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## **Mättransformatorer – Del 9: Digitalt gränssnitt för strömtransformatorer**

*Instrument transformers –*

*Part 9: Digital interface for instrument transformers*

Som svensk standard gäller europastandarden EN IEC 61869-9:2019. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61869-9:2019.

### **Nationellt förord**

Europastandarden EN IEC 61869-9:2019

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 61869-9, First edition, 2016 - Instrument transformers - Part 9: Digital interface for instrument transformers**

utarbetad inom International Electrotechnical Commission, IEC.

Standarden ska användas tillsammans med SS-EN 61869-1, utgåva 1, 2009 och SS-EN 61869-6, utgåva 1, 2017.

Tidigare fastställd svensk standard SS-EN 60044-8, utgåva 1, 2003, gäller ej fr o m 2022-07-05.

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English Version

**Instrument transformers - Part 9: Digital interface for instrument transformers  
(IEC 61869-9:2016)**

Transformateurs de mesure - Partie 9: Interface numérique  
pour les transformateurs de mesure  
(IEC 61869-9:2016)

Messwandler - Teil 9: Digitale Schnittstelle für Messwandler  
(IEC 61869-9:2016)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

## **European foreword**

The text of document 38/502/FDIS, future edition 1 of IEC 61869-9, prepared by IEC/TC 38 "Instrument transformers" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61869-9:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-01-05
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-07-05

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This document supersedes EN 60044-8:2002 (partially).

## **Endorsement notice**

The text of the International Standard IEC 61869-9:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60044-7:1999	NOTE	Harmonized as EN 60044-7:2000 (not modified)
IEC 60044-8:2002	NOTE	Harmonized as EN 60044-8:2002 (not modified)
IEC 61850 (series)	NOTE	Harmonized as EN 61850 (series)
IEC 61850-5:2013	NOTE	Harmonized as EN 61850-5:2013 (not modified)
IEC 61850-8-1	NOTE	Harmonized as EN 61850-8-1
IEC 61850-10	NOTE	Harmonized as EN 61850-10
IEC 61869 (series)	NOTE	Harmonized as EN 61869 (series)
IEC 62271-3	NOTE	Harmonized as EN 62271-3

## Annex ZA

(normative)

### Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

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

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
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	EN 61850-6	2010
IEC 61850-7-1	2011	Communication networks and systems for power utility automation - Part 7-1: Basic communication structure - Principles and models	EN 61850-7-1	2011
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)	EN 61850-7-2	2010
IEC 61850-7-3	2010	Communication networks and systems for power utility automation - Part 7-3: Basic communication structure - Common data classes	EN 61850-7-3	2011
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	EN 61850-8-1	2011
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	EN 61850-9-2	2011
IEC 61850-10	2012	Communication networks and systems for	EN 61850-10	2013

## EN IEC 61869-9:2019 (E)

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
		power utility automation - Part 10: Conformance testing		
IEC 61869-6	2016	Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers	EN 61869-6	2016
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		-
UCA (International - Users Group		Implementation guideline for digital interface to instrument transformers using IEC 61850-9-2		

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSTRUMENT TRANSFORMERS –****Part 9: Digital interface for instrument transformers****FOREWORD**

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International Standard IEC 61869-9 has been prepared by IEC technical committee 38: Instrument transformers.

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:

FDIS	Report on voting
38/502/FDIS	38/508/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.

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.

When a particular clause/subclause of Part 6 is not mentioned in this Part 9, that clause/subclause applies. When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 6 is to be adapted accordingly.

When a particular clause/subclause of Part 1 is not mentioned in Part 6, that clause/subclause applies. When Part 6 states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

For additional clauses, subclauses, figures, tables, annexes or note, the following numbering system is used:

- 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](http://www.iec.ch).

