IEC 61400-25-5

Edition 2.0 2017-09

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Wind energy generation systems –
Part 25-5: Communications for monitoring and control of wind power plants – Compliance testing

Systèmes de génération d'énergie éolienne –
Partie 25-5: Communications pour la surveillance et la commande des centrales éoliennes – Essai de conformité

IEC 61400-25-5:2017-09(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 27.180

ISBN 978-2-8322-8805-4

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND ENERGY GENERATION SYSTEMS –

Part 25-5: Communications for monitoring and control of wind power plants – Compliance testing

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.
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International Standard IEC 61400-25-5 has been prepared by IEC technical committee 88: Wind energy generation systems.

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:

- Harmonization with structure and test cases in IEC 61850-10:2012.
- The use of SCL in the compliance testing process is out of the scope for this edition, but will be considered for Edition 3.
- Reduction of overlap between standards and simplification by increased referencing to the IEC 61850 standard series.

- All test cases applying SCL files are still not a part of the present document as the SCL specifications for wind power domain are still pending to be published.

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

FDIS	Report on voting
88/643/FDIS	88/650/RVD

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

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

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

A list of all parts of the IEC 61400 series, under the general title *Wind energy generation systems,* can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication 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 focus of IEC 61400-25 (all parts) is on the communications between wind power plant components such as wind turbines and actors such as SCADA Systems. Internal communication within wind power plant components is outside the scope of IEC 61400-25 (all parts).

IEC 61400-25 (all parts) is designed for a communication environment supported by a client-server model. Three areas are defined, that are modelled separately to ensure the scalability of implementations:

a) wind power plant information models,

b) information exchange model, and

c) mapping of these two models to a standard communication profile.

The wind power plant information model and the information exchange model, viewed together, constitute an interface between client and server. In this conjunction, the wind power plant information model serves as an interpretation frame for accessible wind power plant data. The wind power plant information model is used by the server to offer the client a uniform, component-oriented view of the wind power plant data. The information exchange model reflects the whole active functionality of the server. IEC 61400-25 (all parts) enables connectivity between a heterogeneous combination of client and servers from different manufacturers and suppliers.

As depicted in Figure 1, IEC 61400-25 (all parts) defines a server with the following aspects:

– information provided by a wind power plant component, e. g., “wind turbine rotor speed” or “total power production of a certain time interval” is modelled and made available for access. The information modelled in the document is defined in IEC 61400-25-2,

– services to exchange values of the modelled information defined in IEC 61400-25-3,

– mapping to a communication profile, providing a protocol stack to carry the exchanged values from the modelled information (IEC 61400-25-4).

IEC 61400-25 (all parts) only defines how to model the information, information exchange and mapping to specific communication protocols. IEC 61400-25 (all parts) excludes a definition of how and where to implement the communication interface, the application program interface and implementation recommendations. However, the objective of IEC 61400-25 (all parts) is that the information associated with a single wind power plant component (such as the wind turbine) is accessible through a corresponding logical device.

The intended readers for the present document are device or system and/or system component manufacturers and test system developers/providers.

NOTE Abbreviations used in IEC 61400-25-5 are listed in Clauses 3 and 4 or can be found in other parts of IEC 61400-25 standard series that are relevant for compliance testing.

WIND ENERGY GENERATION SYSTEMS –

Part 25-5: Communications for monitoring and control of wind power plants – Compliance testing

1 Scope

This part of IEC 61400-25 specifies standard techniques for testing of compliance of implementations, as well as specific measurement techniques to be applied when declaring performance parameters. The use of these techniques will enhance the ability of users to purchase systems that integrate easily, operate correctly, and support the applications as intended.

This part of IEC 61400-25 defines:

- the methods and abstract test cases for compliance testing of server and client devices used in wind power plants,
- the metrics to be measured in said devices according to the communication requirements specified in IEC 61400-25 (all parts).

NOTE The role of the test facilities for compliance testing and certifying the results are outside of the scope of IEC 61400-25-5.

