

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



High-voltage switchgear and controlgear –  
Part 3: Digital interfaces based on IEC 61850

Appareillage à haute tension –  
Partie 3: Interfaces numériques basées sur l'IEC 61850

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**HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –****Part 3: Digital interfaces based on IEC 61850**

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International Standard IEC 62271-3 has been prepared by subcommittee 17C: High-voltage switchgear and controlgear assemblies, of IEC technical committee 17: Switchgear and controlgear.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

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

- a) an update to the latest edition(s) of IEC 61850 series;  
(e.g. Annex B "LNs for sensors and monitoring" of edition 1 has been deleted since these LNs are now covered by standard IEC 61850-7-4:2010)
- b) an update of normative references;

- c) the minimum voltage range this standard refers to, was changed from 72,5 kV to above 1 kV;
- d) the description of performance tests and conformance tests became more specific;
- e) the new – informative – Annex C gives an example for performance type testing;
- f) 6.2.3 “transmission systems” as well as appropriate subclauses have been superseded by standard IEC TR 61850-90-4:2013;
- g) fibre optical connector type LC becomes only recommended type of fibre optic connector in accordance with IEC TR 61850-90-4:2013;
- h) electronic nameplates have been redefined as extension of LN XCBR and LN XSWI with data objects, reflecting required additional name plate information.

NOTE A new common data class Visible String Description (VSD) will be added to the IEC 61850-7-3 to support these new data objects.

This standard has the status of a product family standard and may be used as a normative reference in a dedicated product standard for highvoltage switchgear and controlgear.

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

FDIS	Report on voting
17C/617/FDIS	17C/623/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62271-3:2015

A list of all parts in the IEC 62271 series, published under the general title *High voltage switchgear and controlgear*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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## INTRODUCTION

### 0.1 General

This standard is a product family standard for high-voltage switchgear and controlgear and assemblies thereof. It provides an application of the horizontal standard series IEC 61850 which details layered power utility communication architecture, in the world of high-voltage switchgear and controlgear.

By providing tutorial material such as examples and explanations, it also gives an access for switchgear experts to concepts and methods applied in the IEC 61850 series.

Compared to switchgear equipment, digital communication technology is subject to ongoing changes which are expected to continue in the future. Profound experience with electronics integrated directly into switchgear has yet to be gathered on a broader basis, as this type of equipment is not widely spread in the industry and a change of metabolism has not yet occurred.

This situation is taken into account in this standard by setting an appropriate validity date and by specifying several options to most of the communication-related requirements, such as connectors or fibres.

### 0.2 Position of this standard in relation to the IEC 61850 series

The IEC 61850 series is a horizontal standard intended to be used for communication and systems in the power utility. The most important parts of this series define:

- 1) information models for the power utility automation system.  
These information models include both the models of the switchgear (like circuit-breakers and disconnectors) and other process equipment (like instrument transformers), and the models of the power utility automation system (like protection relays);
- 2) the communication between intelligent electronic devices (IEDs) of the power utility automation system;
- 3) a configuration language used to describe the configuration aspects of the power utility automation system;
- 4) conformance testing of the communication interfaces of the IEDs of the power utility automation system including their data models.

Typically, IEDs like bay level controllers interface to switchgear. In that case, the data models of the switchgear are implemented in these devices. However, this is not the only realization. In the case where electronics are integrated direct into switchgear, the above-mentioned data models should be implemented within the switchgear and the switchgear supports a communication interface.

IEC 61850, being a horizontal standard series, leaves many options open in order to support present and future requirements of all sizes of power utility automation system at all voltage levels.

# HIGH-VOLTAGE SWITCHGEAR AND CONTROLGEAR –

## Part 3: Digital interfaces based on IEC 61850

### 1 Scope

This part of IEC 62271 is applicable to high-voltage switchgear and controlgear for all rated voltage levels above 1 kV and assemblies thereof and specifies equipment for digital communication with other parts of the power utility automation and its impact on testing. This equipment for digital communication, replacing metal parallel wiring, can be integrated into the high-voltage switchgear, controlgear, and assemblies thereof, or can be external equipment in order to provide compliance for existing switchgear and controlgear and assemblies thereof with the standards of the IEC 61850 series.

This International Standard is a product standard based on the IEC 61850 series. It deals with all relevant aspects of switchgear and controlgear, and assemblies thereof with a serial communication interface according to the IEC 61850 series. In particular it defines:

- a) a selection of the information models from the IEC 61850 series that are supported by such switchgear and controlgear, and assemblies thereof;
- b) conformance classes for the set of communication services that are supported by the switchgear and controlgear, and assemblies thereof;
- c) modifications and extensions to type and routine tests of switchgear and controlgear, and assemblies thereof that are required due to the serial communication interface.

