



CSA C61869-9:20

Instrument transformers — Part 9: Digital interface for instrument transformers

(IEC 61869-9:2016, MOD)

CSA C61869-9:20

Transformateurs de mesure — Partie 9 : Interface numérique des transformateurs de mesure

(IEC 61869-9:2016, MOD)



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Instrument transformers — Part 9: Digital interface for instrument transformers (IEC 61869-9:2016, MOD)

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CSA C61869-9:20

Instrument transformers — Part 9: Digital interface for instrument transformers (IEC 61869-9:2016, MOD)

CSA Preface

This is the first edition of CSA C61869-9, *Instrument transformers — Part 9: Digital interface for instrument transformers*, which is an adoption, with Canadian deviations, of the identically titled IEC (International Electrotechnical Commission) Standard 61869-9 (first edition, 2016-04). It replaces relevant parts of CAN/CSA-C60044-8:07 (adopted IEC 60044-8:2002), *Instrument transformers — Part 8: Electronic current transformers*. It is part of the CSA C61869 series of Standards for instrument transformers, which consists of adoptions with Canadian deviations of the IEC 61869 series of Standards.

For brevity, this Standard will be referred to as “CSA C61869-9” throughout.

This Standard is intended to be used in conjunction with CAN/CSA-C61869-1:14, *Instrument transformers — Part 1: General requirements* (adopted IEC 61869-1:2007, with Canadian deviations); and CSA C61869-6:20, *Instrument transformers — Part 6: Additional general requirements for low-power instrument transformers* (adopted IEC 61869-6:2016, with Canadian deviations).

Requirements common to all instrument transformer types are grouped in CAN/CSA-C61869-1. Requirements specific to conventional instrument transformer types are grouped in CAN/CSA-C61869-2, CAN/CSA-C61869-3, CAN/CSA-C61869-4, and CAN/CSA-C61869-5. Those CSA Group Standards present many inherited Canadian deviations justified by the specific conditions, practices, and regulations in Canada.

Requirements common to low-power instrument transformers (LPIT) used for ac applications having rated frequencies from 15 Hz to 100 Hz covering MV, HV, and EHV or used for dc applications are grouped in CSA C61869-6.

The remaining Standards in the series state requirements for specific types of instrument transformers.

The LPIT has low-power analog output or digital output. The requirements for the digital interface associated with LPIT are grouped in CSA C61869-9.

Canada has actively participated in the development of IEC 61869-9, in order to enforce specific Canadian conditions. It should be noted that Parts 6 to 13 of the IEC 61869 series specify the requirements for ac LPIT as well as the interfaces necessary to implement the LPIT into an integrated system for protection and measurement. Such a system uses a universal digital transmission protocol compatible with IEC 61850, and has a digital output. In order to ensure full interoperability, Canadian deviations in CSA C61869-9 are minimal.

This Standard was reviewed for Canadian adoption by the CSA Technical Committee on Instrument Transformers, under the jurisdiction of the CSA Strategic Steering Committee on Power Engineering and Electromagnetic Compatibility, and has been formally approved by the Technical Committee.

This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

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- a) Standard designation (number);
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Canadian deviations

The following deviations are intended to meet local product requirements and to align with electromagnetic compatibility requirements of relevant Canadian regulators.

International Standard IEC 61869-9:2016 (first edition) forms the basis for CSA C61869-9, which contains the following deviations in addition to those shown in CAN/CSA-C61869-1:14 and CSA C61869-6:20.

[Replace all references to “IEC 61869-1” with “CAN/CSA-C61869-1”]

[Replace all references to “IEC 61869-6” with “CSA C61869-6”]

1 Scope

[Add the following note]

Note 1A: Measurement Canada and other local authorities should be contacted and consulted in regard to the applicable specifications and requirements for revenue metering.

2 Normative references

[Add the following]

In this Standard, any reference to International Standards shall be replaced by the relevant National Standard of Canada.

