IEC 61869-11

Edition 1.0 2017-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Instrument transformers –
Part 11: Additional requirements for low-power passive voltage transformers

Transformateurs de mesure –
Partie 11: Exigences supplémentaires pour les transformateurs de tension passifs de faible puissance

IEC 61869-11:2017-12(en-fr)

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INSTRUMENT TRANSFORMERS –

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FOREWORD

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International Standard IEC 61869-11 has been prepared by IEC technical committee 38: Instrument transformers.

This first edition of IEC 61869-11, together with IEC 61869-1 and IEC 61869-6, cancels and replaces the relevant clauses or subclauses of the first edition of IEC 60044-7, published in 1999 and the first edition of IEC 60044-8, published in 2002[1]. This edition constitutes a technical revision.

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1 IEC 60044-7 and 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, these two standards are still in force.

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

FDIS	Report on voting
38/549/FDIS	38/552/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.

This standard is Part 11 of IEC 61869, published under the general title *Instrument transformers.*

This Part 11 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 11 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 1 or Part 6 is not mentioned in this part Part 11, that subclause applies. When this standard 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 notes, the following numbering system is used:

– clauses, subclauses, tables, figures and notes that are numbered starting from 1101 are additional to those in Part 1 and Part 6;
– additional annexes are lettered 11A, 11B, 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	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 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.

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INTRODUCTION

Low-power passive voltage transformers are based on the voltage divider principle. They can be built for example as resistive dividers, capacitive dividers or resistive-capacitive dividers. Annex 11C shows the schematic diagram of the different dividers.

According to a general block diagram given in Figure 601 of IEC 61869-6:2016, the low-power passive voltage 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 voltage transformer is given in Figure 1101.

The applied technology decides which part is necessary for the realization of a low-power passive voltage transformer, i.e. it is not necessary that the transmitting cable or primary converter described in Figure 1101 be included in the low-power passive voltage transformer.

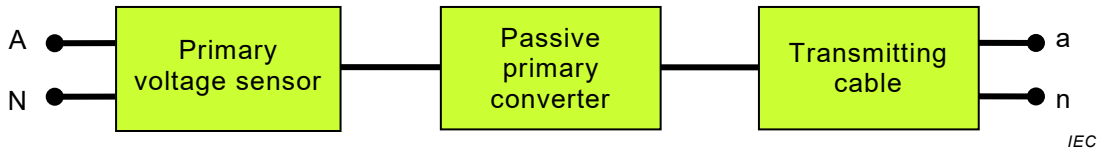

Figure 1101 – General block diagram of a single-phase low-power passive voltage transformer

INSTRUMENT TRANSFORMERS –

Part 11: Additional requirements for low-power passive voltage transformers

1 Scope

This part of IEC 61869 is a product standard and covers only additional requirements for low-power passive voltage transformers (passive LPVT). The product standard for low-power passive voltage transformers is composed of IEC 61869-1, along with IEC 61869-6 and this document with specific requirements.

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

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

Low-power passive voltage transformers have analogue output only (for digital output or for technology using any kind of active electronic components refer to future IEC 61869-7[2]). Such low-power passive voltage transformers can include the secondary signal cable (transmitting cable). The secondary voltage of the low-power passive voltage transformer is proportional to the primary voltage. Derivative output signals are not within the scope of this document.

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

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:

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2 Under preparation.

Note 1101 to entry: For low-power passive voltage transformers the transmitting system is just a transmitting cable.

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

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

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

where

$u_s(t)$ is the output signal in steady state condition;

U_s is the RMS value of secondary voltage, when $u_{s\ res}(t) = 0$;

f is the fundamental frequency;

φ_s is the secondary phase;

$u_{s\ res}(t)$ is the secondary residual voltage including harmonic, sub-harmonic and interharmonic components;

t is the instantaneous value of the time;

f, U_s, φ_s are constant for steady-state condition.

