

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Solid-state relays – Safety requirements

Relais statiques – Exigences de sécurité



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, 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'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Solid-state relays – Safety requirements

Relais statiques – Exigences de sécurité

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.70

ISBN 978-2-8322-1245-5

Warning! Make sure that you obtained this publication from an authorized distributor. Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.
--

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	8
3 Terms and definitions	10
3.1 Terms and definitions related to relays	10
3.2 Terms and definitions related to insulation coordination (see Clause 11)	14
4 Characteristics of solid-state relays	16
5 Rated values	17
5.1 Rated and limiting values for output circuits and for insulation coordination	17
5.2 Load category	17
5.3 Rated and limiting values for control circuits	18
5.4 Overload current profile	19
5.5 Normal service, transport and storage conditions	19
5.5.1 Ambient temperature	19
5.5.2 Atmospheric conditions	19
5.6 Normal mounting conditions	19
6 Provisions for test	19
6.1 Type test	19
6.2 Routine test	20
7 Documentation and marking	21
7.1 Data	21
7.2 Instructions for installation, operation and maintenance	22
7.3 Marking	22
8 Temperature-rise	22
8.1 General	22
8.2 Test conditions	23
9 Basic operating function	23
9.1 OFF-state leakage current measurement	23
9.2 ON-state voltage drop measurement	23
10 Electrical endurance	23
10.1 Overload test	23
10.1.1 General	23
10.1.2 Overload capability test procedure	25
10.2 Endurance test	25
10.3 Verification	25
11 Clearances and creepage distances	27
11.1 General	27
11.2 Basis for insulation coordination	27
11.2.1 Basic principles	27
11.2.2 Rated impulse withstand voltage	27
11.2.3 Insulating materials	27
11.3 Requirements and dimensioning rules	28
11.3.1 Dimensioning of clearances	28
11.3.2 Dimensioning of creepage distances	29
11.3.3 Requirements for solid insulating materials	31
11.4 Tests and measurements	31

11.4.1	Tests	31
11.4.2	Measurement of creepage distances and clearances	31
11.4.3	Electrical tests for solid insulation	31
11.5	Alternative test methods	32
12	Terminations	32
12.1	Quick-connect terminations	32
12.1.1	Purpose	32
12.1.2	Recommended values	33
12.1.3	Requirements	33
12.2	Screw-type and screwless-type clamping-units	34
12.3	Solder terminals – Resistance to soldering heat	34
12.3.1	General	34
12.3.2	Solder pins	34
12.3.3	Terminals for surface mounting (SMD)	35
12.3.4	Other solder terminations (e.g. soldering lugs)	35
12.4	Sockets	35
13	Heat and fire resistance	35
13.1	Materials	35
13.2	Glow-wire test	36
13.3	Ball pressure test	36
14	Electromagnetic compatibility (EMC)	37
14.1	General	37
14.2	Immunity	37
14.3	Emission	37
Annex A	(normative) Test for solid-state relays intended for self ballasted lamp loads	38
Annex B	(informative) Risk assessment	41
B.1	General	41
B.2	Risk assessment procedure	41
B.3	Achieving tolerable risk	42
B.4	An application of risk assessment procedures (proposal for the user)	44
Annex C	(normative) Pollution degree	46
Annex D	(normative) Rated impulse withstand voltages	47
Annex E	(normative) Tests for EMC	48
E.1	General	48
E.2	EMC immunity	48
E.2.1	General	48
E.2.2	Electrostatic discharges	49
E.2.3	Radiated radio-frequency electromagnetic fields	49
E.2.4	Electrical fast transients/bursts	49
E.2.5	Surges	49
E.2.6	Conducted disturbances induced by radio-frequency fields	49
E.2.7	Immunity to power-frequency magnetic fields	49
E.2.8	Voltage dips and voltage interruptions	49
E.2.9	Summary of immunity test conditions	49
E.3	EMC radiated and conducted emission	52
E.3.1	General	52
E.3.2	Conducted radio-frequency emission tests	52
E.3.3	Radiated radio-frequency emission tests	52

Bibliography.....	53
Figure A.1 – Circuit diagram for testing solid-state relay	38
Figure B.1 – Iterative process of risk assessment and risk reduction.....	41
Figure B.2 – Risk reduction.....	43
Table 1 – Load categories.....	18
Table 2 – Type testing	20
Table 3 – Routine tests	21
Table 4 – Required data	21
Table 5 – Minimum requirements for overload capability test conditions.....	24
Table 6 – Endurance test	26
Table 7 – Minimum clearance	29
Table 8 – Minimum creepage distances for solid-state relays.....	30
Table 9 – Preconditioning	32
Table 10 – Cross-sectional areas for conductors depending on the resistive current carried by the terminal	34
Table 11 – Test conditions for test Tb	35
Table A.1 – Values for I_{peak} and I^2t depending on the type of distribution system	39
Table A.2 – Calculated circuit parameters	39
Table A.3 – Number of operations for endurance test	40
Table B.1 – Examples for the relation between failure mode, effects and hazard	44
Table B.2 – Severity of harm.....	44
Table B.3 – Probability of harm.....	45
Table B.4 – Risk category	45
Table D.1 – Rated impulse withstand voltages (waveform: 1,2/50 µs) for solid-state relays connected directly to the mains	47
Table E.1 – Selection criteria for environmental conditions	48
Table E.2 – Specific performance criteria when electro-magnetic disturbances are present	49
Table E.3 – Immunity tests for industrial environments	50
Table E.4 – Immunity tests for residential, commercial and light-industrial environments	51
Table E.5 – Terminal disturbance voltage limits for conducted radio-frequency emission (for control supply input)	52
Table E.6 – Radiated emission test limits.....	52

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SOLID-STATE RELAYS – SAFETY REQUIREMENTS**FOREWORD**

- 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.
- 2) The formal decisions or agreements of 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 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.

IEC 62314 has been prepared by IEC technical committee 94: All-or-nothing electrical relays. It is an International Standard.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

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

- a) addition of load categories for DC load;
- b) addition of load category for self-ballasted lamp load;
- c) addition of "sockets" terminal;
- d) update of references;
- e) introduction of the requirement of EMC;
- f) restructuring of the whole document.

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

Draft	Report on voting
94/670/FDIS	94/701/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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.