Where reference is made to CSA Group publications, such reference shall be considered to refer to the latest edition and all amendments published to that edition. This Standard refers to the following publications, and the years shown indicate the latest editions available at the time of printing:

CSA Group

CAN/CSA-C61869-1:14 (R2019)

Instrument transformers — Part 1: General requirements

CAN/CSA-C61869-2:14 (R2019)

Instrument transformers — Part 2: Additional requirements for current transformers

CAN/CSA-C61869-3:14 (R2019)

Instrument transformers — Part 3: Additional requirements for inductive voltage transformers

CAN/CSA-C61869-4:14 (R2019)

Instrument transformers — Part 4: Additional requirements for combined transformers

CAN/CSA-C61869-5:15 (R2019)

Instrument transformers — Part 5: Additional requirements for capacitor voltage transformers

CSA C61869-6:20

Instrument transformers — Part 6: Additional general requirements for low-power instrument transformers

6 Design and construction

Table 902 — Standard sample rates

[Add the following notes]

Note 1A: *In Canada, the preferred standard sample rates are those given in Rows 2, 3, and 6 of this Table.*

Note 2A: *It is preferred that the ASDU parameter be user-defined, which will facilitate a smoother migration from an IEC 61850-9-2LE based system to an IEC 61869-9 based system.*

Note 3A: *The IEC 61850-9-2LE backwards compatible rate for quality metering applications is F. 5360S8I4U4, which is deprecated from IEC 61869-9 and not widely deployed in Canada; therefore, it is not required.*

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**Instrument transformers –
Part 9: Digital interface for instrument transformers**

**Transformateurs de mesure –
Partie 9: Interface numérique des transformateurs de mesure**



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**Instrument transformers –
Part 9: Digital interface for instrument transformers**

**Transformateurs de mesure –
Partie 9: Interface numérique des transformateurs de mesure**

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CONTENTS

| | |
|---------------------------------------------------------|----|
| FOREWORD..... | 4 |
| INTRODUCTION..... | 7 |
| 1 Scope..... | 12 |
| 2 Normative references | 12 |
| 3 Terms and definitions | 13 |
| 3.5 Terms and definitions related to other ratings..... | 13 |
| 3.7 Index of abbreviations | 13 |
| 4 Normal and special service conditions | 14 |
| 5 Ratings..... | 14 |
| 5.6 Rated accuracy class..... | 14 |
| 5.901 Performance requirements..... | 15 |
| 6 Design and construction | 16 |
| 6.901 Technological boundaries | 16 |
| 6.901.1 Interface point..... | 16 |
| 6.901.2 Digital output interface | 16 |
| 6.901.3 Human-machine interface | 16 |
| 6.902 Electrical requirements | 17 |
| 6.902.1 Frequency response requirements | 17 |
| 6.902.2 Maximum processing delay time requirement..... | 17 |
| 6.903 Specification of the communications profile | 19 |
| 6.903.1 General..... | 19 |
| 6.903.2 Variants | 19 |
| 6.903.3 Digital output sample rates..... | 20 |
| 6.903.4 Logical devices | 21 |
| 6.903.5 Logical nodes LPHD | 21 |
| 6.903.6 Logical nodes LLN0 | 21 |
| 6.903.7 Logical nodes TCTR | 21 |
| 6.903.8 Logical nodes TVTR..... | 24 |
| 6.903.9 Quality | 25 |
| 6.903.10 Dataset(s)..... | 26 |
| 6.903.11 Multicast sampled value control block(s)..... | 27 |
| 6.903.12 Configuration of the merging unit | 27 |
| 6.903.13 Rated conformance classes | 28 |
| 6.904 Synchronization | 34 |
| 6.904.1 General..... | 34 |
| 6.904.2 Precision time protocol synchronization | 34 |
| 6.904.3 1PPS synchronization | 35 |
| 6.904.4 Sample value message SmpSynch attribute..... | 35 |
| 6.904.5 Holdover mode..... | 36 |
| 6.904.6 Free-running mode..... | 37 |
| 6.904.7 Time adjustments..... | 37 |
| 7 Tests | 38 |
| 7.2 Type tests..... | 38 |
| 7.2.6 Test for accuracy | 38 |
| 7.2.901 Digital output conformance tests | 38 |
| 7.2.902 Maximum processing delay time test..... | 38 |

