IEC 61869-10

Edition 1.0 2017-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Instrument transformers –
Part 10: Additional requirements for low-power passive current transformers

Transformateurs de mesure –
Partie 10: Exigences supplémentaires concernant les transformateurs de courant passifs de faible puissance

IEC 61869-10:2017-12(en-fr)

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Instrument transformers – Part 10: Additional requirements for low-power passive current transformers

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INSTRUMENT TRANSFORMERS –

Part 10: Additional requirements for low-power passive current transformers

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 61869-10 has been prepared IEC technical committee 38: Instrument transformers.

This first edition of IEC 61869-10, together with IEC 61869-1, IEC 61869-6, IEC 61869-8 and IEC 61869-9, cancels and replaces the first edition of IEC 60044-8, published in 2002[1]. This edition constitutes a technical revision.

The technical changes concern IEC TC 38's decision to restructure the whole set of stand-alone standards in the IEC 60044 series and transform it into a new set of standards composed of general requirements documents and specific requirements documents.

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1 IEC 60044-8 will eventually be replaced by the IEC 61869 series, but until all the relevant parts of the IEC 61869 series will be published, this standard is still in force.

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

FDIS	Report on voting
38/550/FDIS	38/551/RVD

Full information on the voting for the approval of this part of IEC 61869 can be found in the report on voting indicated in the above table.

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

This standard is Part 10 of IEC 61869, published under the general title *Instrument transformers.*

This Part 10 is to be read in conjunction with, and is based on, IEC 61869-1:2007, *General requirements* and IEC 61869-6:2016, *Additional general requirements for low-power instrument transformers* – however, the reader is encouraged to use the most recent edition of these documents.

This Part 10 follows the structure of IEC 61869-1:2007 and IEC 61869-6:2016 and supplements or modifies the corresponding clauses.

When a particular subclause of Part 1or part 6 is not mentioned in this Part 10, that subclause applies. When this part of IEC 61869 states "addition", "modification" or "replacement", the relevant text in part 1 or part 6 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 1001 are additional to those in Part 1 and Part 6;
– additional annexes are lettered 10A, 10B, 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 on the IEC website.

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

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INTRODUCTION

Low-power passive current transformers (LPCT) are based on passive technologies without any active electronic components. They can have an output signal proportional to the primary current, for example iron core coils with integrated shunt as a current to voltage converter (primary converter) or they can have an output signal proportional to the derivative of the primary current, for example air-core coils (Rogowski coils). This part of IEC 61869 does not cover the air-core coils with active integrator.

According to a general block diagram given in Figure 601 of IEC 61869-6:2016, the low-power passive current transformers do not use an active primary converter (i.e. without any active electronic component); therefore, there is no need for primary power supply. Additionally, neither the secondary converter nor the secondary power supply is used.

The general block diagram of a low-power passive current transformer is given in Figure 1001.

The applied technology decides which part is necessary for the realization of a low-power passive current transformer, i.e. it is not absolutely necessary that the transmitting cable or primary converter described in Figure 1001 be included in the low-power passive current transformer. The derivative LPCT solution considers only the air-core coil as the primary sensor and the transmission cable as the transmitting system. In this technology, the primary converter is not considered. In case of a proportional LPCT solution, the ferromagnetic-core coil is considered as the primary sensor, a burden resistance connected directly to the coil outputs works as a primary converter and the transmission cable is a transmitting system.

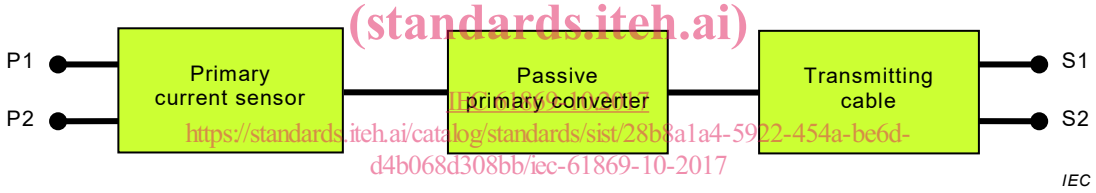

Figure 1001 – General block diagram of a single-phase low-power passive current transformer

INSTRUMENT TRANSFORMERS –

Part 10: Additional requirements for low-power passive current transformers

1 Scope

This part of IEC 61869 is a product standard and covers only additional requirements for low-power passive current transformers. The product standard for low-power passive current transformers comprises IEC 61869-1, together with IEC 61869-6 and this document with specific requirements.

