

INTERNATIONAL STANDARD

**Electrical installations in ships –
Part 304: Equipment – Semiconductor converters**





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.

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 It also gives information on projects, replaced and withdrawn publications.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.



IEC 60092-304

Edition 4.0 2022-08

INTERNATIONAL STANDARD

**Electrical installations in ships –
Part 304: Equipment – Semiconductor converters**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 47.020.60

ISBN 978-2-8322-4030-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	7
4 General requirement.....	8
5 Service conditions	9
5.1 Voltage and frequency	9
5.2 Inclination	9
5.3 Vibration	9
5.4 Ambient temperature.....	9
5.5 Pollution	9
6 Effects from and on the supply or load system.....	9
6.1 Supply- or load side disturbance	9
6.2 Converter-internal fault or disturbance	9
6.3 EMC requirements	9
6.4 Insulation monitoring.....	9
7 Converters for essential services construction and documentation requirements	10
7.1 Cooling arrangements for essential services	10
7.1.1 General	10
7.1.2 Cooling arrangements for secondary essential services.....	10
7.1.3 Cooling arrangements for primary essential services	10
7.2 Alarm and monitoring.....	10
7.3 Low voltage converter.....	10
7.4 High-voltage converter.....	10
7.5 Documentation requirements	11
7.6 Marking.....	11
8 Application	11
8.1 Parallel operation of converters	11
8.2 Accessibility.....	11
8.3 Bypass circuits.....	11
8.4 Means of control	11
8.5 Selectivity or discrimination.....	11
8.6 Converter transformers	11
8.7 Harmonic filters.....	12
8.8 Uninterruptible power supplies	12
8.9 Soft-starters	12
9 Tests	12
Bibliography.....	13

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS IN SHIPS –**Part 304: Equipment – Semiconductor converters**

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 60092-304 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 1980 and Amendment 1:1995. This edition constitutes a technical revision.

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

- a) scope limited to converters greater than 1 kW;
- b) terms and definitions: essential services added;
- c) deleted selenium rectifier;
- d) changed service conditions to 6. Effects from and on supply system new text added with parts from Clause 7 of IEC 60092-304:1980;
- e) Clause 7: application changed to converters for essential services construction and documentation new text added;

- f) Clause 8: application added;
- g) Clause 9: test added;

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

Draft	Report on voting
18/1780/FDIS	18/1782/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/standardsdev/publications.

A list of all parts in the IEC 60092 series, published under the general title *Electrical installations in ships*, can be found on the IEC website.

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.

INTRODUCTION

IEC 60092 (all parts) forms a series of International Standards for electrical installations in sea-going ships, incorporating good practice and co-ordinating, as far as possible, existing rules.

These standards form a code of practical interpretation and amplification of the requirements of the International Convention on Safety of Life at Sea, a guide for future regulations which may be prepared and a statement of practice for use by shipowners, shipbuilders and appropriate organizations.

ELECTRICAL INSTALLATIONS IN SHIPS –

Part 304: Equipment – Semiconductor converters

1 Scope

This part of IEC 60092 specifies special provisions to power electronic converters and systems, using semiconductor elements for use in ships. The conversion may be from AC to DC, from DC to AC, from DC to DC or from AC to AC with a rated output power greater than 1 kW.

This document does not apply to semiconductor converters used in electrical propulsion plant. For semiconductor converters used in electrical propulsion plant, see IEC 60092-501.

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 60092-101:2018, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60092-202, *Electrical installations in ships – Part 202: System design – Protection*

IEC 60092-504:2016, *Electrical installations in ships – Part 504: Automation, control and instrumentation*

IEC 60146-1 (all parts), *Semiconductor converters – General requirements and line commutated converters*

IEC 60146-1-1, *Semiconductor converters – General requirements and line commutated converters – Part 1-1: Specification of basic requirements*

IEC TR 60146-1-2, *Semiconductor converters – General requirements and line commutated converters – Part 1-2: Application guidelines*

IEC 60146-1-3, *Semiconductor converters – General requirements and line commutated converters – Part 1-3: transformers and reactors*

IEC 60146-2, *Semiconductor converters – Part 2: Self-commutated converters including direct d.c. converters*

IEC 60533, *Electrical and electronic installations in ships – Electromagnetic compatibility (EMC) – Ships with a metallic hull*

IEC 60947-4-2, *Low-voltage switchgear and controlgear – Part 4-2: Contactors and motor-starters – Semiconductor motor controllers, starters and soft-starters*

IEC 61204 (all parts), *Low voltage switch mode power supplies*

IEC 61378-1, *Converter transformers – Part 1: Transformers for industrial applications*