

BS EN 61869-2:2012



BSI Standards Publication

Instrument transformers

Part 2: Additional requirements for
current transformers

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National foreword

This British Standard is the UK implementation of EN 61869-2:2012. It is identical to IEC 61869-2:2012. It supersedes BS EN 60044-1:1999 and BS EN 60044-6:1999, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/38, Instrument transformers.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2012

ISBN 978 0 580 59139 6

ICS 17.220.20

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2013.

Amendments issued since publication

Amd. No.	Date	Text affected
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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 61869-2

November 2012

ICS 17.220.20

Supersedes EN 60044-1:1999 + A1:2000 + A2:2003, EN 60044-6:1999

English version

Instrument transformers - Part 2: Additional requirements for current transformers (IEC 61869-2:2012)

Transformateurs de mesure -
Partie 2: Exigences supplémentaires
concernant les transformateurs de courant
(CEI 61869-2:2012)

Messwandler -
Teil 2: Zusätzliche Anforderungen für
Stromwandler
(IEC 61869-2:2012)

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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

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Ref. No. EN 61869-2:2012 E

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Foreword

The text of document 38/435/FDIS, future edition 1 of IEC 61869-2, prepared by IEC/TC 38, "Instrument transformers" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61869-2:2012.

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) 2013-07-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-10-23

This document supersedes EN 60044-1:1999 + A1:2000 + A2:2003 and EN 60044-6:1999.

Additionally it introduces technical innovations in the standardization and adaptation of the requirements for current transformers for transient performance.

This Part 2 is to be used in conjunction with, and is based on, EN 61869-1:2009, *General Requirements* – however the reader is encouraged to use its most recent edition.

This Part 2 follows the structure of EN 61869-1:2009 and supplements or modifies its corresponding clauses.

When a particular clause/subclause of Part 1 is not mentioned in this Part 2, that clause/subclause applies as far as is reasonable. When this standard states "addition", "modification" or "replacement", the relevant text in Part 1 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 201 are additional to those in Part 1;
- additional annexes are lettered 2A, 2B, etc.

Annex ZZ of EN 61869-1 is not applicable for this part of the series.

An overview of the planned set of standards at the date of publication of this document is given below. The updated list of standards prepared by IEC TC38 is available at the website: www.iec.ch; the updated list of standards prepared by IEC TC38 and approved by CENELEC is available at the website: www.cenelec.eu.

PRODUCT FAMILY STANDARDS		PRODUCT STANDARD	PRODUCTS	OLD STANDARD
61869-1 GENERAL REQUIREMENTS FOR INSTRUMENT TRANSFORMERS	61869-6 ADDITIONAL GENERAL REQUIREMENT FOR ELECTRONIC INSTRUMENT TRANSFORMERS AND LOW POWER STAND ALONE SENSORS	61869-2	ADDITIONAL REQUIREMENTS FOR CURRENT TRANSFORMERS	60044-1
		61869-3	ADDITIONAL REQUIREMENTS FOR INDUCTIVE VOLTAGE TRANSFORMERS	60044-2
		61869-4	ADDITIONAL REQUIREMENTS FOR COMBINED TRANSFORMERS	60044-3
		61869-5	ADDITIONAL REQUIREMENTS FOR CAPACITIVE VOLTAGE TRANSFORMERS	60044-5
		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 STAND-ALONE CURRENT SENSORS	
		61869-11	ADDITIONAL REQUIREMENTS FOR LOW POWER STAND ALONE VOLTAGE SENSOR	60044-7
		61869-12	ADDITIONAL REQUIREMENTS FOR COMBINED ELECTRONIC INSTRUMENT TRANSFORMER OR COMBINED STAND ALONE SENSORS	
		61869-13	STAND ALONE MERGING UNIT	

Since the publication of EN 60044-6 (*Requirements for protective current transformers for transient performance*) in 1999, the area of application of this kind of current transformers has been extended. As a consequence, the theoretical background for the dimensioning according to the electrical requirements has become much more complex. In order to keep this standard as user-friendly as possible, the explanation of the background information will be transferred to the Technical Report IEC/TR 61869-100, which is now in preparation.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 61869-2:2012 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Addition to Annex ZA of EN 61869-1:2009:

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 61869-1 (mod)	2007	Instrument transformers - Part 1: General requirements	EN 61869-1	2009

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INSTRUMENT TRANSFORMERS –

Part 2: Additional requirements for Current Transformers

1 Scope

This part of IEC 61869 is applicable to newly manufactured inductive current transformers for use with electrical measuring instruments and/or electrical protective devices having rated frequencies from 15 Hz to 100 Hz.

