



# SLOVENSKI STANDARD

## SIST HD 419.2 S1:1998

01-februar-1998

---

**Low-voltage controlgear - Part 2: Semiconductor contactors (solid state contactors) (IEC 158-2:1982)**

Low-voltage controlgear -- Part 2: Semiconductor contactors (solid state contactors)

Niederspannungs-Schaltgeräte für Energieverbraucher -- Teil 2: Halbleiterschütze

Appareillage de commande à basse tension -- Partie 2: Contacteurs à semi-conducteurs (contacteurs statiques)

**ITeH STANDARD PREVIEW**  
**(standards.iteh.ai)**

**Ta slovenski standard je istoveten z: <sup>SIST HD 419.2 S1:1998</sup> HD 419.2 S1:1987**  
<https://standards.iteh.ai/catalog/standards/sist/ad48417b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

---

**ICS:**

29.130.20	Nizkonapetostne stikalne in krmilne naprave	Low voltage switchgear and controlgear
-----------	---	--

**SIST HD 419.2 S1:1998**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST HD 419.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

UDC: 621.316.53

KEY WORDS: Low-voltage switchgear and controlgear; low-voltage; contactor; semiconductor contactor; solid state contactor; requirements; tests; definitions

LOW-VOLTAGE CONTROLGEAR  
PART 2: SEMICONDUCTOR CONTACTORS (SOLID STATE CONTACTORS)

Appareillage de commande à basse tension  
Deuxième partie: Contacteurs à semi-conducteurs (contacteurs statiques)

Niederspannung-Schaltgeräte für Energieverbraucher  
Teil 2: Halbleiterschütze

## BODY OF THE HD

The Harmonization Document consists of:

- IEC 158-2 (1982) ed 1; IEC/SC 17B, not appended
- with common modifications prepared by CENELEC/TC 17B



REPUBLIKA SLOVENIJA  
MINISTRSTVO ZA ZNANOST IN TEHNOLOGIJO  
Urad RS za standardizacijo in meroslovje  
LJUBLJANA

SIST..... HD 419.2 S1  
PREVZET PO METODI RAZGLASITVE

This Harmonization Document was approved by CENELEC on 1986-02-27.

The English and French versions of this Harmonization Document are provided by the text of the IEC publication and the German version is the official translation of the IEC text. The German translation is available. All texts prepared by CENELEC exist in three official versions (English, French and German).

According to the CENELEC Internal Regulations the CENELEC member National Committees are bound:

to announce the existence of this Harmonization Document at national level by or before 1986-03-01

to publish their new harmonized national standard by or before 1986-09-01

to withdraw all conflicting national standards by or before 1986-09-01.

Harmonized national standards are listed on the HD information sheet, which is available from the CENELEC National Committees or from the CENELEC Central Secretariat.

The CENELEC National Committees are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

© Copyright reserved to all CENELEC members

FOREWORD

This Harmonization Document has been prepared by CENELEC Technical Committee 17B.

ENDORSEMENT NOTICE

IEC Publications 158-2 (1st edition - 1982) applies except for Sub-clause 7.1.2 and the dimensions of terminals for which national rules remain applicable until CENELEC requirements are available, provided that such national rules are specifically referred to in the National Standard relevant to the equipment dealt with in this Harmonization Document, and the following common modifications :

CLAUSE N°	MODIFICATION
8.2.3.3	<p><b>STANDARD PREVIEW</b> (standards.iteh.ai)</p> <p><u>Value of the test voltage</u></p> <p>Add the following note to the IEC text :</p> <p>"Note : For the time being, the values of Tables VIII of IEC Publication 158-1 should be used".</p>
8.2.9.2b)	<p><u>Test 2 : Surge voltage test</u></p> <p>Replace second paragraph by the following :</p> <p>"A transient surge voltage generator shall set transient across the semiconductor contactor. The amplitude of the transients shall be equal to 2.3 times the peak line voltage and the frequency of the transients shall be about 5 kHz".</p>
8.2.9.3b)	<p><u>Test 2 : Surge voltage test</u></p> <p>Replace fifth paragraph by the following :</p> <p>"For the above tests, the transient generator shall be set by means of the variable transformer to produce transients the amplitude of which is 2.3 times the peak line voltage".</p>

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE  
NORME DE LA CEI



INTERNATIONAL ELECTROTECHNICAL COMMISSION  
IEC STANDARD

41

Publication 158-2  
Première édition — First edition  
1982

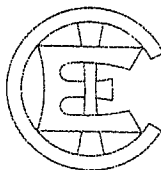
Appareillage de commande à basse tension  
Deuxième partie: Contacteurs à semi-conducteurs (contacteurs statiques)

ITeH STANDARD PREVIEW

(standards.iteh.ai)  
Low-voltage controlgear

Part 2: Semiconductor contactors (solid state contactors)

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd.419-2-s1-1998>



© CEI 1982

Droits de reproduction réservés — Copyright - all rights reserved

Aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'éditeur.

