Transformadores de medida y protección

Transformadores de protección – Normativa IEC

Daniel Slomovitz
Instituto de Ingeniería Eléctrica
Facultad de Ingeniería
UNIVERSIDAD DE LA REPÚBLICA

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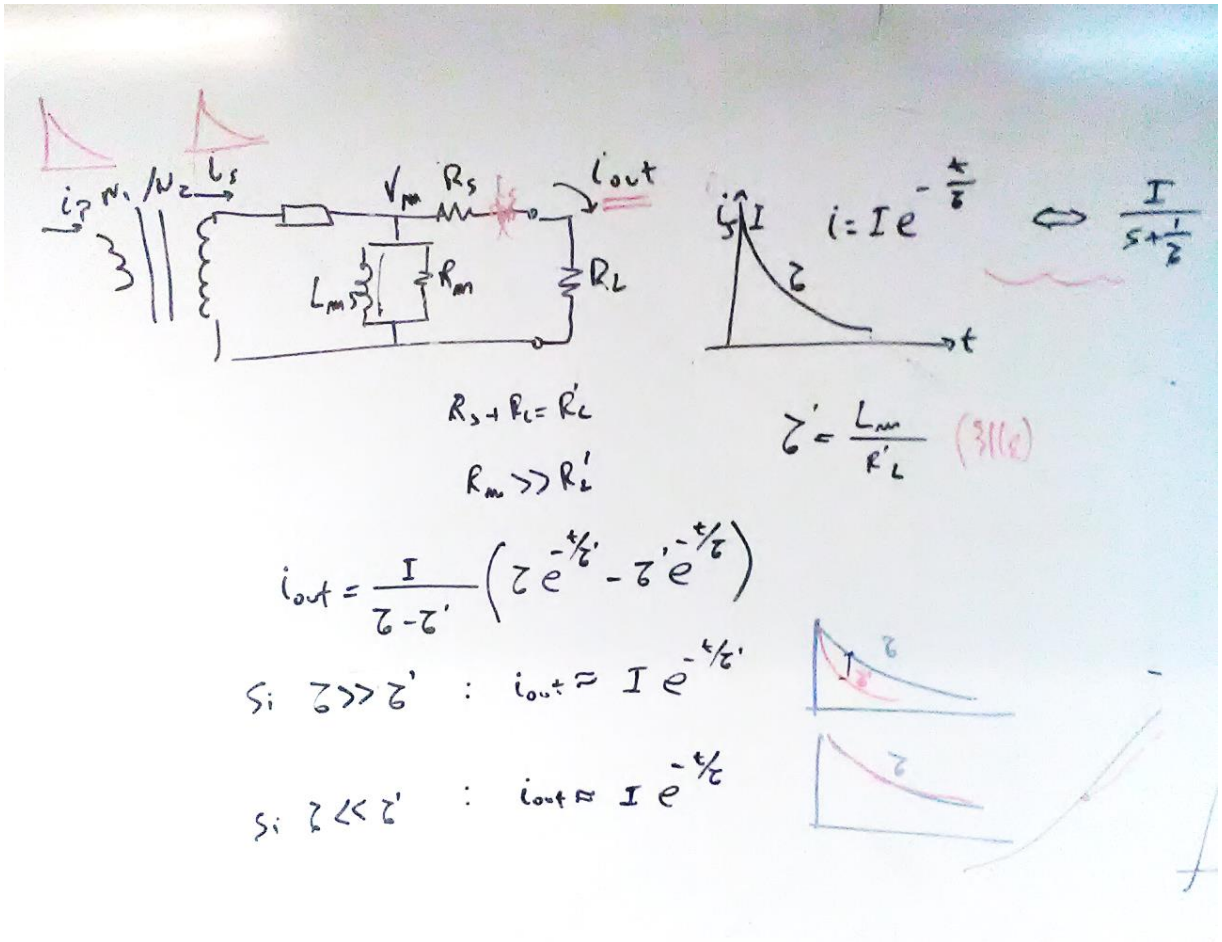
IEC 61869-2 Transformadores de corriente

			Información sobre saturación		
Tipos de CT de protección	Con límite de flujo remanente	Baja inductancia de fuga secundaria	Característica V-I	Pico de error instantáneo	Constante de tiempo. Pico de la componente de error alterna
P	NO	NO	SI	NO	NO
PR	SI	NO	SI	NO	NO
PX	NO	SI	SI	NO	NO
PXR	SI	SI	SI	NO	NO
TPX	NO		NO	SI	NO
TPY	SI		NO	SI	NO
TPZ	SI		NO	NO	SI