2 Normative references

Clause 2 of IEC 61869-1:2007 is applicable with the following additions:

IEC 61869-1:2007, *Instrument Transformers – Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 61869-1:2007 apply with the following additions:

3.1 General definitions

3.1.201

current transformer

instrument transformer in which the secondary current, under normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

[SOURCE: IEC 60050-321:1986, 321-02-01]

3.1.202

measuring current transformer

current transformer intended to transmit an information signal to measuring instruments and meters

[SOURCE: IEC 60050-321:1986, 321-02-18]

3.1.203

protective current transformer

a current transformer intended to transmit an information signal to protective and control devices

[SOURCE: IEC 60050-321: 1986, 321-02-19)

3.1.204

class P protective current transformer

protective current transformer without remanent flux limit, for which the saturation behaviour in the case of a symmetrical short-circuit is specified

3.1.205

class PR protective current transformer

protective current transformer with remanent flux limit, for which the saturation behaviour in the case of a symmetrical short-circuit is specified

3.1.206

class PX protective current transformer

protective current transformer of low-leakage reactance without remanent flux limit for which knowledge of the excitation characteristic and of the secondary winding resistance, secondary burden resistance and turns ratio, is sufficient to assess its performance in relation to the protective relay system with which it is to be used

3.1.207

class PXR protective current transformer

protective current transformer with remanent flux limit for which knowledge of the excitation characteristic and of the secondary winding resistance, secondary burden resistance and turns ratio, is sufficient to assess its performance in relation to the protective relay system with which it is to be used

Note 1 to entry: An increasingly number of situations occur where low DC currents are continuously flowing through current transformers. Therefore, in order to stop the current transformer from saturating, current transformers with air gaps, but with the same performance as Class PX, are used.

Note 2 to entry: The air gaps for remanence reduction do not necessarily lead to a high-leakage reactance current transformer (see Annex 2C).

3.1.208

class TPX protective current transformer for transient performance

protective current transformer without remanent flux limit, for which the saturation behaviour in case of a transient short-circuit current is specified by the peak value of the instantaneous error

3.1.209

class TPY protective current transformer for transient performance

protective current transformer with remanent flux limit, for which the saturation behaviour in case of a transient short-circuit current is specified by the peak value of the instantaneous error

3.1.210

class TPZ protective current transformer for transient performance

protective current transformer with a specified secondary time-constant, for which the saturation behaviour in case of a transient short-circuit current is specified by the peak value of the alternating error component

3.1.211

selectable-ratio current transformer

current transformer on which several transformation ratios are obtained by reconnecting the primary winding sections and / or by means of taps on the secondary winding

3.3 Definitions related to current ratings

3.3.201

rated primary current

I_{pr}
value of the primary current on which the performance of the transformer is based

[SOURCE: IEC 60050-321:1986, 321-01-11, modified title, synonym and definition]

3.3.202

rated secondary current

I_{sr}
value of the secondary current on which the performance of the transformer is based

[SOURCE: IEC 60050-321:1986, 321-01-15, modified title, synonym and definition]

3.3.203

rated short-time thermal current

I_{th}

maximum value of the primary current which a transformer will withstand for a specified short time without suffering harmful effects, the secondary winding being short-circuited

[SOURCE: IEC 60050-321:1986, 321-02-22]

3.3.204

rated dynamic current

I_{dyn}

maximum peak value of the primary current which a transformer will withstand, without being damaged electrically or mechanically by the resulting electromagnetic forces, the secondary winding being short-circuited

[SOURCE: IEC 60050-321:1986, 321-02-24]

3.3.205

rated continuous thermal current

I_{cth}

value of the current which can be permitted to flow continuously in the primary winding, the secondary winding being connected to the rated burden, without the temperature rise exceeding the values specified

[SOURCE: IEC 60050-321:1986, 321-02-25]

3.3.206

rated primary short-circuit current

I_{psc}

r.m.s. value of the a.c. component of a transient primary short-circuit current on which the accuracy performance of a current transformer is based

Note 1 to entry: While I_{th} is related to the thermal limit, I_{psc} is related to the accuracy limit. Usually, I_{psc} is smaller than I_{th} .