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

Bureau Central de la Commission Electrotechnique Internationale

3, rue de Varembe  
Genève, Suisse

Prix Fr.s. 88.—  
Price

## CONTENTS

	Page
FOREWORD . . . . .	7
PREFACE . . . . .	7
Clause	
1. General . . . . .	9
1.1 Scope . . . . .	9
1.2 Object . . . . .	9
2. Definitions . . . . .	9
2.1 Definitions concerning contactors and semiconductor contactors . . . . .	9
2.2 Definitions concerning states, control and auxiliary circuits of a semiconductor contactor . . . . .	15
3. Classification . . . . .	17
4. Characteristics of semiconductor contactors . . . . .	17
4.1 Summary of characteristics . . . . .	17
4.2 Type of semiconductor contactor . . . . .	19
4.3 Rated values . . . . .	19
4.4 Control circuits . . . . .	31
4.5 Auxiliary circuits . . . . .	33
4.6 Co-ordination with short-circuit protective devices . . . . .	33
5. Nameplates . . . . .	35
6. Standard conditions for operation in service . . . . .	35
6.1 Normal service conditions . . . . .	35
7. Standard conditions for construction . . . . .	37
7.1 Mechanical design . . . . .	37
7.2 Enclosures . . . . .	37
7.3 Temperature rise . . . . .	37
7.4 Dielectric properties . . . . .	41
7.5 Limiting values of operation . . . . .	41
8. Tests . . . . .	41
8.1 Verification of the characteristics of semiconductor contactors . . . . .	41
8.2 Type tests . . . . .	43
8.3 Routine tests . . . . .	51
8.4 Special tests . . . . .	53
APPENDIX A — Information to be given by the user when conditions for operation in service differ from the standard . . . . .	65
APPENDIX B — Clearances and creepage distances for low-voltage contactors ( <i>under consideration</i> ) . . . . .	65
APPENDIX C — Protection of a contactor by a short-circuit protective device ( <i>under consideration</i> ) . . . . .	65



	Page
APPENDIX D — Conventional test circuit for the verification of rated making and breaking capacities of contactors . . . . .	65
APPENDIX E — Method of presenting a load diagram . . . . .	67
APPENDIX F — Test equipment and circuits for showering arc test . . . . .	73

---

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST HD 419.2.S1:1998](https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## LOW-VOLTAGE CONTROLGEAR

## Part 2: Semiconductor contactors (solid state contactors)

## FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

## PREFACE

This standard has been prepared by Sub-Committee 17B: Low-voltage Switchgear and Controlgear, of IEC Technical Committee No. 17: Switchgear and Controlgear.

A first draft was discussed at the meeting held in Moscow in 1977. A second draft was circulated to the National Committees, and replaced later on by a third draft circulated under the Accelerated Procedure in June 1978; as a result of which a fourth draft, Document 17B(Central Office)106, was submitted to the National Committees for approval under the Six Months' Rule in May 1979.

Amendments, Document 17B(Central Office)115, were submitted to the National Committees for approval under the Two Months' Procedure in March 1981.

The National Committees of the following countries voted explicitly in favour of publication:

Argentina	France	South Africa (Republic of)
Australia	German Democratic Republic	Spain
Austria	Germany	Sweden
Belgium	Hungary	Switzerland
Bulgaria	Israel	Turkey
China	Italy	Union of Soviet Socialist Republics
Denmark	Japan	United Kingdom
Egypt	Netherlands	United States of America
Finland	Romania	Yugoslavia

## Other IEC publications quoted in this standard:

- Publications Nos. 60-2: High-voltage Test Techniques, Part 2: Test Procedures.
- 65: Safety Requirements for Mains Operated Electronic and Related Apparatus for Household and Similar General Use.
- 144: Degrees of Protection of Enclosures for Low-voltage Switchgear and Controlgear.
- 147-0: Essential Ratings and Characteristics of Semiconductor Devices and General Principles of Measuring Methods, Part 0: General and Terminology.
- 158-1: Low-voltage Controlgear, Part 1: Contactors. Including Supplements A and B.
- 664: Insulation Co-ordination within Low-voltage Systems including Clearances and Creepage Distances for Equipment.
- 664A: First Supplement.