The standard specifies the requirements for digital communication equipment used within high-voltage switchgear, controlgear, and assemblies thereof, as well as the relevant testing requirements.

The relevant switchgear standards of the IEC 62271 series are applicable in general, with the additional specifications described in this standard.

NOTE 1 This standard intends to promote interoperability of communication interfaces. Interchangeability is outside the scope of this standard, as there is no requirement for it. Interchangeability is also outside the scope of the IEC 61850 series.

NOTE 2 For an introduction to power utility automation communication and the related terms, definitions and models, refer to IEC 61850-1 which provides an overview of the objectives and requirements of the IEC 61850 series in general. IEC 61850-7-1 provides an overview of modelling techniques.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60870-4:1990, *Telecontrol equipment and systems – Part 4: Performance requirements*

IEC 61850-3:2013, *Communication networks and systems for power utility automation – Part 3: General requirements*

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

IEC 61850-5:2013, *Communication networks and systems for power utility automation – Part 5: Communication requirements for functions and device models*

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

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 61850-8-1:2011, *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 61850-9-2:2011, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3*

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

IEC TR 61850-90-4:2013, *Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines*

IEC 62271-1:2007, *High-voltage switchgear and controlgear – Part 1: Common specifications*  
IEC 62271-1:2007/AMD1:2011

IEC 62271-100:2008, *High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers*

IEC 62271-100:2008/AMD1:2012

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

#### 3.1

##### **time requirement**

maximum acceptable time delay between source and sink

#### 3.2

##### **mandatory data**

data where coding is specified and the information always present

Note 1 to entry: Mandatory data ensures interoperability in power utility automation.

#### 3.3

##### **optional data**

data where the coding is specified but the information not necessarily present

#### 3.4

##### **data integrity**

ability of a communication system to deliver data from its originator to its destinations with an acceptable residual error rate

Note 1 to entry: In the case of switchgear with a digital interface, data integrity concerns the probability of undetected errors resulting in wrong information about actual process states in the monitoring direction or unintended actions in the control direction of the system.

### **3.5 interoperability**

ability of two or more IEDs from the same vendor, or from different vendors, to exchange information and use that information for correct execution of specified functions

[SOURCE: IEC TR 61850-1:2013, 3.1.8]

### **3.6 logical node LN**

smallest part of a function that exchanges data

Note 1 to entry: A logical node is an object defined by its data and methods.

[SOURCE: IEC TR 61850-1:2013, 3.1.9]

### **3.7 abstract communication service interface ACSI**

virtual interface to an IED providing abstract communication services, for example, connection, variable access, unsolicited data transfer, device control and file transfer services, independent of the actual communication stack and profiles used

[SOURCE: IEC TR 61850-1:2013, 3.1.11]

### **3.8 intelligent electronic device IED**

any device incorporating one or more processors with the capability to receive or send data/controls from or to an external source (for example, electronic multifunction meters, digital relays, controllers)

[SOURCE: IEC TR 61850-1:2013, 3.1.6]

### **3.9 protocol implementation conformance statements PICS**

summary of the capabilities of the system to be tested

Note 1 to entry: PICS contain information regarding the ACSI. This information could typically be optional parts, specific restrictions, or add-ons (see IEC 61850-7-2:2010).

[SOURCE: adapted from ISO/IEC 8823-2:1997]

### **3.10 model implementation conformance statement MICS**

statement which details the standard data object model elements supported by the system or device

[SOURCE: IEC 61850-10:2012, 3.4]

### **3.11 service**

functional capability of a resource which can be modelled by a sequence of service primitives

Note 1 to entry: A resource in the context of this standard is an IED. A service primitive is an abstract, implementation independent representation of an interaction between the service user and the service provider.

[SOURCE: IEC TS 61850-2:2003, 2.121, modified – addition of a new note to entry]

### **3.12 configuration (of a system or device)**

step in system design, for example, selecting functional units, assigning their locations and defining their interconnections

[SOURCE: IEC TS 61850-2:2003, 2.14]

### **3.13 data security**

ability to avoid placing the controlled system in a potentially dangerous or unstable situation by an undetected error

### **3.14 reliability**

measure of a system or equipment to perform its intended function under specified conditions for a specified period of time

Note 1 to entry: It is a probability figure, based on failure data and length of operating time.

[SOURCE: adapted from IEC 60050-191:1990, 191-02-06]

### **3.15 availability**

the ability of an item to be in a state to perform a required function under given conditions at a given instant of time or over a given time interval, assuming that the required external resources are provided

Note 1 to entry: This ability depends on the combined aspects of the reliability performance, the maintainability performance and the maintenance support performance.