3.3.207

exciting current

I_e

r.m.s. value of the current taken by the secondary winding of a current transformer, when a sinusoidal voltage of rated frequency is applied to the secondary terminals, the primary and any other windings being open-circuited

[SOURCE: IEC 60050-321:1986, 321-02-32]

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 addition of the following note:

Note 201 to entry: The current ratio error, expressed in per cent, is given by the formula:

$$\varepsilon = \frac{k_r I_s - I_p}{I_p} \times 100 \%$$

where

k_r is the rated transformation ratio;

I_p is the actual primary current;

I_s is the actual secondary current when I_p is flowing, under the conditions of measurement.

An explicative vector diagram is given in 2A.1.

3.4.4 phase displacement

$\Delta\varphi$

The definition 3.4.4 of IEC 61869-1:2007 is applicable with the addition of the following note:

Note 1 to entry: An explicative vector diagram is given in 2A.1.

3.4.201 rated resistive burden

R_b

rated value of the secondary connected resistive burden in ohms

3.4.202 secondary winding resistance

R_{ct}

actual secondary winding d.c. resistance in ohms corrected to 75 °C or such other temperature as may be specified

Note 1 to entry: R_{ct} is an actual value. It shall not be confused with the upper limit for R_{ct} , which can be specified otherwise.

3.4.203 composite error

ε_c

under steady-state conditions, the r.m.s. value of the difference between

- a) the instantaneous values of the primary current, and
- b) the instantaneous values of the actual secondary current multiplied by the rated transformation ratio,

the positive signs of the primary and secondary currents corresponding to the convention for terminal markings

Note 1 to entry: The composite error ε_c is generally expressed as a percentage of the r.m.s. values of the primary current:

$$\varepsilon_c = \frac{\sqrt{\frac{1}{T} \int_0^T (k_r i_s - i_p)^2 dt}}{I_p} \times 100 \%$$

where

k_r is the rated transformation ratio;

I_p is the r.m.s. value of the primary current;

i_p is the instantaneous value of the primary current;

i_s is the instantaneous value of the secondary current;

T is the duration of one cycle.

For further explanation, refer to 2A.4.

[SOURCE: IEC 60050-321:1986, 321-02-26, modified note to entry]

3.4.204 rated instrument limit primary current

I_{PL}

value of the minimum primary current at which the composite error of the measuring current transformer is equal to or greater than 10 %, the secondary burden being equal to the rated burden

[SOURCE: IEC 60050-321:1986, 321-02-27]

3.4.205 instrument security factor

FS

ratio of rated instrument limit primary current to the rated primary current

Note 1 to entry: Attention should be paid to the fact that the actual instrument security factor is affected by the burden. When the burden value is significantly lower than rated one, larger current values will be produced on the secondary side in the case of short-circuit current.

Note 2 to entry: In the event of system fault currents flowing through the primary winding of a current transformer, the safety of the apparatus supplied by the transformer is at its highest when the value of the rated instrument security factor (*FS*) is at its lowest.

[SOURCE: IEC 60050-321:1986, 321-02-28, modified notes to entry]

3.4.206 secondary limiting e.m.f. for measuring current transformers

E_{FS}

product of the instrument security factor *FS*, the rated secondary current and the vectorial sum of the rated burden and the impedance of the secondary winding

Note 1 to entry: The secondary limiting e.m.f. for measuring current transformers *E_{FS}* is calculated as

$$E_{FS} = FS \times I_{sr} \times \sqrt{(R_{ct} + R_b)^2 + X_b^2}$$

where: R_b is the resistive part of the rated burden;

X_b is the inductive part of the rated burden.

This method will give a higher value than the actual one. It was chosen in order to apply the same test method as used for protective current transformers. Refer to 7.2.6.202 and 7.2.6.203.