| | | |
|------------------------|--------------------------------------------------------------------------------------------------|----|
| 7.2.903 | Loss of synchronization tests | 39 |
| 7.2.904 | 1PPS test..... | 39 |
| Annex 9A (informative) | Dynamic range considerations..... | 40 |
| Annex 9B (informative) | Time synchronization and management example..... | 43 |
| Annex 9C (informative) | Example merging unit ICD file | 45 |
| Annex 9D (informative) | Test circuits for accuracy measurement | 56 |
| Annex 9E (informative) | Electronic nameplate..... | 59 |
| Bibliography..... | | 60 |
| | | |
| Figure 901 | – General block diagram of an electronic LPIT with digital output | 8 |
| Figure 902 | – General illustration of the objects within a merging unit (example)..... | 9 |
| Figure 903 | – Electronic LPIT with digital output (concept example)..... | 10 |
| Figure 904 | – Standalone merging unit..... | 11 |
| Figure 905 | – Duplex LC connector | 16 |
| Figure 906 | – Maximum processing delay time..... | 17 |
| Figure 907 | – Output message timestamp point | 19 |
| Figure 908 | – TCTR naming example | 23 |
| Figure 909 | – 1PPS signal waveform at the merging unit clock input..... | 35 |
| Figure 910 | – Time adjustment example (6 ASDU example)..... | 37 |
| Figure 9A.1 | – Nomogram for current | 41 |
| Figure 9A.2 | – Nomogram for voltage..... | 42 |
| Figure 9B.1 | – Sampled value signal processing example showing 2ASDUs per message (F4800S2I4U4 example) | 43 |
| Figure 9D.1 | – Example test circuit | 56 |
| Figure 9D.2 | – Example test circuit | 58 |
| | | |
| Table 901 | – Maximum processing delay time limits | 18 |
| Table 902 | – Standard sample rates..... | 20 |
| Table 903 | – Extensions to the LPHD class..... | 21 |
| Table 904 | – AmpSv object attribute values | 23 |
| Table 905 | – Extensions to the TCTR class..... | 24 |
| Table 906 | – VoISv object attribute values | 25 |
| Table 907 | – Extensions to the TVTR class..... | 25 |
| Table 908 | – Configuration parameters of the merging unit | 28 |
| Table 909 | – Basic conformance statement..... | 29 |
| Table 910 | – ACSI models conformance statement | 29 |
| Table 911 | – ACSI service conformance statement | 31 |
| Table 912 | – PICS for A-Profile support | 33 |
| Table 913 | – PICS for T-Profile support | 34 |

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INSTRUMENT TRANSFORMERS –

Part 9: Digital interface for instrument transformers

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This first edition replaces the corresponding specific requirements previously contained in IEC 60044-8, published in 2002.

This bilingual version (2017-09) corresponds to the English version, published in 2016-04.

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

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| FDIS | Report on voting |
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The French version of this standard has not been voted upon.

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

A list of all parts in the IEC 61869 series, published under the general title *Instrument transformers*, can be found on the IEC website.

This publication contains an attached file in the form of a .xml file. This file is intended to be used as a complement and does not form an integral part of the publication.

This International Standard contains specific requirements for electronic low power instrument transformers (LPIT) having a digital output.

This Part 9 is to be read in conjunction with, and is based on, IEC 61869-1:2007, *General requirements* and IEC 61869-6:2016. However, the reader is encouraged to use its most recent edition.

This Part 9 follows the structure of IEC 61869-6 and IEC 61869-1 and supplements or modifies their corresponding clauses/subclauses.

