Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050-161	1990	International Electrotechnical Vocabulary (IEV) Chapter 161: Electromagnetic compatibility	-	-
IEC 60269-1	1998	Low-voltage fuses Part 1: General requirements	EN 60269-1	1998
IEC 60410	1973	Sampling plans and procedures for inspection by attributes	-	-
IEC 60439-1	1992	Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies	EN 60439-1 ¹⁾	1994
IEC 60664 (mod)	series	Insulation coordination for equipment within low-voltage systems	HD 625	series
IEC 60947-1 (mod)	1999	Low-voltage switchgear and controlgear Part 1: General rules	EN 60947-1 + corr. October	1999 1999
IEC 60947-4-2 (mod)	1995	Part 4: Contactors and motor-starters Section 2: A.C. semiconductor motor controllers and starters	EN 60947-4-2 ²⁾ + corr. October	1996 1999
IEC 61000-2-1	1990	Electromagnetic compatibility (EMC) Part 2: Environment Section 1: Description of the environment Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems	-	-
IEC 61000-3-2	1995	Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16A per phase)	EN 61000-3-2 + corr. July	1995 1997

1) EN 60439-1 is superseded by EN 60439-1:1999, which is based on IEC 60439-1:1999.

2) EN 60947-4-2 is superseded by EN 60947-4-2:2000, which is based on IEC 60947-4-2:1999.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61000-4-2	1995	Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995
IEC 61000-4-3 (mod)	1995	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3	1996
IEC 61000-4-4	1995	Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	1995
IEC 61000-4-5	1995	Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	1995
IEC 61000-4-6	1996	Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	EN 61000-4-6	1996
IEC 61000-4-11	1994	Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests	EN 61000-4-11	1994
CISPR 11 (mod)	1997	Industrial, scientific and medical (ISM) radio-frequency equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55011	1998
CISPR 14-1	1993	Electromagnetic compatibility Requirements for household appliances, electric tools and similar apparatus Part 1: Emission - Product family standard	EN 55014-1	1993

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**NORME
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60947-4-3

Première édition
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**Partie 4-3:
Contacteurs et démarreurs de moteurs –
Gradateurs et contacteurs à semiconducteurs
pour charges, autres que des moteurs,
à courant alternatif**

Low-voltage switchgear and controlgear –

**Part 4-3:
Contactors and motor-starters –
AC semiconductor controllers
and contactors for non-motor loads**

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International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

**Part 4-3: Contactors and motor-starters –
AC semiconductor controllers and contactors
for non-motor loads**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60947-4-3 has been prepared by subcommittee 17B: Low-voltage switchgear and controlgear, of IEC technical committee 17: Switchgear and controlgear.

This standard shall be used in conjunction with IEC 60947-1.

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

FDIS	Report on voting
17B/1000/FDIS	17B/1013/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. [SIST EN 60947-4-3:2000](https://standards.iteh.ai/catalog/standards/sist/0630d927-ed42-44c6-a605-104588502516/sist-0630d927-ed42-44c6-a605-104588502516-17)

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annexes A and D form an integral part of this standard.

Annexes B, E, F, G and H are for information only.

The committee has decided that this publication remains valid until 2002. At this date, in accordance with the committee's decision, the publication will be

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

INTRODUCTION

This part of IEC 60947 covers low-voltage a.c. semiconductor controllers and contactors (solid-state contactors) intended for the use with non-motor loads. As controllers, they have many capabilities beyond the simple switching on and off of non-motor loads. As contactors, they perform the same functions as mechanical contactors, but utilize one or more semiconductor switching devices in their main poles.

The devices may be single-pole or multi-pole (see 2.3.1 of IEC 60947-1). This standard refers to complete devices rated as a unit incorporating all necessary heat-sinking material and terminals. It includes devices with all necessary terminals, which are supplied with or without heat-sink in knocked-down form for combination by the users, when the manufacturer gives with the device detailed information about choosing the heat-sink and mounting the device on the heat-sink.

