

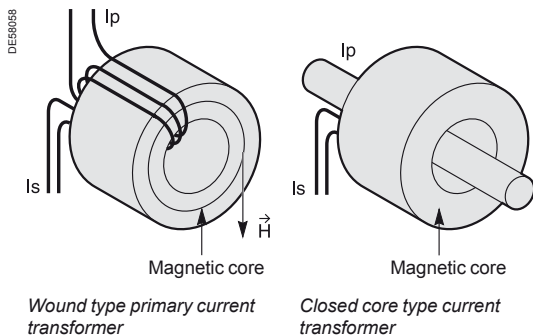
Current transformers (CT) meet standard IEC 60044-1.

Their function is to supply the secondary circuit with a current that is proportional to that of the MV circuit on which they are installed.

The primary is series-mounted on the MV network and subject to the same over-currents as the latter and withstands the MV voltage.

The secondary generally has one of its terminals connected to earth.

The secondary must never be in an open circuit (short circuit).



Current transformers

Current transformers have two basic functions:

- adapting the MV current value at the primary to the characteristics of the metering or protection devices by supplying a secondary current with a reduced, but proportional current value
- isolating power circuits from the metering and/or protection circuit.

Composition and types

A current transformer comprises a primary circuit and a secondary circuit connected via a magnetic core and an insulating coating system in epoxy-silica, in the case of Schneider Electric transformers.

The device is of the following type:

- wound: when the primary and the secondary have a coil wound on the magnetic circuit
- slip-over: primary made up of a conductor that is not insulated from the installation
- core: primary made up of an insulated cable.

Characteristics

These are defined in standard IEC 60044-1.

Insulation

Characterized by the rated voltage:

- of the insulation, which is that of the installation (e.g.: 24 kV)
- of the power frequency withstand 1 min (e.g.: 50 kV)
- of the impulse withstand (e.g.: 125 kV).

Rated frequency

50 or 60 Hz.

Rated primary current (I_{pn})

Rms value of the maximum continuous primary current. Usual values are 25, 50, 75, 100, 200, 400, 600 A.

Rated secondary current (I_{sn})

This is equal to 1 A or 5 A.

Rated transformation ratio

$K_n = I_{\text{rated primary}} / I_{\text{rated secondary}}$ (e.g.: 100 A / 5 A)

Short-time thermal current I_{th} - 1 second

This characterizes the thermal withstand under short circuit conditions for 1 second. It is expressed in kA or in a multiple of the rated primary current (e.g.: 80 x I_{pn}) for 1 second.

The value for a **duration that is different to 1 second** is given by:

$$I'_{th} = I_{th} / \sqrt{2}$$

For example 16 kA - 1 s is equivalent for 2 s to $I'_{th} = 16 \times \sqrt{2} = 22.6$ kA.

Characteristics (cont.)

Short-time thermal current peak value

This value is standardized from $I_{th} - 1$ s at:

- IEC: 2.5 I_{th} at 50 Hz and 2.6 I_{th} at 60 Hz
- ANSI: 2.7 I_{th} 60 Hz.

Accuracy load

The value of the load on which is based the metered current accuracy conditions.

Accuracy power P_n

Apparent power (VA) that the CT can supply on the secondary for the rated secondary current for which the accuracy is guaranteed (accuracy load). Usual values 5 - 7.5 - 10 - 15 VA (IEC).

Accuracy class

Defines the limits of error guaranteed on the transformation ratio and on the phase shift under the specified conditions of power and current. Classes **0.5** and **1** are used for metering class **P** for protection.

Current error ε (%)

Error that the transformer introduces in the measurement of a current when the transformation ratio is different from the rated value.

Phase shift or phase error ψ (minute)

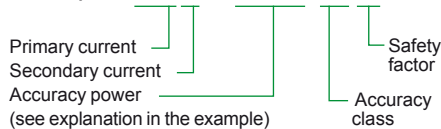
Difference in phase between the primary and secondary currents, in angle minutes.

Table of current transformer characteristics

Characteristics	Rated values				
Rated voltage (kV)	7.2	12	17.5	24	36
Insulation level:					
■ power frequency withstand (kV) 1 min	20	28	38	50	70
■ lightning impulse withstand (kV - peak)	60	75	95	125	170
Frequency (Hz)	50 - 60				
Primary current I_{pn} (A)	25 - 50 - 75 - 100 - 200 - 400 - 600...				
Short-time thermal current I_{th} (1 s)	12.5 - 16 - 20 - 25 - 31.5 - 40 - 50 kA or 40 - 80 - 100 - 200 - 300 x I_n				
Secondary current I_{sn} (A)	1 - 5				
Accuracy power P_n (VA)	2.5 - 5 - 7.5 - 10 - 15				

CT's for protection must have suitable accuracy for fault currents. They are characterized by their accuracy class (generally 5P) and the accuracy limit factor FLP.