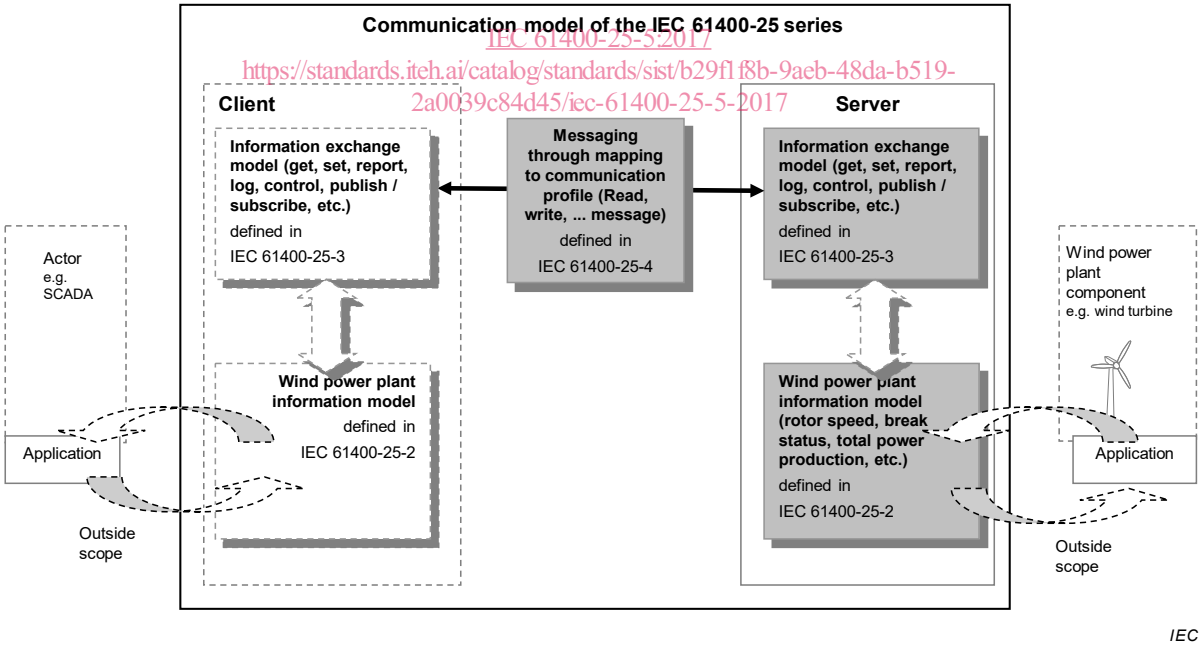

Figure 1 – Conceptual communication model of the IEC 61400-25 standard series

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 61400-25 (all parts), *Wind turbines – Part 25: Communications for monitoring and control of wind power plants*

IEC 61400-25-1:2006, *Wind turbines – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models*

IEC 61400-25-2:2015, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEC 61400-25-3:2015, *Wind turbines – Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models*

IEC 61400-25-4:2016, *Wind energy generation systems – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile*

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 61850-7-1:2011, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and 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 61850-10:2012, *Communication networks and systems for power utility automation – Part 10: Conformance testing*

ISO/IEC 9646 (all parts), *Information technology – Open Systems Interconnection – Compliance testing methodology and framework*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61400-25-1 and the following apply.

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

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

3.1
factory acceptance test
FAT
customer agreed functional tests of the specifically manufactured substation automation system or its parts using the parameter set for the planned application

Note 1 to entry: The FAT shall be carried out in the factory of the manufacturer or other agreed-upon location by the use of process simulating test equipment.

3.2
hold point
point, defined in the appropriate document beyond which an activity shall not proceed without the approval of the initiator of the compliance test

Note 1 to entry: The test facility shall provide a written notice to the initiator at an agreed time prior to the hold point.

Note 2 to entry: The initiator or his representative is obligated to verify the hold point and approve the proceeding of the activity.

3.3
interoperability
ability of two or more devices from the same vendor (or different vendors) to exchange information and use that information for correct co-operation

Note 1 to entry: Set of values defined corresponds with the quantities or values of another set.

3.4
model implementation compliance statement
MICS
statement that details the standard data object model elements supported by the system or device

3.5
negative test
test to verify the correct response of a device or a system when subjected to:

– IEC 61400-25 (all parts) conformant information and services which are not implemented in the device or system under test,
– non IEC 61400-25 (all parts) conformant information and services sent to the device or system under test

3.6
protocol implementation compliance statement
PICS
statement with the summary of the communication capabilities of the system or device to be tested

3.7
protocol implementation extra information for testing
PIXIT
statement with system or device specific information to be tested and which is outside the scope of IEC 61400-25 (all parts)

Note 1 to entry: The PIXIT is not subject to standardisation.

3.8
routine test
test performed by the manufacturer in order to ensure device operation and safety

3.9
site acceptance test
SAT
verification of each data and control point and the correct functionality within the WPP and its operating environment at the whole installed plant by use of the final parameter set

Note 1 to entry: The SAT is the precondition for the WPP being put into operation.

3.10
system test
verification of correct behaviour of the WPP components and of the overall WPP under various application conditions

Note 1 to entry: The system test marks the final stage of the development of a WPP system component.

3.11
system related test
verification of correct behaviour of the IEDs and of the overall PUAS under specific application conditions

Note 1 to entry: The system related test is part of the final stage of the development of IEDs as belonging to a PUAS-product family.

3.12
test equipment
all tools and instruments which simulate and verify the input/outputs of the operating environment of the WPP such as wind turbine, switchgear, transformers, network control centres or connected telecommunication units on the one side, and the communication links between the system components of the WPP on the other

3.13
test facility
organisation able to provide appropriate test equipment and trained staff for compliance testing

Note 1 to entry: The management of compliance tests and the resulting information should follow a quality system.