PRODUCT FAMILY STANDARDS	PRODUCT STANDARD IEC	PRODUCTS	OLD STANDARD IEC
<b>61869-1</b> GENERAL REQUIREMENTS FOR INSTRUMENT TRANSFORMERS	<b>61869-2</b>	ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS	60044-1 60044-6
	<b>61869-3</b>	ADDITIONAL REQUIREMENTS FOR INDUCTIVE VOLTAGE TRANSFORMERS	60044-2
	<b>61869-4</b>	ADDITIONAL REQUIREMENTS FOR COMBINED TRANSFORMERS	60044-3
	<b>61869-5</b>	ADDITIONAL REQUIREMENTS FOR CAPACITOR VOLTAGE TRANSFORMERS	60044-5
	<b>61869-6</b> ADDITIONAL GENERAL REQUIREMENTS FOR LOW POWER INSTRUMENT TRANSFORMERS	<b>61869-7</b>	60044-7
		<b>61869-8</b>	60044-8
		<b>61869-9</b>	
		<b>61869-10</b>	
		<b>61869-11</b>	60044-7
		<b>61869-12</b>	
		<b>61869-13</b>	
		<b>61869-14</b>	
		<b>61869-15</b>	

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.

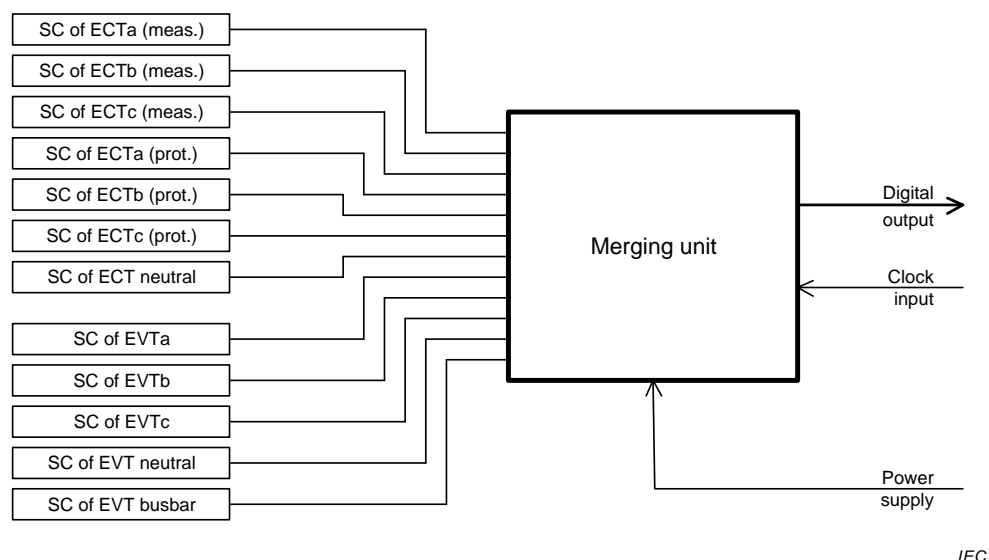
The IEC 61869-9 standard:

- 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

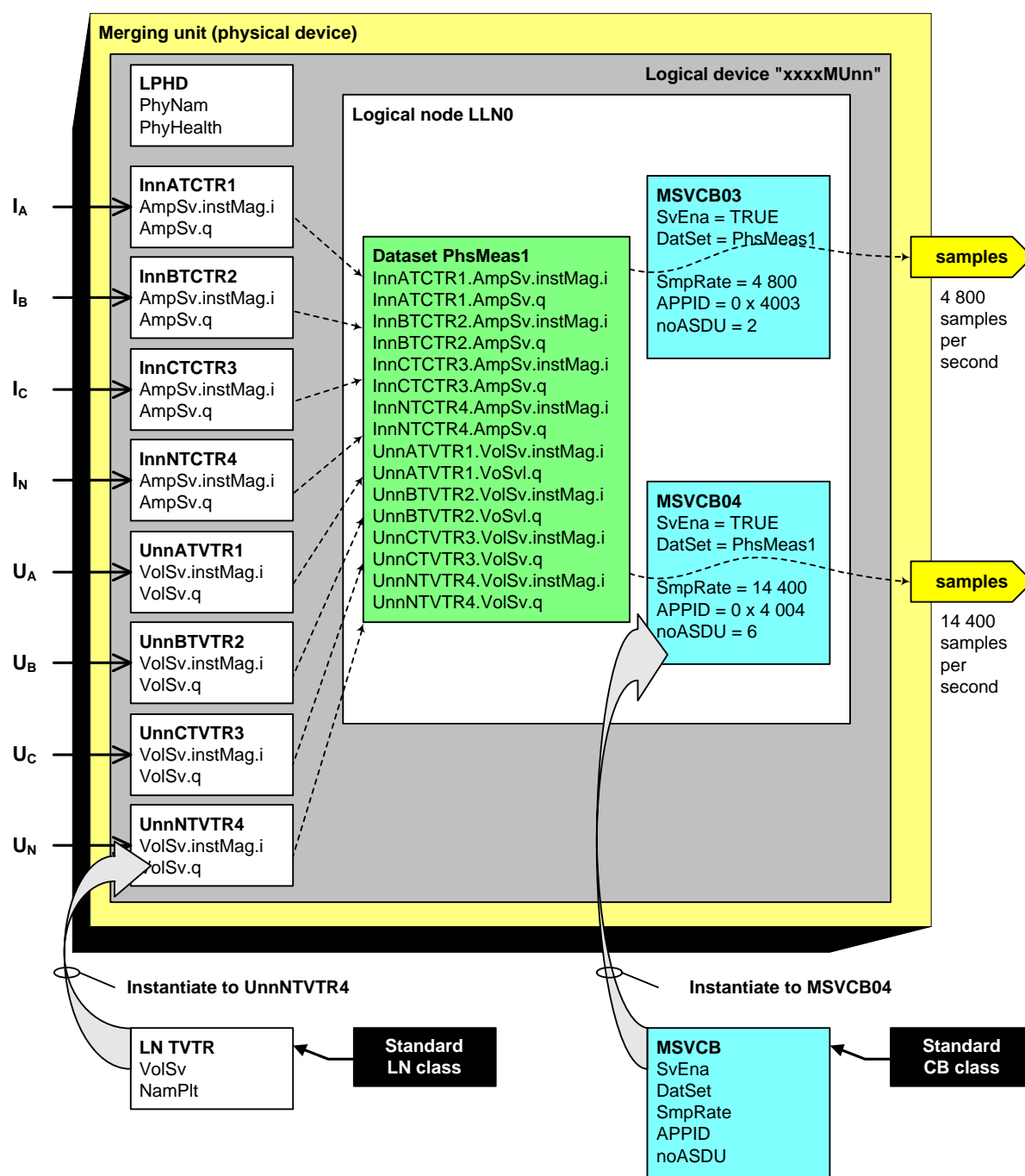
An illustrative general block diagram of an instrument transformer with digital output is shown in Figure 901. It shows multiple current and/or voltage information coming from the secondary converters (SC in Figure 901) and fed into a common block labelled “merging unit”. The merging unit performs all 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.



IEC

**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.



IEC

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

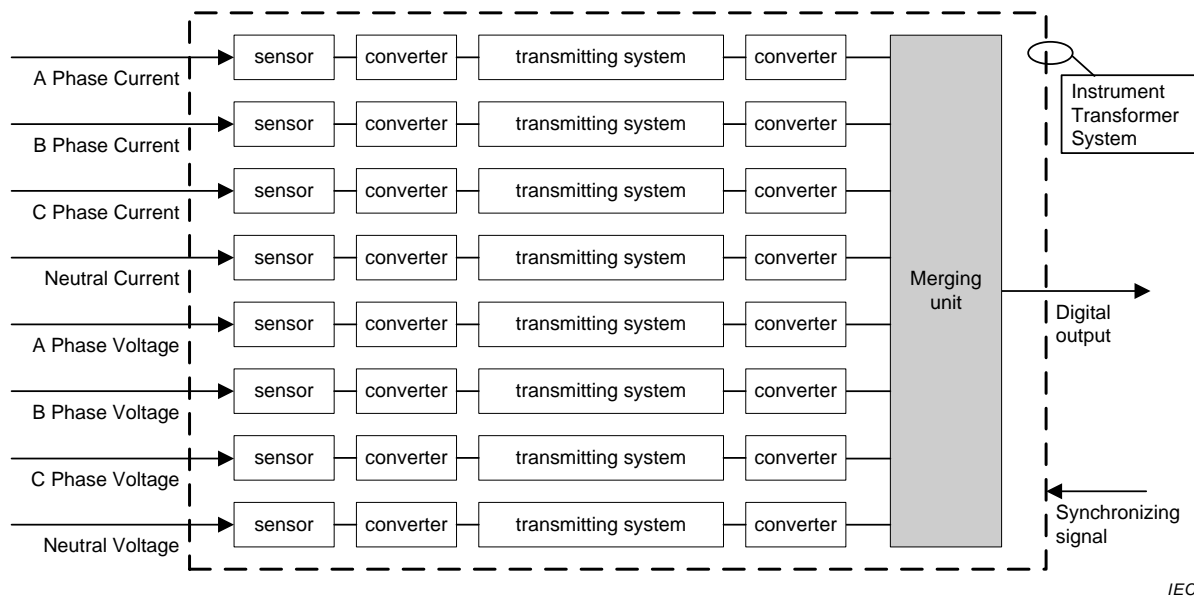
Current and voltage measurements in the example merging unit in Figure 902 are modelled per IEC 61850-7-1 by using the following logical nodes:

- 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.

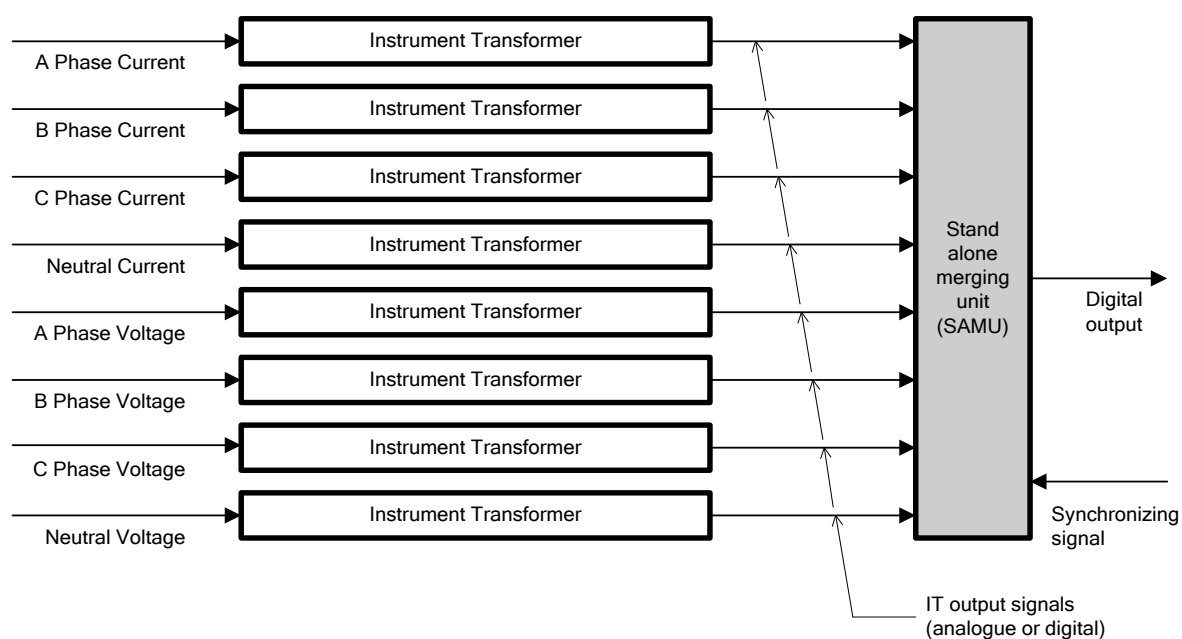
Physical realization of the above concepts may vary with the applied technology determining which parts are necessary for the realization of an actual instrument transformer. One such realization showing an electronic LPIT with built-in digital data output is shown in Figure 903 and further described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



**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).



IEC

An example will be presented in IEC 61869-13<sup>1</sup>, as soon as this standard will be available.

**Figure 904 – Standalone merging unit**

<sup>1</sup> 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*

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

IEC 61869-6:2016, *Instrument transformers – Part 6: Additional general requirements for low-power instrument transformers*

UCA (International Users Group), *Implementation guideline for digital interface to instrument transformers using IEC 61850-9-2*