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- clauses, subclauses, tables, figures and notes that are numbered starting from 901 are additional to those in Part 1;
- additional annexes are lettered 9A, 9B, etc.

An overview of the planned set of standards at the date of publication of this document is given below. The updated list of standards issued by IEC TC 38 is available at the website: www.iec.ch.

| PRODUCT FAMILY STANDARDS | PRODUCT STANDARD IEC | PRODUCTS | OLD STANDARD IEC | |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------|
| 61869-1 GENERAL REQUIREMENTS FOR INSTRUMENT TRANSFORMERS | 61869-2 | ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS | 60044-1 60044-6 | |
| | 61869-3 | ADDITIONAL REQUIREMENTS FOR INDUCTIVE VOLTAGE TRANSFORMERS | 60044-2 | |
| | 61869-4 | ADDITIONAL REQUIREMENTS FOR COMBINED TRANSFORMERS | 60044-3 | |
| | 61869-5 | ADDITIONAL REQUIREMENTS FOR CAPACITOR VOLTAGE TRANSFORMERS | 60044-5 | |
| | 61869-6 ADDITIONAL GENERAL REQUIREMENTS FOR LOW POWER INSTRUMENT TRANSFORMERS | 61869-7 | ADDITIONAL REQUIREMENTS FOR ELECTRONIC VOLTAGE TRANSFORMERS | 60044-7 |
| | | 61869-8 | ADDITIONAL REQUIREMENTS FOR ELECTRONIC CURRENT TRANSFORMERS | 60044-8 |
| | | 61869-9 | DIGITAL INTERFACE FOR INSTRUMENT TRANSFORMERS | |
| | | 61869-10 | ADDITIONAL REQUIREMENTS FOR LOW POWER PASSIVE CURRENT TRANSFORMERS | |
| | | 61869-11 | ADDITIONAL REQUIREMENTS FOR LOW POWER PASSIVE VOLTAGE TRANSFORMERS | 60044-7 |
| | | 61869-12 | ADDITIONAL REQUIREMENTS FOR COMBINED ELECTRONIC INSTRUMENT TRANSFORMERS AND COMBINED STAND ALONE INSTRUMENT TRANSFORMERS | |
| | | 61869-13 | STAND ALONE MERGING UNIT | |
| | | 61869-14 | ADDITIONAL REQUIREMENTS FOR DC CURRENT TRANSFORMERS | |
| | | 61869-15 | ADDITIONAL REQUIREMENTS FOR DC VOLTAGE TRANSFORMERS FOR DC APPLICATIONS | |

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

- 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

General

This standard is a product family standard for instrument transformers. It provides an application of the standard series IEC 61850, which details layered substation communication architecture in the world of instrument transformers.

By providing tutorial material such as examples and explanations, it also provides access for instrument transformer, protective relay and meter experts to concepts and methods applied in the IEC 61850 series.

Compared to instrument transformers, digital communication technology is subject to on-going changes which are expected to continue in the future. Significant experience with electronics integrated directly into instrument transformers 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 paradigm has not yet occurred.

Position of this standard in relation to the IEC 61850 series

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

- a) information models for the substation automation system;
- b) these information models include both the models of the instrument transformers and other process equipment (like circuit-breakers and disconnectors), and the models of the substation automation system (like protection relays and meters). The models are defined in IEC 61850-7-3 and IEC 61850-7-4;
- c) the communication between intelligent electronic devices (IEDs) of the substation automation system. The abstract models are defined in IEC 61850-7-2 and the mappings on communication stacks are defined in IEC 61850-8-1 and IEC 61850-9-2;
- d) a configuration language used to describe the configuration aspects of the substation automation system is described in IEC 61850-6;
- e) conformance testing of the communication interfaces of the IEDs of the power utility automation system including their data models. The conformance testing is defined in IEC 61850-10.