Note 2 to entry: Required external resources, other than maintenance resources do not affect the availability performance of the item.

Note 3 to entry: In French the term "disponibilité" is also used in the sense of "instantaneous availability".

### **3.16 maintainability**

the ability of an item under given conditions of use, to be retained in, or restored to, a state in which it can perform a required function, when maintenance is performed under given conditions and using stated procedures and resources

Note 1 to entry: The term "maintainability" is also used as a measure of maintainability performance.

### **3.17 dependability**

collective term used to describe the availability performance and its influencing factors: reliability performance, maintainability performance, and maintenance support performance

[SOURCE: IEC 60050-191:1990, 191-02-03]

### **3.18 communication conformance test**

check of data flow on communication channels in accordance with the standard conditions concerning access organization, formats and bit sequences, time synchronization, timing, signal form and level and reaction to errors

Note 1 to entry: The conformance test can be carried out and certified to the standard or to specifically described parts of the standard.

Note 2 to entry: The term "communication" has been added to "conformance test" in order to state that this test refers to communication conformance.

### **3.19 performance test**

test on complete intelligent switchgear system to characterize it under operating conditions

### **3.20 intelligent switchgear**

switchgear composed of its primary part, its mechanism and one or more switchgear controllers containing at a minimum set of logical nodes according to the IEC 61850 series

Note 1 to entry: Minimum set of logical nodes are as per 5.1. of this standard.

### **3.21 switchgear controller**

IED with an interface according to IEC 61850-8-1:2011

Note 1 to entry: A switchgear controller can be:

- a circuit-breaker controller (abbreviated as CBC in this standard);
- a disconnecter controller (abbreviated as DCC in this standard);
- an earthing switch controller (abbreviated as ESC in this standard);
- a controller of another type of switchgear.

### **3.22 intelligent sensor**

sensor with a processor and communications interface according to the IEC 61850 series

EXAMPLE An interface according to IEC 61850-9-2:2011, used for current and voltage measurement via a merging unit as specified within IEC 61869-9.<sup>1</sup>

### **3.23 communication device**

equipment used for interconnection of several IEDs

Note 1 to entry: The term "communication switch" is used in this standard in order to distinguish this type of equipment from switches as defined in IEC 62271-103:2011. Such a communication switch is used in local area communication networks to combine communication network segments with different communication hardware, such as copper-based and fibre optic serial communication networks. The defined data rate is available on every network segment in parallel. A communication switch is a device which implements layers 1 and 2 of the ISO/OSI reference model according to ISO/IEC 7498 series.

Note 2 to entry: A communication gateway is a communication device used for interconnection of several IEDs which may use completely different communication methods (for example, one IED with proprietary communication and another IED with communication according to IEC 61850 series). A communication gateway is a device which implements all 7 layers of the ISO/OSI communication reference model according to ISO/IEC 7498 series.

Note 3 to entry: The communication device does not provide for application functionality.

### **3.24 test device**

equipment used for generation of test signals and/or test functions

### **3.25 test object**

device under test

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<sup>1</sup> To be published.

## 4 Normal and special service conditions

Clause 2 of IEC 62271-1:2007/AMD 1:2011 giving service conditions, such as ambient air temperature, altitude is applicable.

## 5 Ratings and classifications

### 5.1 LNs on the process level of a high-voltage substation

According to the number of functions integrated in the switchgear, a choice of LNs, among those given in IEC 61850-5:2013, can be implemented. This standard describes a minimum requirement if the relevant functions are present.

NOTE 1 LNs are one of the basic concepts of the IEC 61850 series. They can be seen as containers of data within an IED. LNs are compatibly defined in IEC 61850-7-4:2010 in order to achieve interoperability between IEDs. For further information, IEC 61850-7-1:2011 is referred to.

NOTE 2 For example, a circuit-breaker controller of an intelligent circuit-breaker implements the LN XCBR. Should that circuit-breaker controller also implement a synchrocheck function, the LN RSYN would also be included. Apart from that, sampled values are subject to IEC 61850-9-2:2011.

The LNs as given in Table 1 shall be used to model the communication interface of the relevant switchgear functions; they are mandatory in the case where the function is present and it has a serial communication interface:

NOTE 3 The LNs given in Table 1 are taken from IEC 61850-7-4:2010. The column "Purpose and explanation" gives requirements and explanations to fit into the context of this standard.

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[IEC 62271-3:2015](https://standards.iteh.ai/catalog/standards/sist/c70355f9-e0f0-46fe-ac1c-0d775633f121/iec-62271-3-2015)

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