Constante de tiempo



Instantaneous error current

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):

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

Error compuesto

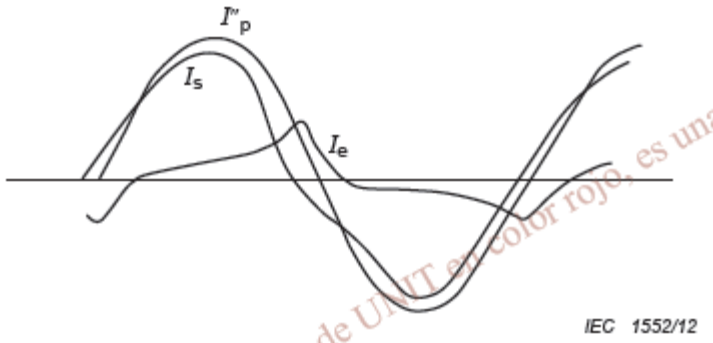


Figure 2A.3 – Typical current waveforms

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:

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

Peak alternating error component

3.4.223

peak alternating error component

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

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

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

Accuracy limit factors (*ALF)*

- Ratio of the rated accuracy limit primary current to the rated primary current
- Standard values: 5 – 10 – 15 – 20 – 30

Accuracy class

- 5P- 10P

The rated burden shall have a power-factor of 0,8 inductive except that, when the rated output is less than 5 VA a power-factor of 1,0 shall be used.

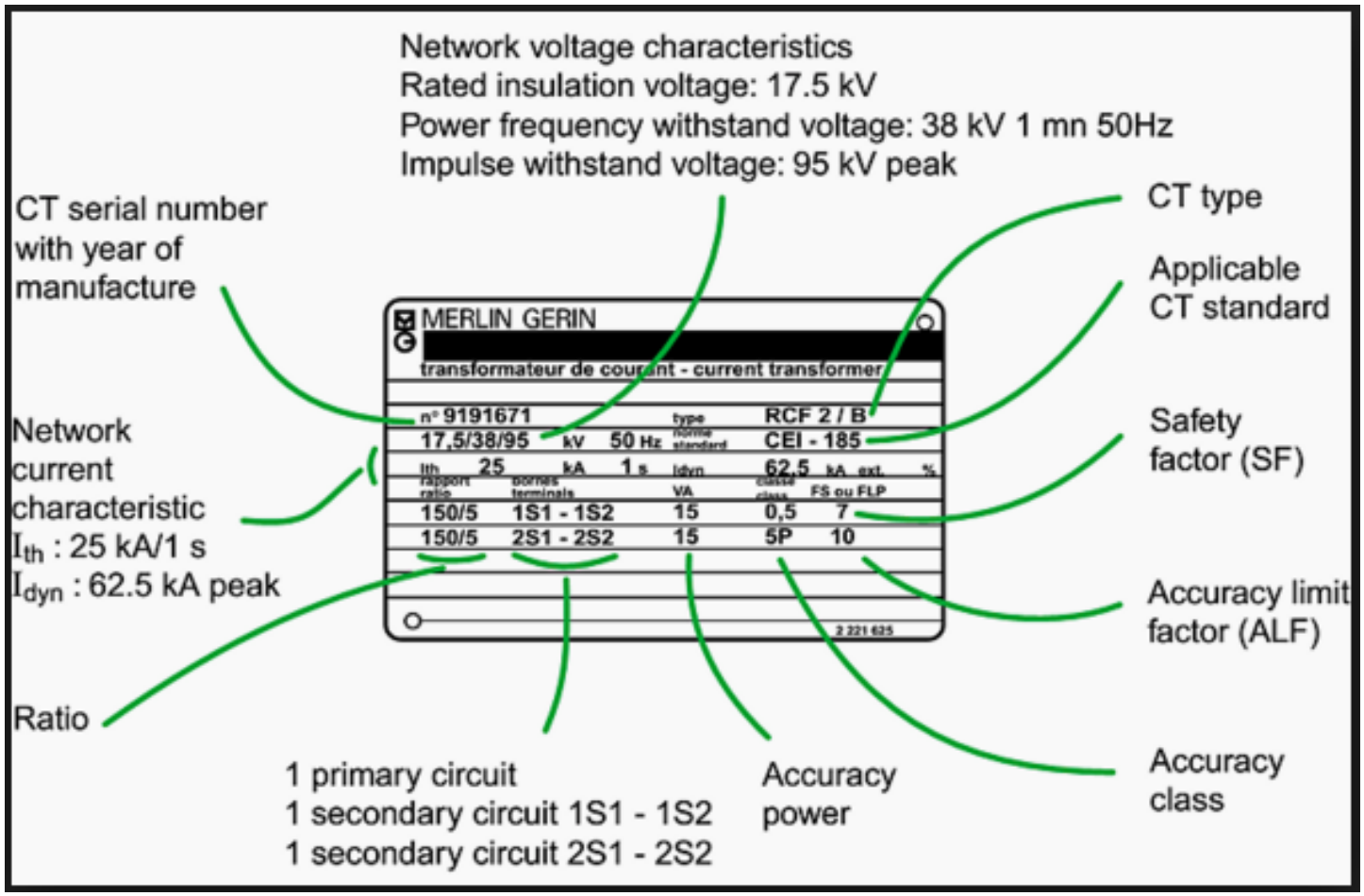
Table 205 – Error limits for protective current transformers class P and PR