Typically, in a traditional system, IEDs like bay level controllers or protection relays interface directly through analogue signals to instrument transformers. In that case, the data models of the instrument transformers are implemented in these bay level devices. However, this is not the only realization. In the case where electronics are integrated directly into electronic LPIT, the above-mentioned data models should be implemented within the instrument transformer and the instrument transformer needs to support a communication interface. The part of an electronic LPIT that does this is known as the merging unit.

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

To reduce the engineering amount required to achieve interoperability for the digital interface between instrument transformers and equipment that uses the digital signal (like protective relays, meters or bay level controllers), this standard specifies additional constraints on implementing a digital communication interface.

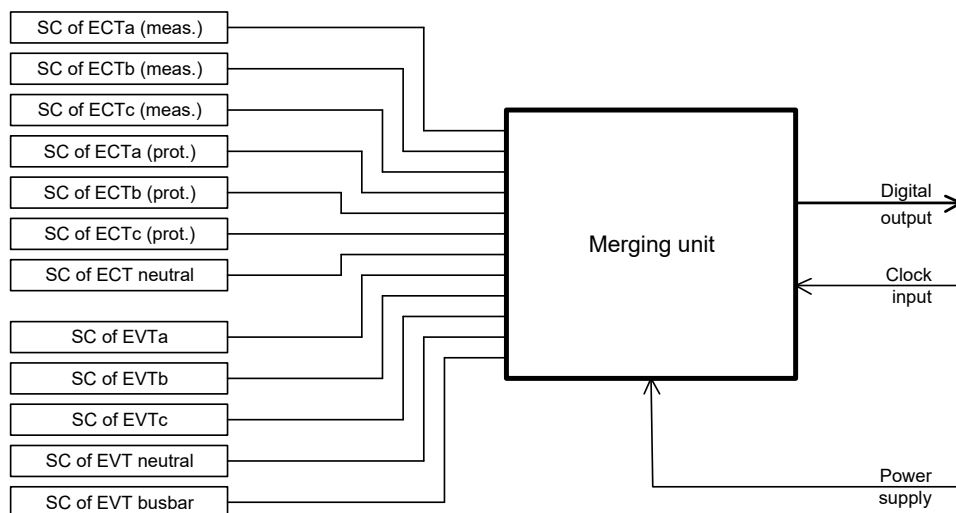
The IEC 61869-9 standard:

- replaces the IEC 60044-8 digital solution;

- provides a product standard for instrument transformers with a digital interface according to the IEC 61850 series; similar to what IEC 62271-3 offers for switchgear;
- includes backward compatibility for the UCA International Users Group *Implementation Guideline for Digital Interface to Instrument Transformers Using IEC 61850-9-2*;
- uses IEC 61588 based time synchronization in accordance with IEC/IEEE 61850-9-3, with an option for 1PPS (pulse per second).