The generic term, "controller", is used in this standard wherever the unique features of the power semiconductor switching elements are the most significant points of interest. The generic term "contactor" is used in this standard wherever the feature of simple switching on and off is the most significant point of interest. Specific designations (for example, form 4, form HxB, etc.) are used wherever the unique features of various configurations comprise significant points of interest.

The provisions of the general rules (IEC 60947-1) are applicable to this standard, where specifically called for. Clauses and subclauses thus applicable, as well as tables, figures, and annexes, are identified by reference to IEC 60947-1, for example 1.2.3, table 4 of IEC 60947-1 or annex A of IEC 60947-1.

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 4-3: Contactors and motor-starters – AC semiconductor controllers and contactors for non-motor loads

1 Scope and object

This part of IEC 60947 applies to a.c. semiconductor non-motor load controllers and contactors intended for performing electrical operations by changing the state of a.c. electric circuits between the ON-state and the OFF-state. Typical applications are given in table 2.

As controllers, they may be used to reduce the amplitude of the r.m.s. a.c. voltage on the load terminals from that of the applied voltage – either continuously or for a specified period of time. The half-wave period of the a.c. wave form remains unchanged from that of the applied voltage.

They may include a series mechanical switching device and are intended to be connected to circuits, the rated voltage of which does not exceed 1 000 V a.c.

The semiconductor controllers and contactors dealt with in this standard are not normally intended to interrupt short-circuit currents. Therefore, suitable short-circuit protection (see 8.2.5) should form part of the installation but not necessarily of the controller itself.

In this context, this standard gives requirements for semiconductor controllers and contactors associated with separate short-circuit protective devices.

This standard does not apply to

- continuous operation of a.c. motors;
- low-voltage a.c. semiconductor motor controllers and starters covered by IEC 60947-4-2;
- electronic a.c. power controllers covered by IEC 60146;
- all-or-nothing solid-state relays.

Contactors and control-circuit devices used in semiconductor controllers and contactors should comply with the requirements of their relevant product standard. Where mechanical switching devices are used, they should meet the requirements of their own IEC product standard and the additional requirements of this standard.

The object of this standard is to state

- a) the characteristics of semiconductor controllers and contactors and associated equipment;
- b) the conditions with which semiconductor controllers and contactors should comply with reference to
 - their operation and behaviour;
 - their dielectric properties;

- the degrees of protection provided by their enclosures, where applicable;
 - their construction;
- c) the tests intended for confirming that these conditions have been met, and the methods to be adopted for these tests;
- d) the information to be given with the equipment or in the manufacturer's literature.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60947. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60947 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(161):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 161: Electromagnetic compatibility*

IEC 60269-1:1998, *Low-voltage fuses – Part 1: General requirements*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 60439-1:1992, *Low-voltage switchgear and controlgear assemblies – Part 1: Type-tested and partially type-tested assemblies*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60947-1:1999, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-4-2:1995, *Low-voltage switchgear and controlgear – Part 4: Contactors and motor-starters – Section 2: AC semiconductor motor controllers and starters*

IEC 61000-2-1:1990, *Electromagnetic compatibility (EMC) – Part 2: Environment – Section 1: Description of the environment – Electromagnetic environment for low-frequency conducted disturbances and signalling in public power supply systems*

IEC 61000-3-2:1995, *Electromagnetic compatibility (EMC) – Part 3: Limits – Section 2: Limits for harmonic current emissions (equipment input current ≤16 A per phase)*

IEC 61000-4 (all parts), *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques*

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IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test – Basic EMC publication*

IEC 61000-4-3:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radiofrequency, electromagnetic field immunity test*

IEC 61000-4-4:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test – Basic EMC publication*

IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity test*

IEC 61000-4-6:1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radiofrequency fields*

IEC 61000-4-11:1994, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 11: Voltage dips, short interruptions and voltage variations immunity tests – Basic EMC publication*

CISPR 11:1997, *Industrial, scientific and medical (ISM) radiofrequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 14-1:1993, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission – Product family standard*

3 Definitions

For the purposes of this part of IEC 60947, relevant definitions of clause 2 of IEC 60947-1 apply with the following additional definitions:

3.1 Definitions concerning a.c. semiconductor (non-motor-load) control devices

3.1.1 AC semiconductor controllers and contactors (solid-state contactors) (see figure 1)

3.1.1.1

a.c. semiconductor controller

semiconductor switching device (see 2.2.3 of IEC 60947-1) that provides a switching function for an a.c. electrical load (non-motor load) and an OFF-state

NOTE 1 – Because dangerous levels of leakage currents (see 3.1.13) can exist in a semiconductor controller in the OFF-state, the load terminals should be considered to be live at all times.