Accuracy class	Ratio error at rated primary current	Phase displacement at rated primary current		Composite error at rated accuracy limit primary current
	± %	± Minutes	± Centiradians	%
5P and 5PR	1	60	1,8	5
10P and 10PR	3	–	–	10

Error limits for TPX, TPY and TPZ current transformers

Class	At rated primary current			Transient error limits under specified duty cycle conditions
	Ratio error ±%	Phase displacement Minutes	Centiradians	
TPX	0,5	±30	±0,9	$\hat{\varepsilon}$ =10 %
TPY	1,0	±60	±1,8	$\hat{\varepsilon}$ =10 %
TPZ	1,0	180±18	5,3±0,6	$\hat{\varepsilon}_{ac}$ =10 %

Placa característica



Ensayo de error en CT de protección

7.2.6.203 Test for composite error of class P and PR protective current transformers

The following two test procedures are given:

a) Compliance with the limits of composite error given in Table 205 shall be demonstrated by a direct test in which a substantially sinusoidal current equal to the rated accuracy limit primary current is passed through the primary winding with the secondary winding connected to a burden of magnitude equal to the rated burden but having, at the discretion of the manufacturer, a power factor between 0,8 inductive and unity (see 2A.4, 2A.5, 2A.6, 2A.7.

The test may be carried out on a transformer similar to the one being supplied, except that reduced insulation may be used, provided that the same geometrical arrangement is retained.

As far as very high primary currents and single-bar primary winding current transformers are concerned, the distance between the return primary conductor and the current transformer should be taken into account from the point of view of reproducing service conditions.

Ensayo de error en CT de protección

b) For low-leakage reactance current transformers according to Annex 2C, the direct test may be replaced by the following indirect test.

With the primary winding open-circuited, the secondary winding is energized at rated frequency by a substantially sinusoidal voltage having an r.m.s. value equal to the secondary limiting e.m.f. E_{ALF}.

The resulting exciting current, expressed as a percentage of $I_{sr} \times ALF$ shall not exceed the composite error limit given in Table 205.

The exciting voltage shall be measured with an instrument which has a response proportional to the average of the rectified signal, but calibrated in r.m.s.. The exciting current shall be measured using an r.m.s measuring instrument having a minimum crest factor of 3.

In determining the composite error by the indirect method, a possible correction of the turns ratio need not be taken into account.

Ensayo de error en CT de protección

7.2.6.204 Test for error at limiting conditions for class TPX, TPY and TPZ protective current transformers

The purpose of the type test is to prove the compliance with the requirements at limiting conditions. For test methods refer to Annex 2B.

If the current transformer is a low-leakage reactance type according to Annex 2C, an indirect type test may be performed according to 2B.2, otherwise a direct test shall be performed according to 2B.3.

2B.2 Measurement of the core magnetization characteristic

2B.2.1 General

Measuring the core magnetization characteristic implies

- the measurement of the magnetizing inductance L_m;
- the measurement of the remanence factor K_R;
- the determination of the error at limiting conditions using an indirect method.

IEC 61869-3 Transformadores de tensión inductivos

5% a (1,2 1,5 o 1,9) de la tensión nominal

Al 2% de la tensión asignada, los límites del error de tensión y del desfase serán el doble de los dados en la tabla 302.