Overview of the digital interface for instrument transformers

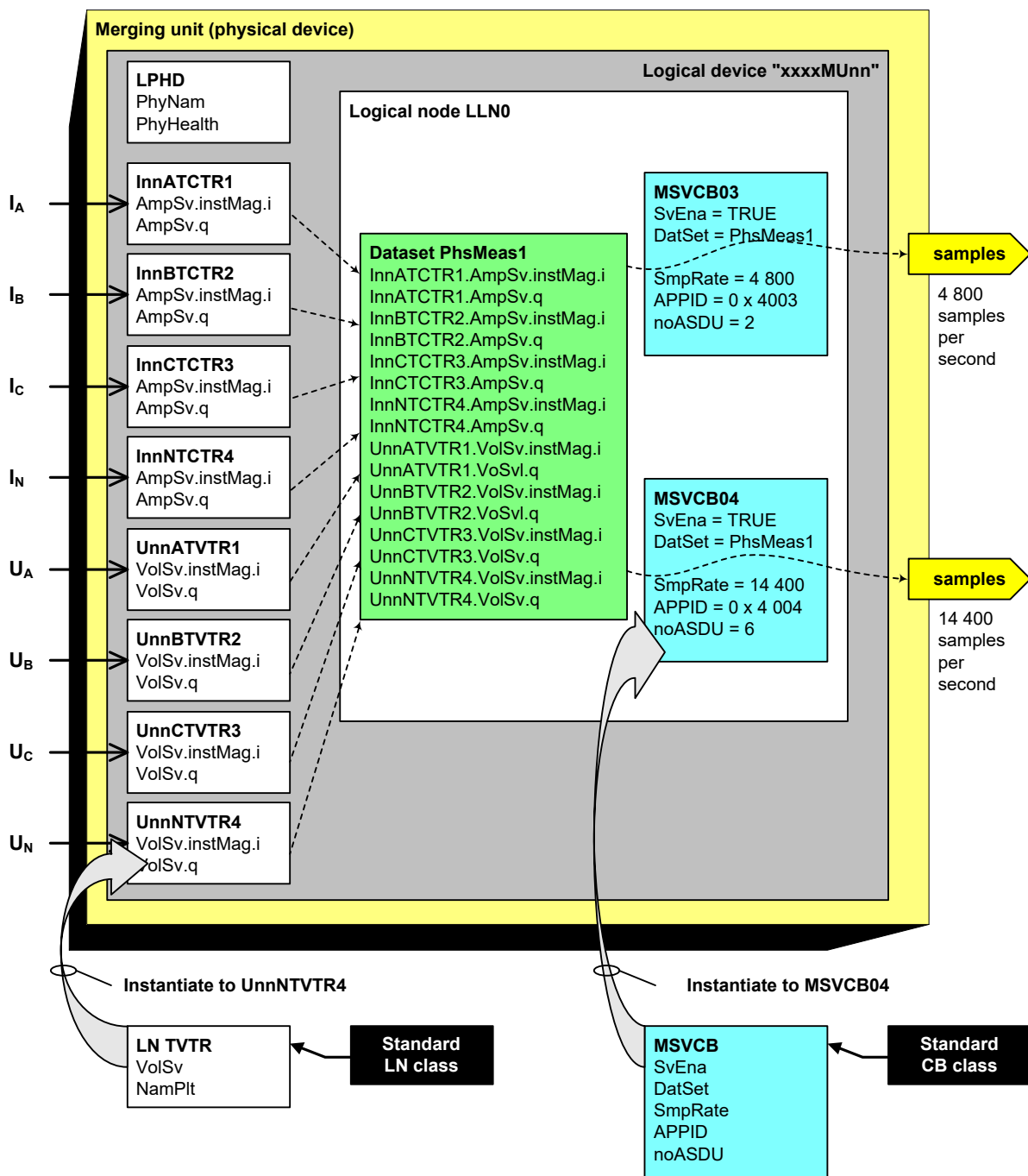
An illustrative general block diagram of an instrument transformer with digital output is shown in Figure 901. It shows multiple current and/or voltage information coming from the secondary converters (SC in Figure 901) and fed into a common block labelled “merging unit”. The merging unit performs all the data processing (sampling, analogue to digital conversion, scaling, message formatting, etc.) necessary to produce a time-coherent output data stream according to this standard. For the purposes of this standard a merging unit is a physical unit (hardware subsystem) used to assemble and transmit digital output data frames.



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Figure 901 – General block diagram of an electronic LPIT with digital output

A merging unit is modelled as one or more logical devices that contain multiple logical nodes as illustrated in Figure 902.



