

TECHNICAL REPORT



**Communication networks and systems for power utility automation –
Part 10-3: Functional testing of IEC 61850 systems**



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INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMUNICATION NETWORKS AND
SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 10-3: Functional testing of IEC 61850 systems

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IEC TR 61850-10-3, which is a Technical Report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
57/2199/DTR	57/2328/RVDTR

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 Technical Report is English.

A list of all parts in the IEC 61850 series, published under the general title *Communication networks and systems for power utility automation*, can be found on the IEC website.

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.

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INTRODUCTION

The growing success of the IEC 61850 series calls for guidelines for testing of substations implementing this standard. This Technical Report aims at producing a practical guide for protection, automation and control (PAC) engineers on best practise for testing of the latest amended IEC 61850 based devices and systems.

Since the release of the first edition of the IEC 61850 standard in 2002-2005 thousands of substations have been built making use of the new multi-part standard. Most of those systems are more integrated and complex than the previously deployed, making use of multi-function capable IEDs and the rich feature set of IEC 61850. Especially the sending and receiving of protection trips via GOOSE messaging control commands/indications, monitoring and time synchronisation information over the same shared equipment or network will need to drive changes to existing test methods and practices as many of the traditional test boundaries have changed.

Despite the large number of commissioned IEC 61850 substations, considerable uncertainty among end-users (system integrators and power utilities) regarding the correct testing procedures still exists. Devices implemented according to the first edition of the standard also utilized a limited part of the test related functionality in the standard. Much of the functionality included in IEC 61850 to allow efficient, functional oriented testing has been clarified and extended in the second edition of IEC 61850-6, IEC 61850-7-1 to IEC 61850-7-4, IEC 61850-8-1 and IEC 61850-9-2. Therefore, there is a need to help the industry by describing the methods and principles for testing the IEC 61850 based applications.

This Technical Report provides insight into the changing requirements and practice of testing following the introduction of IEC 61850 based devices and systems. One example is the disappearance of so-called 'hardwired' connections between substation automation devices. These connections are replaced by communication networks and this means that traditional simulation and isolation of signals for the purpose of testing is no longer possible.

COMMUNICATION NETWORKS AND SYSTEMS FOR POWER UTILITY AUTOMATION –

Part 10-3: Functional testing of IEC 61850 systems

1 Scope

This part of IEC 61850, which is a technical report, is applicable to testing of applications within substations. It is intended to give practical guidelines to perform the stages of quality assurance defined in IEC 61850-4:2011. However, while the quality assurance in that document begins with the IED manufacturer development stage and focuses on the role of the system integrator this document focuses on end-user requirement fulfilment.

The report may be useful to users applying IEC 61850 to other domains, however testing of IEC 61850 systems outside the substation domain is not within the scope of this document.

This document describes:

- A methodical approach to the verification and validation of a substation solution
- The use of IEC 61850 resources for testing in Edition 2.1
- Recommended testing practices for different use cases
- Definition of the process for testing of IEC 61850 based devices and systems using communications instead of hard wired system interfaces (ex. GOOSE and SV instead of hardwired interfaces)
- Use cases related to protection and control functions verification and testing

This document does not cover the conformance testing of devices according to IEC 61850-10 or methodologies for testing of abstract device independent functions.

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 61850-4:2011, *Communication networks and systems for power utility automation - Part 4: System and project management*

IEC 61850-6:2009, *Communication networks and systems for power utility automation - Part 6: Configuration description language for communication in electrical substations related to IEDs*
IEC 61850-6:2009/AMD1:2018
IEC 61850-6:2009/AMD1:2018

IEC 61850-7-1:2011, *Communication networks and systems for power utility automation - Part 7-1: Basic communication structure - Principles and models*
IEC 61850-7-1:2011/AMD1:2020

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation - Part 7-2: Basic information and communication structure - Abstract communication service interface (ACSI)*
IEC 61850-7-2:2010/AMD1:2020

IEC 61850-7-3:2010, *Communication networks and systems for power utility automation - Part 7-3: Basic communication structure - Common data classes*
IEC 61850-7-3:2010/AMD1:2020

IEC 61850-7-4:2010, *Communication networks and systems for power utility automation - Part 7-4: Basic communication structure - Compatible logical node classes and data object classes*
IEC 61850-7-4:2010/AMD1:2020

IEC 61850-8-1:2011, *Communication networks and systems for power utility automation - Part 8-1: Specific communication service mapping (SCSM) - Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*
IEC 61850-8-1:2011/AMD1:2020

IEC 61850-9-2:2011, *Communication networks and systems for power utility automation - Part 9-2: Specific communication service mapping (SCSM) - Sampled values over ISO/IEC 8802-3*
IEC 61850-9-2:2011/AMD1:2020

IEC 61850-10:2012, *Communication networks and systems for power utility automation - Part 10: Conformance testing*

IEC 81346-2, *Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes*

3 Terms, definitions, abbreviated terms and acronyms

3.1 Terms and definitions

3.1.1 Testing types

3.1.1.1

acceptance tests

tests which serve to verify if an IED or a scheme meets the customer requirements

Note 1 to entry: This could include a specific FAT if it is required by the customer.

3.1.1.2

commissioning tests

test on an item carried out on site, to prove that it is correctly installed and can operate correctly

Note 1 to entry: The commissioning phase is carried out on site (in the substation) when the installation phase is complete. These tests are performed to ensure the safe and reliable operation of the system with associated substation interfaces. The commissioning phase is a global operation which follows the installation and runs until the energization, load tests and adjustments are completed.

[SOURCE: IEC 60050-151:2001, 151-16-24]

3.1.1.3

conformance tests

first of the functional tests of the components of an integrated substation automation system (SAS)

Note 1 to entry: Every IED or Device Under Test (DUT) which belongs to the SAS, is tested. The conformance tests are performed to show that the IED are compliant to requirements relative to environment, data model, communication and functional standards. These tests can be performed by a vendor or by an independent authority who certify test results.