Tabla 302 – Límites del error de tensión y del desfase de los transformadores de tensión para protección

Clase	Error de tensión (relación) ε_u	Desfase $\Delta\varphi$	
	± %	± Minutos	± Centirradianes
3P	3,0	120	3,5
6P	6,0	240	7

NOTA Cuando se soliciten transformadores que tengan dos arrollamientos secundarios separados, y debido a su interdependencia, el usuario debería especificar dos rangos de potencia de salida, uno para cada arrollamiento, correspondiendo el límite superior de cada rango de potencia a un valor de potencia de precisión normalizado. Cada arrollamiento debería satisfacer sus respectivos requisitos de precisión dentro de este rango de potencia de salida, mientras que a la vez el otro arrollamiento tiene una potencia de salida de cualquier valor desde cero hasta el 100% del límite superior de su rango de potencia de salida. Para verificar el cumplimiento de este requisito, es suficiente ensayar solamente los valores extremos. Si no se proporciona especificación de los rangos de potencia de salida, se considera que estos rangos son del 25% al 100% de la potencia de precisión para cada arrollamiento.

IEC 61869-5 Transformadores de tensión capacitivos

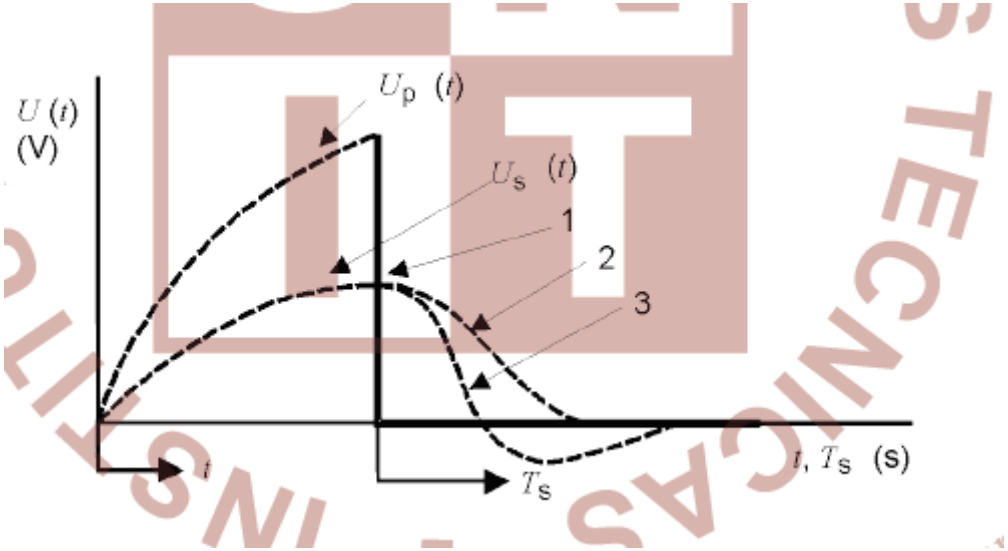
- Para las clases de precisión de protección, el rango de frecuencias asignado es del 96% al 102% de la frecuencia asignada.

Errores

Tabla 502 – Límites del error de tensión y del desfase para transformadores de tensión capacitivos de protección

Clases de protección	% de la tensión asignada											
	2	5	100	X	2	5	100	X	2	5	100	X
	Error de tensión (de relación) ε_u ± %				Desfase, $\Delta\varphi$ ± minutos				Desfase, $\Delta\varphi$ ± centiradianes			
3P	6,0	3,0	3,0	3,0	240	120	120	120	7,0	3,5	3,5	3,5
6P	12,0	6,0	6,0	6,0	480	240	240	240	14,0	7,0	7,0	7,0
NOTA X = $F_V \cdot 100$ (factor de tensión asignado multiplicado por 100).												

Respuesta transitoria



1 Cortocircuito de $U_P(t)$

2 Amortiguamiento aperiódico de $U_S(t)$

3 Amortiguamiento periódico de $U_S(t)$

Respuesta transitoria

Tabla 507 – Valores y clases normalizadas de respuesta transitoria

Tiempo T_S s	Relación $\frac{\lvert U_S(t)\rvert}{\sqrt{2} \times U_S} \times 100\,\%$		
	Clases		
	3PT1 6PT1	3PT2 6PT2	3PT3 6PT3
10×10^{-3}	–	≤ 25	≤ 4
20×10^{-3}	≤ 10	≤ 10	≤ 2
40×10^{-3}	< 10	≤ 2	≤ 2
60×10^{-3}	< 10	≤ 0,6	≤ 2
90×10^{-3}	< 10	≤ 0,2	≤ 2

Fin