3.1.1101
voltage divider
device comprising resistors, inductors, capacitors (or a combination of these components) such that, between two points of the device, a desired fraction of the voltage applied to the device as whole can be obtained

[SOURCE: IEC 60050-312:2001, 312-02-32, modified – transformer deleted]

3.1.1102
high-voltage resistor
R_1
resistor connected between the high-voltage terminal and the intermediate-voltage secondary terminal of a voltage divider

3.1.1103
high- voltage capacitor
C_1
capacitor connected between the high-voltage terminal and the intermediate-voltage secondary terminal of a voltage divider

[SOURCE: IEC 60050-436:1990, 436-02-12]

3.1.1104
low- voltage resistor
R_2
resistive part of an R- or RC-divider between the secondary terminals

3.1.1105
low-voltage capacitor
C_2
capacitive part of a C- or RC-divider between the secondary terminals

3.1.1106
voltage limitation device
device connected in parallel to the secondary terminals to limit overvoltage

3.2 Definitions related to dielectric ratings and voltages

3.2.1101
rated voltage factor
F_V
multiplying factor to be applied to the rated primary voltage to determine the maximum voltage at which a transformer must comply with the relevant thermal requirements for a specified time and with the relevant accuracy requirements

[SOURCE: IEC 60050-321:1986, 321-03-12]

3.4 Definitions related to accuracy

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

Note 1101 to entry: The ratio error, expressed in percent, is given by the following formula:

$$\varepsilon = \frac{K_r \cdot U_s - U_p}{U_p} \times 100\ \%$$

where

K_r is the rated transformation ratio;

U_p is the RMS value of the primary voltage;

U_s is the RMS value of the secondary voltage.

This definition is only related to the rated frequency component of both the primary and secondary signal.

3.4.602
rated delay time
t_{dr}
Not applicable.

3.4.1101
ratio correction factor
CF_U
factor by which the rated transformation ratio evaluated at rated burden and rated frequency of an individual passive LPVT is to be multiplied to achieve the specified accuracy class

3.4.1102
corrected transformation ratio
K_{cor}
individual transformation ratio of a passive LPVT

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

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

3.4.1103
phase offset correction
$\varphi_{o\,cor}$
value to be added to the rated phase offset evaluated at rated burden and rated frequency of an individual passive LPVT to achieve the specified accuracy class

3.4.1104
corrected phase offset
$\varphi_{cor\ \varphi o}$
individual phase offset of a passive LPVT

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

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

3.4.1105
corrected ratio error
$\varepsilon_{cor\ U}$
ratio error of an individual passive LPVT corrected by the factor defined in 3.4.1102

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

$$\varepsilon_{corU}(\%) = \frac{CF_U \cdot K_r \cdot U_s - U_p}{U_p} \times 100$$

where

CF_U is the ratio correction factor of the individual passive LPVT.

3.4.1106
corrected phase error
$\varphi_{e\ cor}$
phase error of an individual passive LPVT corrected by the value defined in 3.4.1104

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 and symbols

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

C_1	high-voltage capacitor of a divider
C_2	low-voltage capacitor of a divider
CF_U	correction factor
F	mechanical load
f_r	rated frequency
F_V	rated voltage factor
K	actual transformation ratio
K_{cor}	corrected transformation ratio
K_r	rated transformation ratio
LPIT	low-power instrument transformer
LPVT	low-power voltage transformer
R_1	high-voltage resistor of a divider
R_2	low-voltage resistor of a divider
R_{br}	rated burden
U_m	highest voltage for equipment
U_{pr}	rated primary voltage

U_{sr}	rated secondary voltage
U_{sys}	highest voltage for system
ε	ratio error
$\varepsilon_{cor\ U}$	corrected ratio error
$\varepsilon_U(t)$	instantaneous voltage error for transient conditions
φ_e	phase error
φ_o	phase offset
$\varphi_{o\ cor}$	phase offset correction
φ_{or}	rated phase offset
$\Delta\varphi$	phase displacement
$\varphi_{e\ cor}$	corrected phase error
$\varphi_{cor\ \varphi o}$	corrected phase offset

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 with the following addition:

For rated secondary voltage > 10 V the test voltage is 3 kV regardless of the cable length.