NOTE 2 – In a circuit where the current passes through zero (alternately or otherwise), the effect of "not making" the current following such a zero value is equivalent to breaking the current.

3.1.1.1.1

semiconductor controller (form 4)

a.c. semiconductor controller in which the switching function may comprise any method specified by the manufacturer. It provides control functions which may include any combination of ramp-up, load control or ramp-down. A FULL-ON state may also be provided

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3.1.1.1.2

Vacant

3.1.1.1.3

semiconductor direct-on-line (DOL) contactor (form 5)

special form of a.c. semiconductor controller in which the switching function is limited to the full-voltage, unramped method only and where the additional control function is limited to providing FULL-ON (also known as a semiconductor contactor or solid-state contactor).

It is a device (see 2.2.13 of IEC 60947-1) which performs the function of a contactor by utilizing a semiconductor switching device (see 2.2.3 of IEC 60947-1). It has only one position of rest (OFF-state or Open state in the case of an HxB hybrid controller) and is operated by the application of a control signal. It is capable of carrying load currents as well as changing the state of the said load (electrical circuit) between the FULL-ON and the OFF-states (Open) under normal circuit conditions including operating overload conditions.

3.1.1.2

Vacant

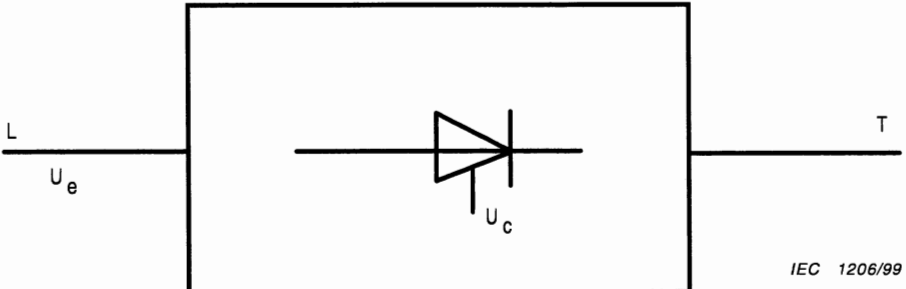
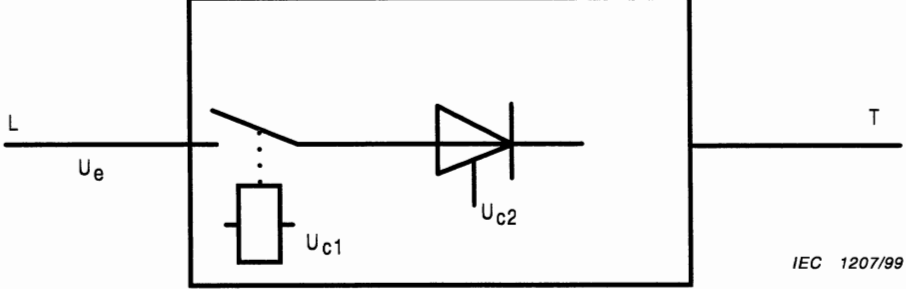

Device	
<p>Controller (all forms)</p>	 <p style="text-align: right;"><i>IEC 1206/99</i></p>
<p>Hybrid controller HxA* where x = 4 or 5</p>	 <p style="text-align: right;"><i>IEC 1207/99</i></p>
<p>Hybrid controller HxB** where x = 4 or 5</p>	 <p style="text-align: right;"><i>IEC 1208/99</i></p>
<p>* Two separate controls for the controller and the series mechanical switching device respectively. ** One control only for the series mechanical switching device.</p>	

Figure 1 – Graphical possibilities of controllers