3.14
technical issues compliance statement
TICS
statement with device specific information regarding the implemented technical issues detected after publication of the standard

Note 1 to entry: The TICS is not subject to standardisation.

3.15
type test
verification of correct behaviour of the IEDs (systems components) of the WPP by use of the system tested software under the test conditions corresponding with the technical data

Note 1 to entry: The type test marks the final stage of the hardware development and is the precondition for the start of the production. This test shall be carried out with system components which have been manufactured through the normal production cycle.

3.16
witness point
point, defined in the appropriate document, at which an inspection will take place on an activity

Note 1 to entry: The activity may proceed without the approval of the initiator of the compliance test. The test facility provides a written notice to the initiator at an agreed time prior to the witness point. The initiator or his representative has the right, but is not obligated, to verify the witness point.

4 Abbreviated terms

ACSI	Abstract Communication Service Interface
BRCB	Buffered Report Control Block
CDC	Common Data Class
DUT	Device Under Test
FAT	Factory Acceptance Test
GI	General Interrogation
HMI	Human Machine Interface
ICD	IED capability subscription
IED	Intelligent Electronic Device
IID	Instantiated IED description
IP	Inter-networking protocol internet Protocol
LCB	Log Control Block
LD	Logical Device
LN	Logical Node
MICS	Model Implementation Compliance Statement
PICS	Protocol Implementation Compliance Statement
PIXIT	Protocol Implementation eXtra Information for Testing
PUAS	Power Utility Automation System
RCB	Report Control Block
RTU	Remote Terminal Unit
SAT	Site Acceptance Test
SCADA	Supervisory Control And Data Acquisition
SCSM	Specific Communication Service Mapping
SGCB	Setting Group Control Block
SoE	Sequence-of-Events
SUT	System Under Test
TICS	Technical Issues Compliance Statement
TPAA	Two Party Application Association
TUT	Tool Under Test
URCB	Unbuffered Report Control Block
UTC	Coordinated Universal Time
WPP	Wind Power Plant

5 Introduction to compliance testing

5.1 General

There are many steps involved from the development and production of a device to the proper running of a complete system designed according the specific needs of a customer. Suitable test steps are incorporated in this process.

Many internal tests during the development of a device or a system component result in a type test (unit level test) performed at least by the provider and – if required by applicable standards – by an independent test authority. In the context of this part of IEC 61400-25 (all parts), the term type test is restricted to the functional behaviour of the device excluding communication.

Continuing routine tests in the production chain are necessary to ensure a constant quality of delivered devices in accordance with the quality procedures of the producer.

A compliance test is the type test for communication and – since communication establishes a system – the basic integrated systems test of the incorporated system components. As a global communications standard, IEC 61400-25 (all parts) includes standardised compliance tests to ensure that all suppliers comply with applicable requirements.

Type tests and compliance tests do not completely guarantee that all functional and performance requirements are met. However, when properly performed, such tests significantly reduce the risk of costly problems occurring during system integration in the factory and on-site.

Compliance testing does not replace project specific system tests such as the FAT and SAT. The FAT and SAT are based on customer requirements for a dedicated WPP system and are done by the system integrator and normally witnessed by the customer. These tests increase the confidence level that all potential problems in the system have been identified and solved. These tests establish that the delivered WPP system is performing as specified.

5.2 Compliance test procedures

In general, compliance testing of the communication behaviour of a system component should address the functional requirements and performance requirements of typical applications supported by these devices in a WPP.

Compliance testing demonstrates the capability of the Device Under Test (DUT) to operate with other systems or system components in a specified way according to IEC 61400-25 (all parts).

Compliance testing requires consideration of the following issues:

– The problem of all testing is the completeness of the tests. The number of all possible situations can be very large. It may be possible to cover all normal operating cases, but this may not be true for all failure cases.

– It is impossible to test all system configurations using system components from different world-wide suppliers. Therefore, standardised test architecture with device simulators should be used. The use of such test architecture implies agreement about its configuration and the test procedures applied in order to achieve compatible results.

– A communication standard does not standardise the functions of the communicating equipment. Therefore, the failure modes of the functions are outside the scope of this part of IEC 61400-25 (all parts). But both the existence of distributed functions and the impact of function response in devices on the data flow create some interdependence.

– Depending on the definition range of IEC 61400-25 (all parts), some properties of the device may be proven by information and documents provided with the DUT for the compliance testing instead of the compliance test itself.

The compliance test establishes that the communication of the DUT works according to IEC 61400-25 (all parts). IEC 61400-25 (all parts) is focused on interoperability using data objects, functions and device models including services above or at the application level (ACSI).

Since IEC 61400-25 (all parts) defines no new communication stacks, the compliance to all seven ISO/OSI layers may be proven by documentation that communication stack software compliant with the corresponding specifications is implemented and may have been pre-tested and optionally certified. In the standard compliance test, only the application according to ACSI can be tested.