This document is applicable to newly manufactured low-power passive current transformers with analogue output for use with electrical measuring instruments or electrical protective devices having a rated frequency from 15 Hz to 100 Hz.

This document covers low-power passive current transformers used for measurement or protection and multi-purpose low-power passive current transformers used for both measurement and protection.

Subclause 5.6.1001 covers the accuracy requirements that are necessary for low-power passive current transformers for use with electrical measuring instruments.

Subclause 5.6.1002 covers the accuracy requirements that are necessary for low-power passive current transformers for use with electrical protective relays, and particularly for forms of protection in which the prime requirement is to maintain the accuracy up to several times the rated current. If required, the transient accuracy of low-power passive current transformers during fault is also given in 5.6.1002.

Low-power passive current transformers have analogue voltage output only (for digital output or for technology using any kind of active electronic components refer to IEC 61869-8[2]). Such low-power passive current transformers can include the secondary signal cable (transmitting cable). The principle of operation of derivative low-power passive current transformers using air-core coils (Rogowski coils) is given in Annex 10B and the principle of operation of proportional low-power passive current transformers using iron-core coils with integrated shunt is given in Annex 10C.

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.

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

IEC 60059, *IEC standard current ratings*

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

2 Under preparation.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61869-1 and IEC 61869-6 apply with the following additions and modifications.

3.1 General definitions

3.1.613
transmitting system
Definition 3.1.613 of IEC 61869-6:2016 is applicable with the following addition:

Note 1001 to entry: For low-power passive current transformers the transmitting system is just a transmitting cable.

3.1.621
output signal
Definition of 3.1.621 of IEC 61869-6:2016 is applicable with the following modification:

Note 1 to entry: In an electrical steady-state condition, the output signal is defined by the following formula:

$$u_s(t) = U_s\sqrt{2}\,\sin(2\pi f t + \varphi_s) + u_{sres}(t)$$

where

$u_S(t)$ is the output signal;
U_s is theRMS value of the secondary voltage, when $u_{sres}(t) = 0$;
f is the fundamental frequency;
φ_s is the secondary phase angle;
$u_{sres}(t)$ is the secondary residual voltage including harmonic, interharmonic and sub-harmonic components;
t is the instantaneous value of the time;
f, U_s, φ_s being constant for steady-state condition.

3.1.1001
derivative LPCT
low-power passive current transformer providing an output signal proportional to the derivate of the input signal

Note 1 to entry: LPCT based on non-magnetic-core coil technology without a built-in integrator (e.g. Rogowski coils) are derivate LPCT.

3.1.1002
proportional LPCT
low-power passive current transformer providing an output signal proportional to the input signal

Note 1 to entry: LPCT based on iron-core technology with a built-in primary converter providing output voltage are proportional LPTC.

3.4 Definitions related to accuracy

3.4.3
ratio error
ε
Definition 3.4.3 of IEC 61869-1:2007 and IEC 61869-6:2016 is applicable with the following addition:

Note 1001 to entry: The ratio error, expressed in percent, is given by the formula:

$$\varepsilon(\%) = \frac{K_r \cdot U_s - I_p}{I_p} \times 100$$

where

K_r is the rated transformation ratio;

I_p is the RMS value of the primary current;

U_s is the RMS value of the secondary voltage.

3.4.602
rated delay time
t_{dr}
not applicable

3.4.607
composite error
ε_c
Definition 3.4.607 of IEC 61869-6:2016 is applicable with the following addition:

Note 1001 to entry: The composite error ε_c, expressed in per cent, is given by the formula:

$$\varepsilon_c(\%) = \frac{1}{I_p}\sqrt{\frac{1}{T}\int_0^T \left[K_r \cdot u_s(t) - i_p(t)\right]^2 dt} \times 100$$

where

K_r is the rated transformation ratio;

I_p is the RMS value of the primary current;

$i_p(t)$ is the instantaneous primary current;

$u_s(t)$ is the instantaneous secondary voltage;

T is the duration of one cycle;

t is the instantaneous value of the time.

