IEC 60947-6-1

Edition 3.0 2021-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

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

IEC 60947-6-1:2021-03(en-fr)

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LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

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

FOREWORD

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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.

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 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC 60715:2017, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of switchgear, controlgear and accessories*

IEC 60812, *Failure modes and effects analysis (FMEA and FMECA)*

IEC 60947 (all parts), *Low-voltage switchgear and controlgear*

IEC 60947-1:2020, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:2016, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*
IEC 60947-2:2016/AMD1:2019

IEC 60947-3:2020, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

IEC 60947-4-1:2018, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*

IEC 61000-4-13:2002, *Electromagnetic compatibility (EMC) – Part 4-13: Testing and measurement techniques – Harmonics and interharmonics including mains signalling at a.c. power port, low frequency immunity tests*
IEC 61000-4-13:2002/AMD1:2009
IEC 61000-4-13:2002/AMD2:2015

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

3 Terms and definitions

3.1 General

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60947-1:2020, and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at http://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

3.2 Alphabetical index of terms

3.3 Transfer switching devices

3.3.1
transfer switching equipment
TSE
equipment containing one or more switching devices and associated operating mechanism for disconnecting load circuits from one supply and connecting to another supply

3.3.2
manually operated transfer switching equipment
MTSE
transfer switching equipment operated manually and non-electrically

3.3.3
remotely operated transfer switching equipment
RTSE
transfer switching equipment that is electrically operated and not self-acting

Note 1 to entry: RTSE can have a feature for local and/or manual operation.

3.3.4
automatic transfer switching equipment
ATSE
self-acting transfer switching equipment, including all necessary sensing inputs, monitoring, and control logic for transferring operations

Note 1 to entry: ATSE can have a feature for local and/or remote and/or manual operation.

3.3.5
derived transfer switching equipment
derived TSE
TSE based on switching devices that have certain tests required for compliance with IEC 60947-6-1 as defined in Table 9, covered by IEC 60947-3 for Class PC, IEC 60947-2 or IEC 60947-6-2 for Class CB, or IEC 60947-4-1 for Class CC

Note 1 to entry: It is not necessary to repeat tests fully covered in the switching devices product standards.

3.3.6
Class PC TSE
transfer switch equipment based on mechanical switching devices, that do not need electrical power to hold the main contacts open or closed and capable of making, carrying, and breaking currents under normal circuit conditions including operating overload conditions, and making and withstanding short-circuit currents

Note 1 to entry: For the purposes of this document, a fuse-combination unit is considered a Class PC device capable of breaking short-circuit current.

Note 2 to entry: Class PC TSE are also capable of withstanding conditional short-circuit currents.

3.3.7
Class CB TSE
transfer switch equipment based on mechanical switching devices and capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions, and making and breaking short-circuit currents

Note 1 to entry: Class CB TSE for which the manufacturer has assigned a short-time withstand current are also capable of withstanding short-circuit currents.

3.3.8
Class CC TSE
transfer switch equipment based on mechanical switching devices having only one position of rest, operating otherwise than by hand, and capable of making, carrying and breaking currents under normal circuit conditions including operating overload conditions

Note 1 to entry: Class CC TSE are not capable of making or breaking short-circuit currents. They are only capable of withstanding conditional short-circuit currents.

Note 2 to entry: Class CC TSE is not suitable for isolation.

3.3.9
ATS controller
device intended for sensing and monitoring the power supply sources, and controlling the automatic transfer sequence

Note 1 to entry: ATS controller can be either integral to the ATSE or stand-alone to be associated with an RTSE.

3.3.10
dedicated wiring accessory
prefabricated connection wiring system specifically intended for identified switchgear or controlgear

Note 1 to entry: A dedicated wiring accessory can be integrated in the switchgear or controlgear or delivered separately.

Note 2 to entry: A typical dedicated wiring accessory is for example a connection link.

3.4 Operation of TSE

3.4.1
operating sequence
automatic transfer of a load from one supply to another in the event of a monitored supply deviation and/or other predefined conditions

Note 1 to entry: This definition applies only for ATSE.

3.4.2
monitored supply deviation
variation in the measured power supply characteristics that exceeds predetermined limits

EXAMPLE Abnormal changes in voltage or frequency of the supply are supply deviations.

Note 1 to entry: This definition applies only for ATSE.

3.4.3
voltage supply deviation
change in voltage level from the nominal voltage of the monitored supply

3.4.4
frequency supply deviation
change in frequency from the nominal operating frequency of the monitored supply

3.4.5
contact transfer time
time measured from the mechanical opening of all poles from one set of main contacts of one power supply to the mechanical closing of any pole of a second set of main contacts on another power supply, with any adjustable time-delay set to the minimum value

Note 1 to entry: Contact transfer time does not apply to three-position MTSE.

3.4.6
operating transfer time
time measured from the instant when the transfer conditions are fulfilled to the closing of the main contacts on the other source, with any adjustable time delay set to the minimum value, transfer condition being typically supply deviations and programmed conditions for ATSE or remote control commands for RTSE

Note 1 to entry: Operating transfer times from source I to source II and from source II to source I can be different, and can vary depending on the monitored supply deviation.

Note 2 to entry: Operating transfer time does not apply to MTSE.

3.4.7
open transition
a break before make transfer operation that intentionally breaks the load current from one source for a period of time prior to making it to the other source

3.4.8
in-phase transfer
control function of an ATSE to only allow an open transition transfer when the two sources are considered in phase, at the same voltage and frequency

3.4.9
closed transition
a make before break transfer operation that intentionally makes the load current of a second synchronized source for a short period of time before breaking it from the first source

3.4.10
interlocking
<TSE> feature(s) that make(s) the state of two mechanisms mutually exclusive, preventing any of the phases of source I and source II from being connected together

Note 1 to entry: Interlocking prevents the closed position of switching devices to be simultaneously achieved under all conditions. The state of two mechanisms mutually dependent prevents the change of position of operation of one mechanism depending on the position of operation of the other.

3.5 Main contact positions

3.5.1
switching position
position of the main contacts defining whether the load terminals are connected to source I or source II terminals, or not connected

3.5.2
position I
contact position of the equipment when the load terminals are connected to source I terminals

3.5.3
position II
contact position of the equipment when the load terminals are connected to source II terminals

3.5.4
OFF position
stable contact position of rest of the equipment when the load terminals are connected to neither source I nor source II terminals

Note 1 to entry: The OFF position may also be marked as the O position.