Example: 400/5 A, 15 VA, 5P10



CT for protection

Accuracy class

A protection CT is designed to send as reliable an image as possible of the **fault current** (overload or short circuit). The accuracy and the power are suited to these currents and different from those for metering applications. IEC standard 60044-1 determines the maximum error for each accuracy class in the phase and in the module according to the indicated operating range.

Error limits according to the accuracy class

Accuracy class	Combined error for the accuracy limit current	Current error between I_{pn} and $2I_{pn}$	Phase shift error for the rated current
5P	5%	$\pm 1\%$	± 60 min
10P	10%	$\pm 3\%$	No limit

For example for class 5P the maximum error is $\leq \pm 5\%$ at the accuracy limit current and $\leq \pm 1\%$ at the rated current.

Standardized classes are 5P and 10P. The choice depends on the application. The accuracy class is always followed by the accuracy limit factor.

Accuracy class according to application

Application	Class
Zero sequence protection Differential protection	5P
Impedance relay Amperemetric protection	5P - 10P

Accuracy limit factor: FLP

A protection CT must saturate at sufficiently high currents to enable sufficient accuracy in the measurements of fault currents by the protection device whose operating threshold can be very high.

We define the limit primary current (I_{pl}) for which current errors and phase shift errors in the secondary do not exceed values in the table opposite. The standard then defines the accuracy limit factor FLP.

$$FLP = \frac{I_{pl}}{I_{pn}} \quad (\text{standardized values: } 5 - 10 - 15 - 20 - 30)$$

In practice this corresponds to the linearity limit (saturation curve) of the CT.

Example

Protection CT: **100/5 A, 7.5 VA, 5P20.**

- rated primary current 100 A
- rated secondary current 5 A
- rated transformation ratio 100/5 A
- accuracy power 7.5 VA
- accuracy class 5P.

Under a load corresponding to the accuracy power of 7.5 VA, the error limit table gives an error $\leq \pm 1\%$ and ± 60 min at I_{pn} (100 A).

- accuracy limit factor 20.

At a load corresponding to the accuracy power, the error $\leq \pm 5\%$.

Selection guide

Using the order forms

The tables on the following pages allow you to define the current transformer reference that corresponds to the necessary and required characteristics, and to place your order.

The selection factors enabling you to find the reference you require are explained in the example given below for a DIN type metering CT, in reference to the previous definitions.

Network insulation 12 kV

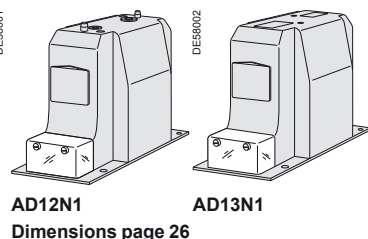
Rated primary current 75 A and secondary output 5 A

Short-time thermal current MV side 31.5 A - 1 s

Power supplied to the secondary 15 VA. Accuracy class 0.5 defines the metering error limits. The safety factor is < 10

Mark the quantity to be ordered

Insulation level and frequency	Transformation ratio A / A	Short-time thermal current kA x 1 s	Power, accuracy class, safety factor FS	Type	Reference	Quantity
Ur 12 kV Ud 28 kV - 1 min Up 75 kV peak fr 50/60 Hz	50 / 5	12.5	15 VA cl. 0.5 Fs < 10	AD12	03811366N0	
		16		AD12	03811368N0	
		25		AD12	03811371N0	
		31.5		AD12	03811373N0	
	100 / 5	25		AD12	03811376N0	
		31.5		AD12	03811378N0	
		25		AD12	03811380N0	
		31.5		AD12	03811382N0	
	200 / 5	40		AD12	03811384N0	
		40		AD12	03811386N0	
		50	20 VA cl. 0.5 Fs < 10	AD12	03811388N0	
		50		AD12	03811390N0	
	400 / 5	50	30 VA cl. 0.5 Fs < 10	AD13	03811392N0	
		50		AD13	03811394N0	
	600 / 5	50				
	750 / 5	50				
	1000 / 5	50				
	1250 / 5	50				



Calculating the power (VA)

Indicative metering consumptions

Device		Max. consumption in VA (per circuit)
Ammeter	Electromagnetic	3
	Electronic	1
Transducer	Self-powered	3
	External powered	1
Meter	Induction	2
	Electronic	1
	Wattmeter, varmeter	1

Indicative protection consumption

Device	Max. consumption in VA (per circuit)
Static over-current relay	0.2 to 1
Electromagnetic over-current relay	1 to 8

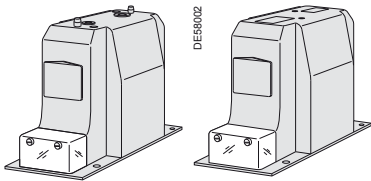
Indicative secondary cabling consumption