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Figure 902 – General illustration of the objects within a merging unit (example)

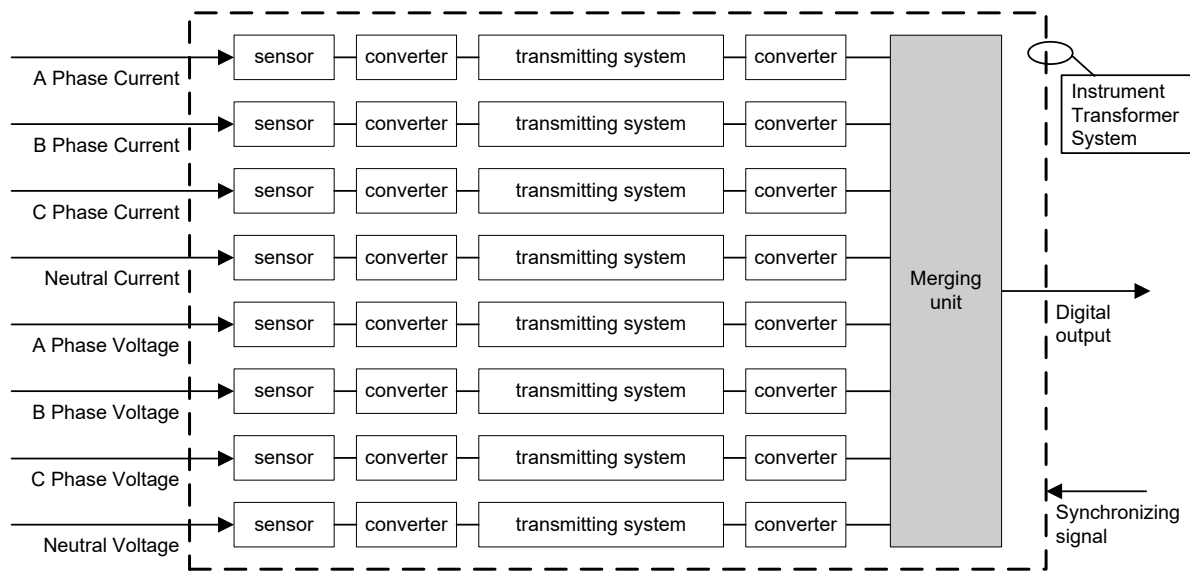
Current and voltage measurements in the example merging unit in Figure 902 are modelled per IEC 61850-7-1 by using the following logical nodes:

- Class **TCTR** per IEC 61850-7-4, instantiated individually for each of the three current transformer phases, and for the neutral current measurement.
- Class **TVTR** per IEC 61850-7-4, instantiated individually for each of the three voltage transformer phases, and for the neutral voltage measurement.
- Logical node zero **LLN0** containing instances of the sampled value control blocks (MSVCB03 and MSVCB04 in this example) controlling simultaneous publishing of IEC 61850-9-2 data streams (in this example one with 4 800 samples per second and 2 samples per frame yielding a frame rate of 2 400 per second, the other with 14 400 samples per second and 6 samples per frame also yielding a frame rate of

2 400 per second), and a dataset that controls the content of the sampled value digital output messages.

Applicable sample rates, time synchronization, control blocks and dataset are defined in this standard.

Physical realization of the above concepts may vary with the applied technology determining which parts are necessary for the realization of an actual instrument transformer. One such realization showing an electronic LPIT with built-in digital data output is shown in Figure 903 and further described in the relevant product specific standards in the IEC 61869 series (Part 7, Part 8, Part 12, Part 14, Part 15).