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

Not applicable.

5.5 Rated output

5.5.601 Rated burden (R_{br})

Subclause 5.5.601 of IEC 61869-6:2016 is applicable with the following addition:

The cable included in the LPVT shall not be changed/modified in order to preserve the specified characteristics of the device.

5.5.602 Standard values for rated delay time (t_{dr})

Not applicable.

5.6 Rated accuracy class

5.6.1101 Accuracy based on the rated transformation ratio and rated phase offset

Ratio error ε is calculated according to the formula in Note 1101 of definition 3.4.3. No correction for individual characteristics of the passive LPVT is done.

5.6.1102 Accuracy based on individual corrected transformation ratio and corrected phase offset

As alternative to the accuracy based on the rated transformation ratio and rated phase offset, for passive LPVT the compliance to the accuracy class can be based on the individual

corrected transformation ratio or individual ratio correction factor and the individual corrected phase offset or individual phase offset correction.

Corrected ratio error $\varepsilon_{cor\ U}$ is calculated according to the formula in Note 1 of definition 3.4.1105. The correction factor CF_U shall be in the range of 0,900 to 1,100 and specified with the suitable accuracy and number of decimals according to the relevant accuracy class (with a minimal resolution of 0,001).

The corrected phase error is calculated according to the formula in Note 1 of definition 3.4.1106. For passive LPVT the individual corrected phase offset $\varphi_{cor\ \varphi o}$ replaces the rated phase offset φ_{or}. Since rated delay time for passive LPVT is not applicable, φ_{tdr} is zero. The phase offset correction shall be in the range of ± 300 min and specified with the suitable accuracy and number of decimals according to the relevant accuracy class (with a minimal resolution of 1 min).

If the accuracy is based on the individual correction, the correction factors or the corrected transformation ratio and the corrected phase offset shall be indicated on the rating plate. Additional information on the designation of the accuracy class using the corrected transformation ratio and the ratio correction factor is given in Annex 11B.

5.6.1103 Accuracy requirements for measuring low-power passive voltage transformer

5.6.1103.1 Accuracy class designation

For measuring passive LPVT, the accuracy class is designated by the highest permissible percentage of the ratio error at rated primary voltage and with rated burden.

5.6.1103.2 Standard accuracy classes

The standard accuracy classes for metering low-power passive voltage transformers are:

0,1 – 0,2 – 0,5 – 1,0 – 3,0

5.6.1103.3 Limits of ratio error and phase error

The ratio error and phase error shall not exceed the values given in Table 1101 for the appropriate accuracy class at any voltage between 80 % and 120 % of the rated voltage and at any value of temperature and frequency within the reference ranges and connected to a burden within the range of:

– ± 5 % of the resistive part of rated burden, and
– between 0 % and 100 % of the capacitive part of the rated burden.

Table 1101 – Limits of ratio error and phase error for measuring LPVT

Accuracy class	Percentage ratio error ε, $\varepsilon_{cor\ U}$ ± %			Phase error φ_e, $\varphi_{cor\ \varphi o}$ ±					
				Minutes			Centiradians		
	at voltage (% of rated)			at voltage (% of rated)			at voltage (% of rated)		
	80	100	120	80	100	120	80	100	120
0,1	0,1	0,1	0,1	5	5	5	0,15	0,15	0,15
0,2	0,2	0,2	0,2	10	10	10	0,3	0,3	0,3
0,5	0,5	0,5	0,5	20	20	20	0,6	0,6	0,6
1,0	1,0	1,0	1,0	40	40	40	1,2	1,2	1,2
3,0	3,0	3,0	3,0	Not specified			Not specified		