[SOURCE: IEC 60050-321:1986, 321-02-31, modified title, synonym and note to entry]

3.4.207 rated accuracy limit primary current

value of primary current up to which the current transformer will comply with the requirements for composite error

[SOURCE: IEC 60050-321:1986, 321-02-29]

3.4.208 accuracy limit factor

ALF

ratio of the rated accuracy limit primary current to the rated primary current

[SOURCE: IEC 60050-321:1986, 321-02-30]

3.4.209 secondary limiting e.m.f. for protective current transformers

E_{ALF}

product of the accuracy limit factor, the rated secondary current and the vectorial sum of the rated burden and the impedance of the secondary winding

Note 1 to entry: The secondary limiting e.m.f. for class P and PR protective current transformers *E_{ALF}* is calculated as

$$E_{ALF} = ALF \times I_{sr} \times \sqrt{(R_{ct} + R_b)^2 + X_b^2}$$

where: R_b is the resistive part of the rated burden;

X_b is the inductive part of the rated burden.

3.4.210 **saturation flux**

Ψ_{sat}

maximum value of secondary linked flux in a current transformer, which corresponds to the magnetic saturation of the core material

Note 1 to entry: The most suitable procedure for the determination of the saturation flux Ψ_{sat} is given with the d.c. saturation method described in 2B.2.3.

Note 2 to entry: In the former standard IEC 60044-6, Ψ_s was defined as a knee point value, which characterized the transition from the non-saturated to the fully saturated state of a core. This definition could not gain acceptance because the saturation value was too low, and led to misunderstandings and contradictions. Therefore, it was replaced by Ψ_{sat} , which defines the condition of complete saturation.

3.4.211 **remanent flux**

Ψ_r

value of secondary linked flux which would remain in the core 3 min after the interruption of a magnetizing current of sufficient magnitude to induce saturation flux (Ψ_{sat})

3.4.212 **remenance factor**

K_R

ratio of the remanent flux to the saturation flux, expressed as a percentage

3.4.213 **secondary loop time constant**

T_s

value of the time constant of the secondary loop of the current transformer obtained from the sum of the magnetizing and the leakage inductances (L_s) and the secondary loop resistance (R_s)

$$T_s = L_s / R_s$$

3.4.214 **excitation characteristic**

graphical or tabular presentation of the relationship between the r.m.s. value of the exciting current and a sinusoidal voltage applied to the secondary terminals of a current transformer, the primary and other windings being open-circuited, over a range of values sufficient to define the characteristics from low levels of excitation up to 1.1 times the knee point e.m.f.

3.4.215 **knee point voltage**

r.m.s. value of the sinusoidal voltage at rated frequency applied to the secondary terminals of the transformer, all other terminals being open-circuited, which, when increased by 10 %, causes the r.m.s. value of the exciting current to increase by 50 %

[SOURCE: IEC 60050-321:1986, 321-02-34]

3.4.216 **knee point e.m.f.**

e.m.f. of a current transformer at rated frequency, which, when increased by 10 %, causes the r.m.s. value of the exciting current to increase by 50 %

Note 1 to entry: While the knee point voltage can be applied to the secondary terminals of a current transformer, the knee point e.m.f. is not directly accessible. The values of the knee point voltage and of the knee point e.m.f. are deemed as equal, due to the minor influence of the voltage drop across the secondary winding resistance.

3.4.217

rated knee point e.m.f.

E_k

lower limit of the knee point e.m.f.

Note 1 to entry: The rated knee point e.m.f. appears in the specifications of class PX and PXR protective current transformers. It may be calculated as

$$E_k = K_x \times (R_{ct} + R_b) \times I_{sr}$$

3.4.218

rated turns ratio

specified ratio of the number of primary turns to the number of secondary turns

EXAMPLE 1 1/600 (meaning 1 primary turn to 600 secondary turns)

EXAMPLE 2 2/1200 (meaning 2 primary turns to 1200 secondary turns)

Note 1 to entry: The rated turns ratio appears in the specifications of class PX and PXR protective current transformers.

Note 2 to entry: Rated turns ratio and rated transformation ratio are both defined as primary to secondary entities. If they shall be compared, the value of the rated turns ratio has to be inverted.

