

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Low-voltage switchgear and controlgear –
Part 6-1: Multiple function equipment – Transfer switching equipment**

**Appareillage à basse tension –
Partie 6-1: Matériels à fonctions multiples – Equipement de transfert de source**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2021 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 Central Office
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 It also gives information on projects, replaced and withdrawn publications.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 online collection - oc.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 22 000 terminological entries in English and French, with equivalent terms in 18 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 online collection - oc.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 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Low-voltage switchgear and controlgear –
Part 6-1: Multiple function equipment – Transfer switching equipment**

**Appareillage à basse tension –
Partie 6-1: Matériels à fonctions multiples – Equipement de transfert de source**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 29.120.40; 29.130.20

ISBN 978-2-8322-9448-2

**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
INTRODUCTION	7
1 Scope	8
2 Normative references	9
3 Terms and definitions	9
3.1 General	9
3.2 Alphabetical index of terms	10
3.3 Transfer switching devices	10
3.4 Operation of TSE	12
3.5 Main contact positions	13
3.6 Symbols and abbreviated terms	14
4 Classification	14
5 Characteristics	15
5.1 Summary of characteristics	15
5.2 Type and characteristics of equipment	15
5.3 Rated and limiting values for the main circuit	16
5.3.1 General	16
5.3.2 Rated voltages	16
5.3.3 Rated operational current (I_e)	16
5.3.4 Rated frequency	16
5.3.5 Rated making and breaking capacities	16
5.3.6 Short-circuit characteristics	17
5.4 Utilization category	17
5.5 Control circuits	18
5.5.1 General	18
5.5.2 Electro-mechanical devices operating the main circuit	18
5.5.3 ATS controller	18
5.6 Auxiliary circuits	18
6 Product information	18
6.1 Nature of information	18
6.2 Marking	18
6.3 Instructions for installation, operation and maintenance, decommissioning and dismantling	20
6.4 Environmental information	21
7 Normal service, mounting and transport conditions	22
8 Constructional and performance requirements	22
8.1 Constructional requirements	22
8.1.1 General	22
8.1.2 Materials	22
8.1.3 Indication of the switching position	23
8.1.4 Equipment suitable for isolation	23
8.1.5 Opening and closing of main contacts	23
8.1.6 Clearances and creepage distances	23
8.1.7 Provision for protective earthing	23
8.1.8 Stored charge energy circuit	23

8.1.9	Stored energy closing	24
8.1.10	Dedicated enclosures for TSE	24
8.2	Performance requirements	24
8.2.1	Operating conditions	24
8.2.2	Temperature-rise	25
8.2.3	Dielectric properties	25
8.2.4	Ability to make, carry, and break under no-load, normal load and overload conditions	25
8.2.5	Ability to make and break under short-circuit conditions	27
8.2.6	Critical load current performance (DC equipment)	29
8.3	Electromagnetic compatibility (EMC)	29
8.3.1	General	29
8.3.2	Immunity	29
8.3.3	Emission	30
9	Tests	30
9.1	Kinds of tests	30
9.2	Type tests	30
9.2.1	General test conditions	30
9.2.2	Test sequences	30
9.2.3	Test sequence I – General performance characteristics	33
9.2.4	Test sequence II – Operational performance capability	39
9.2.5	Test sequence III – Short-circuit performance capability	44
9.2.6	Test sequence IV – Conditional short-circuit current	47
9.2.7	Test sequence V – critical load current performance of equipment with a DC rating	48
9.2.8	Test sequence VI – EMC tests	51
9.3	Routine tests	53
9.4	Environmental tests	55
Annex A (normative)	Assignment of utilization categories based on results of tests	57
Annex B (informative)	Items subject to agreement between manufacturer and user	58
Bibliography	59
Figure 1	– Example of operating sequences for TSE with three positions	21
Figure 2	– Test circuit for connection to source I and source II supplies	54
Figure 3	– Test circuit for the verification of making and breaking capacities	55
Table 1	– Utilization categories	18
Table 2	– Product information	19
Table 3	– Verification of making and breaking capacity – Conditions for making and breaking corresponding to the utilization categories	26
Table 4	– Verification of operational performance – Conditions for making and breaking corresponding to the utilization categories	27
Table 5	– Value of the test current for the verification of the ability to operate under short-circuit conditions	28
Table 6	– Value of the test current for the verification of the ability to operate under short-circuit conditions (harmonized table)	29
Table 7	– Acceptance criteria of immunity test	30
Table 8	– List of type tests (overall scheme of test sequences)	31

Table 9 – List of type tests to which a derived TSE shall be submitted	32
Table 10 – Number and duration of operating cycles for the making and breaking capacity test	41
Table 11 – Number and rate of operating cycles for the electrical and mechanical operational performance tests for type A utilization categories	42
Table 12 – Number and rate of operating cycles for the electrical and mechanical operational performance tests for type B utilization categories	42
Table 13 – Temperature-rise limits for terminals and accessible parts.....	43
Table 14 – Number of operating cycles corresponding to the critical load current.....	50
Table 15 – Test circuit parameters for Table 14	50
Table 16 – Test sequence V: Critical load current performance of equipment with a DC rating	51

INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –**Part 6-1: Multiple function equipment –
Transfer switching equipment**

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.

