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

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60947-6-1:2021. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2021. This edition constitutes a technical revision.

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

– clarification of scope;
– clarification of terms and definitions;
– Annex C for Bypass/Isolation Transfer Switch Equipment;
– Annex D for ATSE having closed transition capability;
– Annex E for Stand-alone ATS controller;
– Annex F for TSE used with electric driven fire pump control equipment.

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

Draft	Report on voting
121A/711/FDIS	121A/719/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.

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 is to 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 60947-6-1 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 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, or
– revised.

INTRODUCTION

The availability of power in low voltage electrical installations is playing an ever increasing role in modern society. In 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 is often realised by implementing a transfer function within the electrical installation, and this critical function ~~can~~ needs to be ~~inappropriately~~ appropriately designed. Using a TSE following the requirements of this document ensure the safety and the performance of the transfer function which are necessary for reaching the objectives listed above.

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.

Specific requirements for bypass/isolation transfer switch equipment are given in Annex C, ATSE having closed transition capability are given in Annex D, stand-alone ATS controllers are given in Annex E, and TSE for electric driven fire pump controllers are given in Annex F.

It covers:

– manually operated transfer switching equipment (MTSE);
– remotely operated transfer switching equipment (RTSE);
– automatic transfer switching equipment (ATSE), including the controller;
– stand-alone ATS controllers;
– bypass/isolation transfer switch equipment (BTSE);
– ATSE having closed transition capability;
– fire pump TSE.

It does not cover:

– TSE configurations that are ~~either~~ not fully manufacturer type tested ~~and/~~or ~~not~~ marked according to this document as a complete transfer switch;
– auxiliary contacts (for guidance, see IEC 60947-5-1);
– transfer switches used in explosive atmospheres (for guidance, see IEC 60079 (all parts));
– embedded software design (for guidance, see IEC TR 63201);
– cybersecurity aspects (for guidance, see IEC ~~TS~~ 63208);
– 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 to IEC 60947-4-1~~:2018~~);
– 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, bus-tie TSE, and hybrid TSE;
– static transfer switches covered by IEC 62310 series.

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:

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

d) 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 60417:2025, *Graphical symbols for use on equipment* ~~- (available at http://www.graphical-symbols.info/equipment)~~ *12-month subscription to regularly updated online database comprising all graphical symbols published in IEC 60417*

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

IEC 60812:2018, *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~~2024, *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~~2023, *Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

IEC 60947-5-1:2024, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices*

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

IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies - Part 1: General rules*

IEC 61439-2:2020, *Low-voltage switchgear and controlgear assemblies - Part 2: Power switchgear and controlgear assemblies*

IEC 61557-12:2018, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC - Equipment for testing, measuring or monitoring of protective measures - Part 12: Power metering and monitoring devices (PMD)*
IEC 61557-12:2018/AMD1:2021

IEC 61812-1:2023, *Time relays and coupling relays for industrial and residential use - Part 1: Requirements and tests*

Bibliography

CSA-C22.2 No. 60947-4-1-14:14 (R2019), *Low-voltage switchgear and controlgear - Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters*

IEC 60034-12:~~2016~~2024, *Rotating electrical machines - Part 12: Starting performance of single-speed three-phase cage induction motors*

IEC 60079 (all parts), *Explosive atmospheres - Part 0: Equipment - General requirements*

~~IEC 60364-1:2005, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*~~

IEC 60364-5-56:2018, *Low-voltage electrical installations - Part 5-56: Selection and erection of electrical equipment - Safety services*

~~IEC 60947-5-1, *Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices*~~

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

IEC 60947-6-2:~~—[10]~~2020, *Low-voltage switchgear and controlgear - Part 6-2: Multiple function equipment - Control and protective switching devices (or equipment) (CPS)*

IEC 61010-2-201:2024, *Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 62091:2007, *Low-voltage switchgear and controlgear - Controllers for drivers of stationary fire pumps*

IEC 62310 (all parts), *Static transfer systems (STS)*

IEC 62443 (all parts), *Industrial communication networks - Network and system security*

IEC TR 63054:2017, *Low-voltage switchgear and controlgear - Fire risk analysis and risk reduction measures*

~~IEC TS 63058:— [11], *Environmental aspects for low-voltage switchgear and controlgear and their assemblies*~~

IEC TR 63201:2019, *Low-voltage switchgear and controlgear - Guidance for the development of embedded software*

IEC 63058:2026, *Switchgear and controlgear and their assemblies for low voltage - Environmental aspects*

~~IEC TS 63208, *Low-voltage Switchgear and controlgear – Security aspects*~~

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~~[10] Under preparation. Stage at the time of publication: IEC PRVD 60947-6-2:2020~~

~~[11] Under preparation. Stage at the time of publication: IEC DECPUB 63058:2020.~~

~~CSA-C22.2 No.60947-4-1-14, *Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters*~~

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