3.4.219

turns ratio error

difference between the actual turns ratio and the rated turns ratio, expressed as a percentage of the rated turns ratio

3.4.220

dimensioning factor

K_x

factor to indicate the multiple of rated secondary current (I_{sr}) occurring under power system fault conditions, inclusive of safety margins, up to which the transformer is required to meet performance requirements

Note 1 to entry: See formula under 3.4.217.

3.4.221

instantaneous error current

i_ε

difference between the instantaneous values of the secondary current (i_s) multiplied by the rated transformation ratio (k_r) and the primary current (i_p):

$$i_\varepsilon = k_r \times i_s - i_p$$

Note 1 to entry: When both alternating current components (i_{sac} , i_{pac}) and direct current components (i_{sdc} , i_{pdc}) are present, the constituent components ($i_{\varepsilon ac}$, $i_{\varepsilon dc}$) are separately identified as follows:

$$i_\varepsilon = i_{\varepsilon ac} + i_{\varepsilon dc} = (k_r \times i_{sac} - i_{pac}) + (k_r \times i_{sdc} - i_{pdc})$$

3.4.222

peak instantaneous error

$\hat{\varepsilon}$

peak value (i_ε) of instantaneous error current (see 3.4.221) for the specified duty cycle, expressed as a percentage of the peak value of the rated primary short-circuit current:

$$\hat{\varepsilon} = \frac{\hat{i}_\varepsilon}{\sqrt{2} \times I_{psc}} \times 100\%$$

3.4.223

peak alternating error component

$\hat{\varepsilon}_{ac}$

peak value $\hat{i}_{ac}$ of the alternating component of the instantaneous error current, expressed as a percentage of the peak value of the rated primary short-circuit current:

$$\hat{\varepsilon}_{ac} = \frac{\hat{i}_{ac}}{\sqrt{2} \times I_{psc}} \times 100 \%$$

3.4.224

specified duty cycle (C-O and / or C-O-C-O)

duty cycle in which, during each specified energization, the primary short circuit current is assumed to have the worst-case inception angle (see Figure 201)

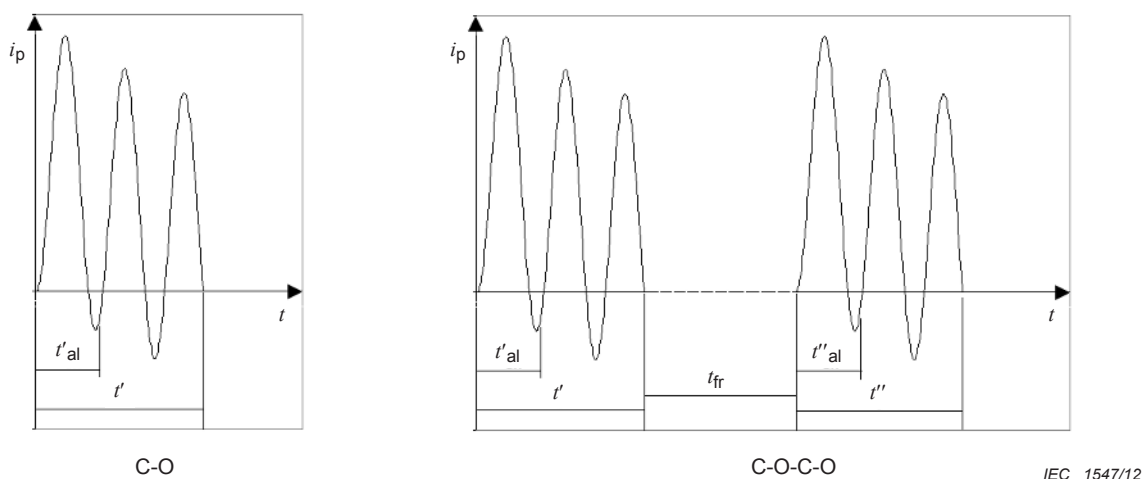


Figure 201 – Duty cycles

3.4.225

Specified primary time constant

T_p

that specified value of the time constant of the d.c. component of the primary short-circuit current on which the transient performance of the current transformer is based (see Figure 202)