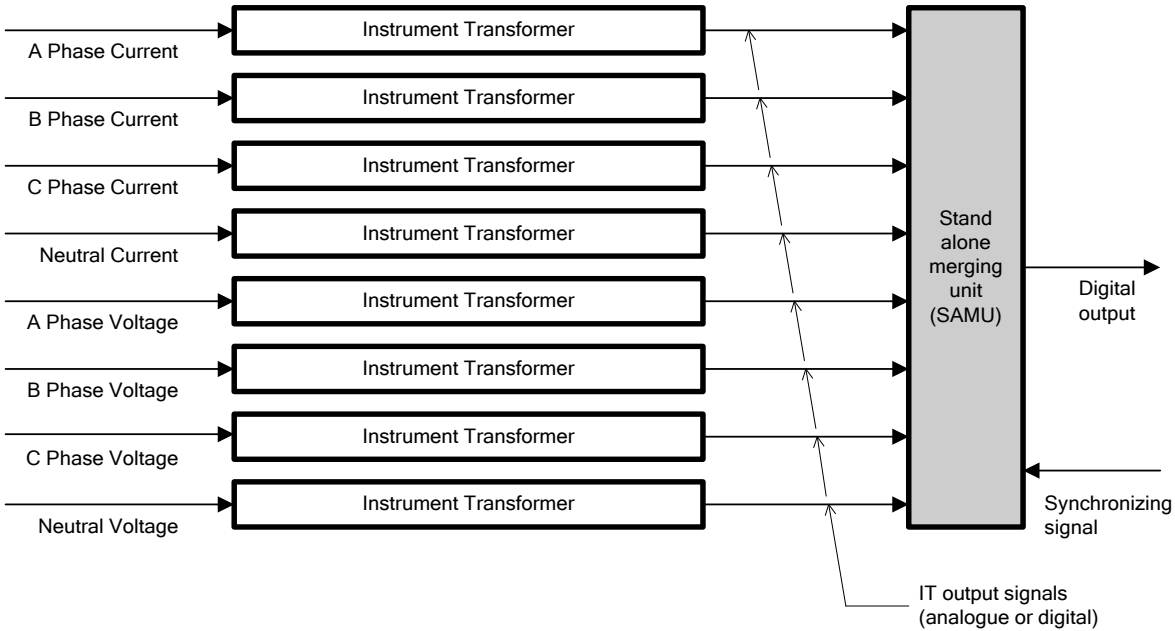


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Figure 903 – Electronic LPIT with digital output (concept example)

It is not absolutely necessary that all parts shown in Figure 903 be included. For clarity, power supplies are not shown here. An instrument transformer may be implemented in a single physical unit or in multiple physical units. For example, there may be a separate physical unit for each phase containing the primary voltage and/or current sensors, primary converters and primary insulation, with all secondary converters and the merging unit in a separate physical unit located in the control house. The number of primary inputs and their type (voltage or current) in a single instrument transformer may be other than shown here.

For comparison, an illustrative general block diagram of an installation using a stand-alone merging unit (SAMU) is shown in Figure 904. Unlike the merging unit in an instrument transformer, a SAMU is a separate product covered in IEC 61869-13. It accepts as inputs the outputs of instrument transformers, said outputs conforming to the specifications of one of the product standards in the IEC 61869 series. The number of inputs and their type (voltage or current) may be other than shown in Figure 904. Output produced by a SAMU and output produced by an electronic LPIT with built in merging unit should in principle be indistinguishable from each other (excluding the fact that SAMU output will typically have lower accuracy due to cascading the separately given instrument transformer and SAMU accuracy specifications).



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An example will be presented in IEC 61869-13¹, as soon as this standard will be available.

Figure 904 – Standalone merging unit

¹ Under consideration.

INSTRUMENT TRANSFORMERS –

Part 9: Digital interface for instrument transformers

1 Scope

This part of IEC 61869 is a product family standard applicable to instrument transformers with digital output. The product standard is composed of IEC 61869-1 and IEC 61869-6, in addition to this standard and the relevant product specific standards in the IEC 61869 series (Part 7, Part 8, Part 12, Part 13, Part 14, and Part 15).

This standard defines requirements for digital communications of instrument transformer measurements. It is based on the IEC 61850 series, UCA international users group document *Implementation guideline for digital interface to instrument transformers using IEC 61850-9-2*, and the relevant parts of IEC 60044-8 that are replaced by this standard. It includes additional improvements including the IEC 61588 network based time synchronization.

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.

Clause 2 of IEC 61869-6:2016 is applicable with the following additions:

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems*

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 61850-8-1:2011, *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/IEEE 61850-9-3:2016, *Communication networks and systems for power utility automation – Part 9-3: Precision time protocol profile for power utility automation*