International Standard IEC 60947-6-1 has been prepared by sub-committee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

This third edition cancels and replaces the second edition published in 2005, and its Amendment 1:2013. This edition constitutes a technical revision.

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

- clarification of scope and object;
- clarification of terms and definitions;
- removal of unnecessary definitions;
- modification of characteristics;

- modification of utilization categories definitions;
- introduction of new markings requirements;
- addition of new requirements for clearances and creepage distances;
- addition of new requirements and tests for mechanical and electrical interlocks;
- clarification of transfer sequences;
- modification of requirements for rated short-time withstand currents;
- modification of new requirements for electromagnetic compatibility;
- clarification of performance requirements for CB type TSE, in alignment with requirements stated in IEC 60947-2;
- addition of new test sequence V: Critical load current performance of equipment with DC ratings.

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

FDIS	Report on voting
121A/403/FDIS	121A/411/RVD

Full information on the voting for the approval of this document 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 the parts in the IEC 60947 series, published under the general title *Low-voltage switchgear and controlgear*, can be found on the IEC website.

This document shall be read in conjunction with IEC 60947-1:2020, *Low voltage switchgear and controlgear – Part 1: General rules*.

The provisions of the general rules are applicable to IEC 60947-1 where specifically called for. General rules clauses and subclauses thus applicable as well as tables, figures and appendices are identified by reference to IEC 60947-1:2020, for example, 1.2.3, Table 4, or Annex A of IEC 60947-1:2020. The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The availability of power in low voltage electrical installations is playing an ever increasing role in modern society. In actual fact, this requirement is a fundamental characteristic for the creation of economically and functionally efficient installations. A system able to switch a load from one source to another safely and with minimum disturbance to the load reduces problems caused by faulty conditions in the normal supply to the minimum.

All these operations, commonly known as “transfer switching”, control the installations and can be done automatically, remotely or manually.

Therefore, an installation with installed “transfer switching” capability:

- ensures the continuity of production processes;
- provides a backup source of power if the main network is out of service;
- reduces the effect caused by network faults on parts of the installation;
- achieves a good compromise between reliability, simplicity and cost-effectiveness;
- provides the facility manager and managing system with a power source able to supply all or part of the installation.

Key factors motivating customers to use Transfer Switch Equipment (TSE) include:

- the continuous world growth population, the increasing number of electronic devices and the new demands of electric vehicles;
- the mediated pressure on climate change with a resulting increase in the cost of energy;
- the evolution of the electricity market with a greater number of alternate energy sources;
- the user’s expectations of better grid reliability, better economic performance, and a desire to manage their energy.

Stakeholders involved in the management of electricity also have new expectations:

- customers want to reduce the cost of their energy and to have a quality energy supply;
- suppliers want to reinforce confidence to their customers;
- producers expect to optimize their investments;
- governments and regulators are willing to create a competitive and sustainable energy market.

Today, the performance of Transfer Switching Equipment is defined by TSE manufacturers and also by this document. Consultants, integrators, facility managers and end users rely on this document for their power availability needs.

Transfer switching are often realised by implementing a transfer function within the electrical installation, but this critical function can be inappropriately designed. Using a TSE following the requirements of this document ensures the safety and the performance of the transfer function which are necessary for reaching the objectives listed above.

LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

Part 6-1: Multiple function equipment – Transfer switching equipment

1 Scope

This document applies to transfer switching equipment (TSE), to be used in power systems for ensuring the continuity of the supply and allowing the energy management of the installation, by transferring a load between power supply sources, the rated voltage of which does not exceed 1 000 V AC or 1 500 V DC.

It covers:

- manually operated transfer switching equipment (MTSE);
- remotely operated transfer switching equipment (RTSE);
- automatic transfer switching equipment (ATSE), including the controller.

It does not cover:

- 1) TSE configurations that are either not manufacturer tested and/or not marked according to this document as a complete transfer switch;
- 2) auxiliary contacts (for guidance, see IEC 60947-5-1);
- 3) transfer switches used in explosive atmospheres (for guidance, see IEC 60079 (all parts));
- 4) embedded software design (for guidance, see IEC TR 63201);
- 5) cybersecurity aspects (for guidance, see IEC TS 63208);
- 6) TSE rated for direct-on-line starting asynchronous motor of design NE and HE, according to IEC 60034-12:2016 (for guidance, see AC-3e utilisation category according IEC 60947-4-1:2018);
- 7) other types of TSE under consideration including closed transition TSE, overlapping neutral TSE, multi-source TSE (i.e. TSE with more than two sources of supply), stand-alone ATS controllers, bypass isolation TSE, TSE with load-shedding functions and bus-tie TSE.

NOTE TSE used for safety services and for emergency escape lighting systems as described in IEC 60364-5-56 are subject to specific rules and/or legal requirements.

The object of this document is to state:

- 1) the characteristics of the equipment;
- 2) the conditions of the equipment with respect to:
 - a) operation for which the equipment is intended;
 - b) operation and behaviour in case of specified abnormal conditions, for example, short-circuit;
 - c) dielectric properties;
- 3) the tests intended to confirm that these conditions have been met and the methods for performing these tests;
- 4) the product information to be provided by the manufacturer.