## LOW-VOLTAGE CONTROLGEAR

### Part 2: Semiconductor contactors (solid state contactors)

#### 1. General

##### 1.1 Scope

This standard applies to semiconductor contactors intended for performing electrical operations by changing the state of electric circuits between on state and off state.

This standard is additional to IEC Publication 158-1: Low-voltage Controlgear, Part 1: Contactors (including Supplements A and B) which is applicable, provided it is not amended by this standard.

It applies only to semiconductor contactors, the main circuit of which is intended to be connected to circuits, the rated voltage of which does not exceed 1 000 V a.c. or 1 500 V d.c.

*Notes 1.* — Semiconductor contactors dealt with in this standard are not intended to provide short-circuit protection of the main circuit, but may contain short-circuit protective devices for semiconductor parts.

*2.* — Semiconductor motor-starters will be dealt with in a later publication.

This standard applies also to hybrid semiconductor contactors, which are also covered by the scope of IEC Publication 158-1 as concerns their electromagnetic part.

SIST HD 419.2 S1:1998

##### 1.2 Object

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

See IEC Publication 158-1\*.

#### 2. Definitions

For the purpose of this standard, the following definitions shall apply:

##### 2.1 Definitions concerning contactors and semiconductor contactors

###### 2.1.1 Semiconductor switching device

A switching device designed to make the current in an electric circuit by means of the controlled conductivity of a semiconductor.

*Note.* — 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.

###### 2.1.2 Mechanical switching device

See IEC Publication 158-1.

\* Whenever reference is made to IEC Publication 158-1, the clause with the same clause number applies, in some instances modified by the text which follows, it being understood that the word "contactor" shall be replaced by "semiconductor contactor".

158-2 © IEC 1982

— 11 —

2.1.3 *Controlgear*

See IEC Publication 158-1.

2.1.4 *Contactors (mechanical)*

See IEC Publication 158-1.

2.1.5 *Semiconductor* (Sub-clause 0-1.1 of IEC Publication 147-0\*)

A material with resistivity usually in the range between metals and insulators, in which the electrical charge carrier concentration increases with increasing temperature over a certain temperature range.

2.1.6 *Semiconductor contactor*

A device which performs the function of a contactor by utilizing a semiconductor switching device.

*Note.* — A semiconductor contactor may also contain mechanical switching devices.

2.1.7 *Hybrid semiconductor contactor*

A device which performs the function of a contactor by utilizing a combination of semiconductor and mechanical devices with the switching duty performed by a semiconductor device while the current-carrying duty is taken care of by a mechanical device.

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

## 2.1.8 (Vacant)

## 2.1.9 (Vacant)

[SIST HD 419.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-c407a50086ab/sist-hd-419-2-s1-1998)

2.1.10 *Main circuit (of a semiconductor contactor)*

All the conductive parts of a semiconductor contactor included in the circuit it is designed to control.

2.1.11 *Pole of a contactor*

See IEC Publication 158-1.

## 2.1.12 (Vacant)

2.1.13 *Breaking current (of a semiconductor contactor)*

A general term used to designate the value of current in a pole of a semiconductor contactor:

- a) for a.c., the r.m.s. value of the current immediately before the change from the "on-state" to the "off-state";
- b) for d.c., the value of the current just before the turn-off is initiated.

\* Essential Ratings and Characteristics of Semiconductor Devices and General Principles of Measuring Methods, Part 0: General and Terminology.

### 2.1.14 *Breaking capacity (of a semiconductor contactor)*

For a.c., the r.m.s. value of the maximum breaking current of a semiconductor contactor which will cease to flow when the control initiating the "on-state" is removed and for d.c., the maximum current that can be turned off when the "turn off" signal is applied and the "turn on" signal is removed, at a stated value of voltage under prescribed conditions of use and behaviour.

### 2.1.15 *Making capacity*

See IEC Publication 158-1.

### 2.1.16 *Recovery voltage*

See IEC Publication 158-1.

#### 2.1.16.1 *Transient recovery voltage*

See IEC Publication 158-1.

#### 2.1.16.2 *Power-frequency recovery voltage*

See IEC Publication 158-1.

### 2.1.17 *Short-time withstand current*

The current that a semiconductor contactor can carry in the on-state during a specified short-time under prescribed conditions of use and behaviour.

### 2.1.18 *Over-current*

See IEC Publication 158-1.