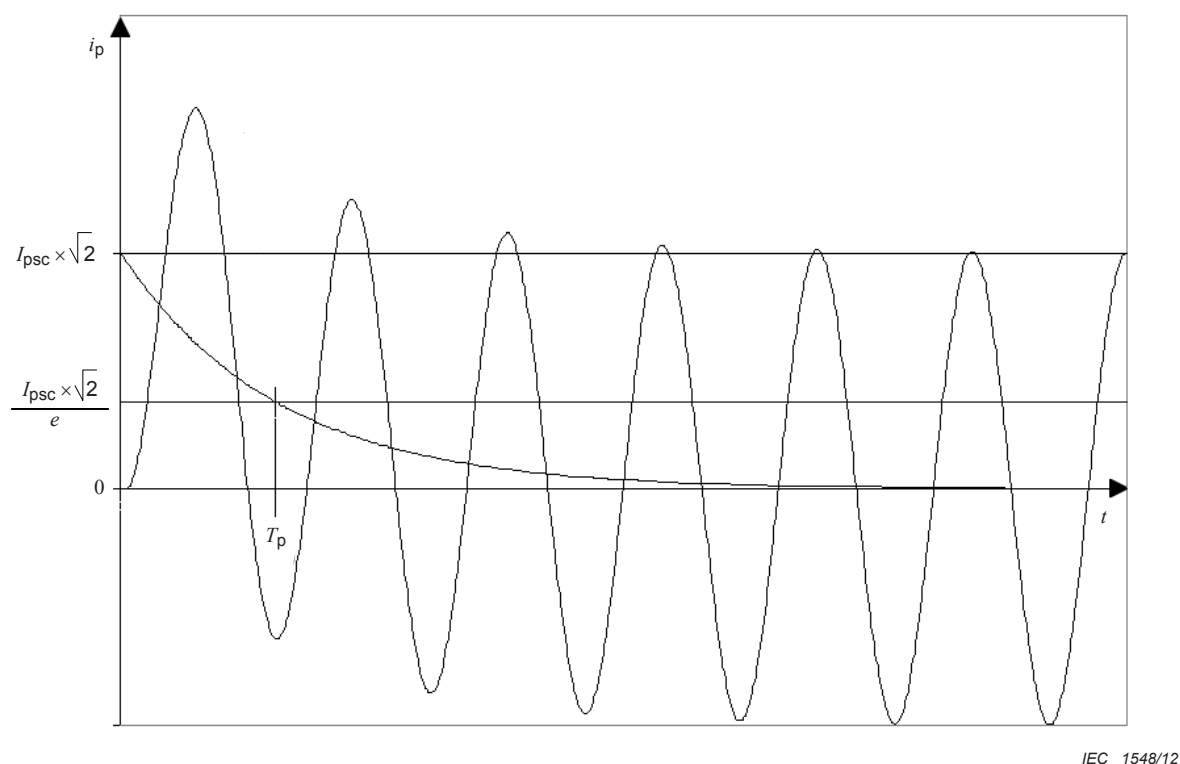


Figure 202 – Primary time constant T_p

3.4.226

duration of the first fault

t'

duration of the fault in a C-O duty cycle, or of the first fault in a C-O-C-O duty cycle

Note 1 to entry: See Figure 201.

3.4.227

duration of the second fault

t''

duration of the second fault in a C-O-C-O duty cycle

Note 1 to entry: See Figure 201.

3.4.228

specified time to accuracy limit in the first fault

t'_{al}

time in a C-O duty cycle, or in the first energization of a C-O-C-O duty cycle, during which the specified accuracy has to be maintained

Note 1 to entry: See Figure 201. This time interval is usually defined by the critical measuring time of the associated protection scheme.

3.4.229

specified time to accuracy limit in the second fault

t''_{al}

time in the second energization of a C-O-C-O duty cycle during which the specified accuracy has to be maintained

Note 1 to entry: See Figure 201. This time interval is usually defined by the critical measuring time of the associated protection scheme.

3.4.230 fault repetition time

t_{fr}
time interval between interruption and re-application of the primary short-circuit current during a circuit breaker auto-reclosing duty cycle in case of a non-successful fault clearance

Note 1 to entry: See Figure 201.