Cables (mm ²)	Consumption (VA/m)	
	1 A	5 A
2.5	0.008	0.2
4	0.005	0.13
6	0.003	0.09
10	0.002	0.05

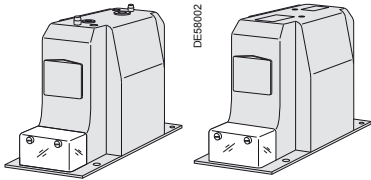
Order form

DIN standard 12 kV CT - single and double secondary

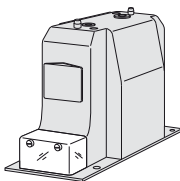
Single secondary metering CT

Insulation level and frequency	Transformation ratio A / A	Short-time thermal current kA x 1 s	Power, accuracy class, safety factor FS	Type	Reference	Qty
Ur 12 kV Ud 28 kV - 1 min Up 75 kV peak fr 50/60 Hz  AD12 AD13 Dimensions page 26	50 / 5	12.5	15 VA cl. 0.5 Fs < 10	AD12/N1	03811366N0	
		16		AD12/N1	03811368N0	
		25		AD12/N1	03811371N0	
	75 / 5	31.5		AD12/N1	03811373N0	
		25		AD12/N1	03811376N0	
		31.5		AD12/N1	03811378N0	
	100 / 5	25		AD12/N1	03811380N0	
		31.5		AD12/N1	03811382N0	
		40		AD12/N1	03811384N0	
	200 / 5	40		AD12/N1	03811386N0	
		50	20 VA cl. 0.5 Fs < 10	AD12/N1	03811388N0	
		50		AD12/N1	03811390N0	
	400 / 5	50		AD13/N1	03811392N0	
		50	30 VA cl. 0.5 Fs < 10	AD13/N1	03811394N0	
		50				

Single secondary protection CT

Insulation level and frequency	Transformation ratio A / A	Short-time thermal current kA x 1 s	Power and accuracy class (possible double use)	Type	Reference	Qty
Ur 12 kV Ud 28 kV - 1 min Up 75 kV peak fr 50/60 Hz  AD12 AD13 Dimensions page 26	50 / 5	12.5	15 VA 5P10 - 7.5 VA 5P20	AD12/N1	03811367N0	
		16		AD12/N1	03811369N0	
		25		AD12/N1	03811370N0	
	75 / 5	25	15 VA 5P10 - 7.5 VA 5P20	AD12/N1	03811372N0	
		31.5		AD12/N1	03811374N0	
		40		AD12/N1	03811375N0	
	100 / 5	25	15 VA 5P10 - 7.5 VA 5P20	AD12/N1	03811377N0	
		31.5		AD12/N1	03811379N0	
		40		AD12/N1	03811839N0	
	200 / 5	25	15 VA 5P10 - 7.5 VA 5P20	AD12/N1	03811381N0	
		31.5		AD12/N1	03811383N0	
		40		AD12/N1	03811385N0	
	400 / 5	40		AD12/N1	03811387N0	
		50		AD12/N1	03811389N0	
		50		AD12/N1	03811391N0	
	1000 / 5	50	10 VA 5P20	AD13/N1	03811393N0	
		50		AD13/N1	03811395N0	

Double secondary metering and protection CT

Insulation level and frequency	Transformation ratio A / A	Short-time thermal current kA x 1 s	Metering secondary: power, accuracy class, safety factor FS	Metering secondary: power and accuracy class (possible double use)	Type	Reference	Qty
Ur 12 kV Ud 28 kV - 1 min Up 75 kV peak fr 50/60 Hz  AD12 Dimensions page 26	50 / 5-5	12.5	7.5 VA cl. 0.5 Fs < 10	7.5 VA 5P10	AD12/N2	03811396N0	
		16			AD12/N2	03811397N0	
		25			AD12/N2	03811398N0	
	75 / 5-5	16			AD12/N2	03811399N0	
		25			AD12/N2	03811400N0	
		31.5			AD12/N2	03811401N0	
	100 / 5-5	25	15 VA cl. 0.5 Fs < 10	15 VA 5P10 - 7.5 VA 5P20	AD12/N2	03811402N0	
		31.5			AD12/N2	03811403N0	
		40			AD12/N2	03811404N0	
	200 / 5-5	40	15 VA cl. 0.5 Fs < 10	15 VA 5P10 - 7.5 VA 5P20	AD12/N2	03811405N0	
		50			AD12/N2	03811406N0	
		50			AD12/N2	03811407N0	
	400 / 5-5	50	20 VA cl. 0.5 Fs < 10	10 VA 5P20	AD13/N2	03811408N0	
		50			AD13/N2	03811409N0	