3.4.1001
ratio correction factor
CF_I
factor by which the rated transformation ratio evaluated at rated burden and rated frequency of an individual passive LPCT is to be multiplied to achieve the specified accuracy class

Note 1 to entry: Derivative LPCT is a frequency dependent device because its output linearly changes with frequency. It can be used under different system frequencies without any change in its design and without loss of accuracy. However, when the system frequency is different from the rated frequency, the correction factor is given by using the following formula:

$$CF_{I\,f} = CF_{I\,f_r} \cdot \frac{f_r}{f}$$

where

CF_{If} is the ratio correction factor at frequency f;

CF_{Ifr} is the ratio correction factor at rated frequency f_r;

f_r is the rated system frequency of the passive LPCT;

f is the actual system frequency.

3.4.1002
corrected transformation ratio
K_{cor}
individual transformation ratio of a passive LPCT

Note 1 to entry: The relationship between the corrected transformation ratio and rated transformation ratio is:

$$K_{cor} = CF_I \cdot K_r$$

3.4.1003
phase offset correction

$\varphi_{o\ cor}$
value added to the rated phase offset evaluated at the rated burden and rated frequency of an individual passive LPCT to achieve the specified accuracy class

3.4.1004
corrected phase offset

$\varphi_{cor\ \varphi o}$
individual phase offset of a passive LPCT

Note 1 to entry: The relationship between the corrected phase offset and phase offset correction is:

$$\varphi_{cor\varphi o} = \varphi_{ocor} + \varphi_{or}$$

3.4.1005
corrected ratio error

$\varepsilon_{cor\ I}$
ratio error of an individual passive LPCT corrected by the factor defined in 3.4.1001

Note 1 to entry: The corrected ratio error is given by the formula:

$$\varepsilon_{corI}(\%) = \frac{CF_I \cdot K_r \cdot U_s - I_p}{I_p} \times 100$$

where

CF_I is the ratio correction factor of the individual passive LPCT.

3.4.1006
corrected composite error

$\varepsilon_{c\ cor\ I}$
composite error of an individual passive LPCT corrected by the factor defined in 3.4.1001

Note 1 to entry: The corrected composite error is given by the formula:

$$\varepsilon_{ccorI}(\%) = \frac{1}{I_p}\sqrt{\frac{1}{T}\int_0^T [CF_I \cdot K_r \cdot u_s(t+\delta t) - i_p(t)]^2\, dt} \times 100$$

where

CF_I is the ratio correction factor of the individual passive LPCT;

$\delta t = \varphi_{ecor} \cdot T/2\pi$ is the time adjustment due to the corrected phase error.

3.4.1007
corrected phase error

$\varphi_{e\ cor}$
phase error of an individual passive LPCT corrected by the value defined in 3.4.1004

Note 1 to entry: The corrected phase error is given by the formula:

$$\varphi_{ecor} = \varphi_s - \varphi_p - \varphi_{cor\varphi o}$$

3.7 Index of abbreviations

Subclause 3.7 of IEC 61869-1:2007 is replaced by the following:

CF_I	ratio correction factor
f_r	rated frequency
I_{cth}	rated continuous thermal current
I_{dyn}	rated dynamic current
I_{epr}	rated extended primary current
$i_{p(t)}$	primary current in transient condition
I_{pr}	rated primary current
I_{psc}	rated primary short-circuit current
I_{th}	rated short-time thermal current
K_{cor}	corrected transformation ratio
K_{pcr}	rated extended primary current factor
K_r	rated transformation ratio
K_{ssc}	rated symmetrical short-circuit factor
LPCT	low- power current transformer
LPIT	low-power instrument transformer
R_{br}	rated burden
T_p	specified primary time constant for transient performance
U_m	highest voltage for equipment
U_{sr}	rated secondary voltage
ε	ratio error
ε_c	composite error
$\varepsilon_{c\ cor\ I}$	corrected composite error
$\varepsilon_{cor\ I}$	corrected ratio error
$\varphi_{cor\ \varphi o}$	corrected phase offset
φ_o	phase offset
$\varphi_{o\ cor}$	phase offset correction
φ_{or}	rated phase offset
$\varphi_{e\ cor}$	corrected phase error

5 Ratings

5.3 Rated insulation levels and voltages

5.3.5 Insulation requirements for secondary terminals

Subclause 5.3.5 of IEC 61869-6:2016 is applicable.

5.3.601 Rated auxiliary power supply voltage (U_{ar})

Not applicable.