3.4.231 secondary loop resistance

R_s
total resistance of the secondary circuit

$$R_s = R_b + R_{ct}$$

3.4.232 rated symmetrical short-circuit current factor

K_{ssc}
ratio of the rated primary short circuit current to the rated primary current

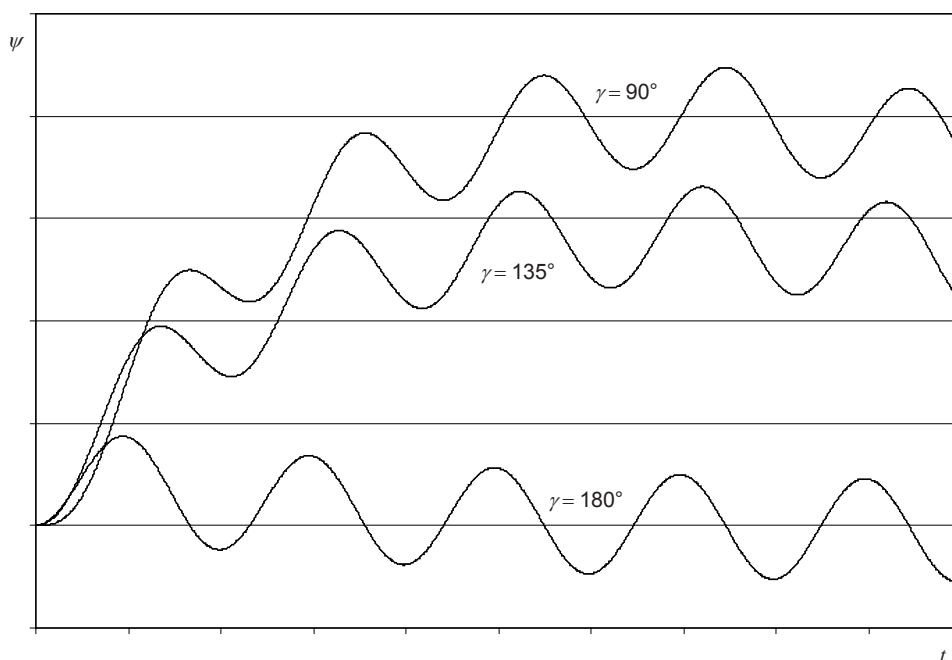
$$K_{ssc} = \frac{I_{psc}}{I_{pr}}$$

3.4.233 transient factor

K_{tf}
ratio of the secondary linked flux at a specified point of time in a duty cycle to the peak value of its a.c. component

Note 1 to entry: K_{tf} is calculated analytically with different formulae depending on T_p , T_S , on the duty cycle and on the fault inception angle. A determination of K_{tf} is given in Annex 2B.1.

Note 2 to entry: Figure 203 shows possible courses of the secondary linked flux for different fault inception angles γ .



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Figure 203 – Secondary linked flux for different fault inception angles γ

3.4.234 transient dimensioning factor

K_{td}

dimensioning factor to consider the increase of the secondary linked flux due to a d.c. component of the primary short circuit current

Note 1 to entry: While K_{tf} is defined as a function of time, K_{td} is the definitive dimensioning parameter. K_{td} is derived from current transformer requirements given by the relay manufacturer (gained from relay stability type tests) or from worst-case considerations based on the K_{tf} curves (see 2B.1).

3.4.235 Low-leakage reactance current transformer

current transformer for which measurements made at the secondary terminals (while primary open-circuited) are sufficient for an assessment of its protection performance up to the required accuracy limit

3.4.236 high-leakage reactance current transformer

current transformer which does not satisfy the requirements of 3.4.235, and for which an additional allowance is made by the manufacturer to take account of influencing effects which result in additional leakage flux

3.4.237 rated equivalent limiting secondary e.m.f.

E_{al}

that r.m.s. value of the equivalent secondary circuit e.m.f. at rated frequency necessary to meet the requirements of the specified duty cycle:

$$E_{al} = K_{ssc} \times K_{td} \times (R_{ct} + R_b) \times I_{sr}$$

3.4.238 peak value of the exciting secondary current at E_{al}

$\hat{I}_{al}$

peak value of the exciting current when a voltage corresponding to E_{al} is applied to the secondary terminals while the primary winding is open

3.4.239 factor of construction

F_c

factor reflecting the possible differences in measuring results at limiting conditions between direct test and indirect test methods

Note 1 to entry: The measuring procedure is given in 2B.3.3.