### 2.1.19 *Overload*

See IEC Publication 158-1.

### 2.1.20 *Conductive part*

See IEC Publication 158-1.

### 2.1.21 *Clearance*

See IEC Publication 158-1.

#### 2.1.21.1 *Clearance between poles*

See IEC Publication 158-1.

#### 2.1.21.2 *Clearance to earth*

See IEC Publication 158-1.

#### 2.1.21.3 (Vacant)

### 2.1.22 *Creepage distance*

See IEC Publication 158-1.

ITEH STANDARD PREVIEW  
(standards.iteh.ai)

SIST HD 419.2 S1:1998

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

### 2.1.23 *Exposed conductive part*

A conductive part which can be touched readily and which normally is not live, but which may become live under fault conditions.

*Note.* — Typical exposed conductive parts are walls of enclosures, operating handles, etc.

### 2.1.24 *Ambient air temperature*

See IEC Publication 158-1.

### 2.1.25 *Maximum on-state current for one-half a cycle*

The peak value of the current which a semiconductor contactor can carry in the on-state for half a cycle of the supply voltage without losing its ability to perform as intended.

### 2.1.26 *Off-state leakage current $I_L$*

The maximum current which flows through the main circuit of a semiconductor contactor in the off-state.

### 2.1.27 *Minimum load current*

The minimum operational current in the main circuit which is necessary for correct action of a semiconductor contactor in the on-state.

*Note.* — The minimum load current should be given as r.m.s. value.

iTech STANDARD PREVIEW  
(standards.iteh.ai)

## 2.2 *Definitions concerning states, control and auxiliary circuits of a semiconductor contactor*

### 2.2.1 *Inactive state*

SIST HD 419.2 S1:1998

The condition of a semiconductor contactor without any control signal.

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

### 2.2.2 *Control circuit (of a semiconductor contactor)*

All the conductive parts (conductors, resistors, capacitors, coils, diodes, etc.) of a semiconductor contactor intended to be included in a circuit (other than the main circuit) used to initiate the making and breaking operation of the semiconductor contactor.

### 2.2.3 (Vacant)

### 2.2.4 *Auxiliary circuit*

All the conductive parts (conductors, resistors, capacitors, contacts, diodes, etc.) of a semiconductor contactor intended to be included in a circuit other than the main circuit and the control circuits of the semiconductor contactor.

*Note.* — Some auxiliary circuits serve supplementary requirements such as signalling, interlocking, cooling, etc. and, as such, they may be part of the control circuit of another switching device.

### 2.2.5 *Auxiliary contact*

A contact included in an auxiliary circuit of a semiconductor contactor and operated by the contactor.

158-2 © IEC 1982

— 17 —

2.2.6 (Vacant)

2.2.7 (Vacant)

2.2.8 *ON-state*

The condition of a semiconductor contactor when the conduction current can flow through its main circuit.

2.2.9 *OFF-state*

The condition of a semiconductor contactor when no control signal is applied and no current exceeding the OFF-state leakage current  $I_L$  flows through the main circuit.

*Note.* — Semiconductor contactors may not provide in the OFF-state a contact gap in the main circuit. Therefore, the main circuit on the load side shall be considered to be live.

2.2.10 *Operation (of a semiconductor contactor)*

The transition from the ON-state to the OFF-state or the reverse.

2.2.11 *Operating cycle (of a semiconductor contactor)*

A succession of operations from one state to the other and back to the first state.

*Note.* — A succession of operations not forming an operating cycle is referred to as an operating series.

## iTeh STANDARD PREVIEW (standards.iteh.ai)

2.2.12 *Making operation*

An operation by which the semiconductor contactor is brought from the OFF-state to the ON-state.

[SIST HD 419.2 S1:1998](https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998)

<https://standards.iteh.ai/catalog/standards/sist/ad484f7b-34e9-40f7-922c-e467a56686ab/sist-hd-419-2-s1-1998>

2.2.13 *Breaking operation*

An operation by which the semiconductor contactor is brought from the ON-state to the OFF-state.

### 3. Classification

3.1 (Vacant)

3.2 According to the cooling system, semiconductor contactors can be divided into different groups, for example natural cooling, forced air cooling, liquid cooling. The cooling system is considered as a part of the device.

3.3 According to the degree of protection provided by the enclosure. Full details are given in IEC Publication 144: Degrees of Protection of Enclosures for Low-voltage Switchgear and Controlgear.

### 4. Characteristics of semiconductor contactors

4.1 *Summary of characteristics*

See IEC Publication 158-1.