3.7 Index of abbreviations

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

<i>AIS</i>	Air-Insulated Switchgear
<i>ALF</i>	Accuracy limit factor
<i>CT</i>	Current Transformer
<i>CVT</i>	Capacitive Voltage Transformer
E_{al}	rated equivalent limiting secondary e.m.f.
E_{ALF}	secondary limiting e.m.f. for class P and PR protective current transformers
E_{FS}	secondary limiting e.m.f. for measuring current transformers
E_k	rated knee point e.m.f.

F	mechanical load
F_c	factor of construction
f_R	rated frequency
F_{rel}	relative leakage rate
FS	instrument security factor
GIS	Gas-Insulated Switchgear
$\hat{I}_{al}$	peak value of the exciting secondary current at E_{al}
I_{cth}	rated continuous thermal current
I_{dyn}	rated dynamic current
I_e	exciting current
I_{PL}	rated instrument limit primary current
I_{pr}	rated primary current
I_{psc}	rated primary short-circuit current
I_{sr}	rated secondary current
IT	Instrument Transformer
I_{th}	rated short-time thermal current
i_ε	instantaneous error current
k	actual transformation ratio
k_r	rated transformation ratio
K_R	remanence factor
K_{ssc}	rated symmetrical short-circuit current factor
K_{td}	transient dimensioning factor
K_{tf}	transient factor
K_x	dimensioning factor
L_m	magnetizing inductance
R_b	rated resistive burden
R_{ct}	secondary winding resistance
R_s	secondary loop resistance
S_r	rated output
t'	duration of the first fault
t''	duration of the second fault
t'_{al}	specified time to accuracy limit in the first fault
t''_{al}	specified time to accuracy limit in the second fault
t_{fr}	fault repetition time
T_p	specified primary time constant
T_s	secondary loop time constant
U_m	highest voltage for equipment
U_{sys}	highest voltage for system
VT	Voltage Transformer
$\Delta\varphi$	phase displacement
ε	ratio error

ε_c	composite error
$\hat{\varepsilon}$	peak value of instantaneous error
$\hat{\varepsilon}_{ac}$	peak value of alternating error component
Ψ_r	remanent flux
Ψ_{sat}	saturation flux

5 Ratings

5.3 Rated insulation levels

5.3.2 Rated primary terminal insulation level

Clause 5.3.2 of IEC 61869-1:2007 is applicable with the addition of the following:

For a current transformer without primary winding and without primary insulation of its own, the value $U_m = 0,72$ kV is assumed.

5.3.5 Insulation requirements for secondary terminals

Clause 5.3.5 of IEC 61869-1:2007 is applicable with the addition of the following:

The secondary winding insulation of class PX and class PXR current transformers having a rated knee point e.m.f. $E_k \geq 2$ kV shall be capable of withstanding a rated power frequency withstand voltage of 5 kV r.m.s. for 60 s.

5.3.201 Inter-turn insulation requirements

The rated withstand voltage for inter-turn insulation shall be 4,5 kV peak.

For class PX and class PXR current transformers having a rated knee point e.m.f. of greater than 450 V, the rated withstand voltage for the inter-turn insulation shall be a peak voltage of 10 times the r.m.s. value of the specified knee point e.m.f., or 10 kV peak, whichever is the lower.

NOTE 1 Due to the test procedure, the wave shape can be highly distorted.

NOTE 2 In accordance with the test procedure 7.3.204, lower voltage values may result.

5.5 Rated output

5.5.201 Rated output values

The standard values of rated output for measuring classes, class P and class PR are:

2,5 – 5,0 – 10 – 15 and 30 VA.

Values above 30 VA may be selected to suit the application.

NOTE For a given transformer, provided one of the values of rated output is standard and associated with a standard accuracy class, the declaration of other rated outputs, which may be non-standard values, but associated with other standard accuracy classes, is not precluded.

5.5.202 Rated resistive burden values

Standard values for rated resistive burden in Ω for class TPX, TPY and TPZ current transformers are:

0,5 – 1 – 2 – 5 Ω