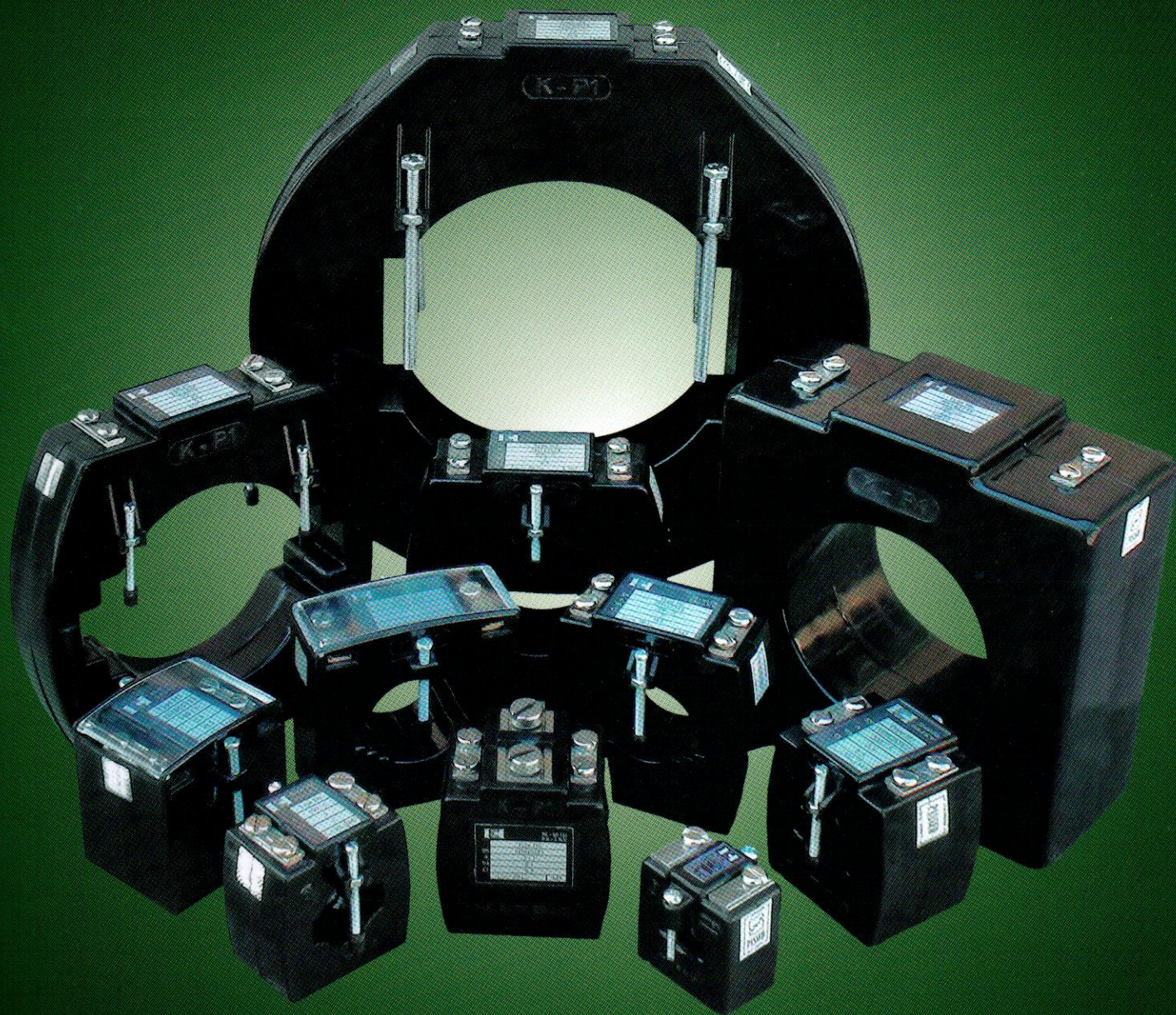


**HARRIS
CURRENT
TRANSFORMER**



**HARRIS
VOLTAGE
TRANSFORMER**



**5 - 15000 A
0.6 - 3 KV
50 - 60 Hz**

**ACCORDING TO:
INTERNATIONAL ELECTROTECHNIC COMMISSION (IEC 60044-1)
AND VEREIN DEUTSCHER ELEKTROTECHNIKER (VDE 0414)**

Application

Measuring instruments, such as ammeters, voltmeters, kilowatt-hours meters, wattmeters, VAR meters and power factor meters, whether electromechanical or electronic, meet insuperable design problems if faces with the high voltages or high currents commonly used in power systems. Furthermore, the range of currents employed throughout is such that it would not be practical to manufacture instruments on a mass production scale to meet the wide variety of current ranges required. The current transformer makes it possible to measure, high currents using ordinary instruments.

Principle of operation

A current transformer is defined as an instrument transformer in which the secondary current is substantially proportional to the primary current (under normal conditions of operation) and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections. This highlights the accuracy requirement of the current transformer but also important is the isolating function, which means no matter what the system voltage the secondary circuit need be insulated only for a low voltage. The current transformer works on the principle of variable flux. In the ideal current transformer, secondary current would be exactly equal (when multiplied by the turns ratio) and opposite to the primary current. But, some of the primary current or the primary ampere-turns is utilized for magnetizing the core, thus leaving less than the actual primary ampere turns to be "transformed" into the secondary ampere-turns. This naturally introduces an error in the transformation. The error is classified into two-the current or ratio error and the phase error.

Accuracy class

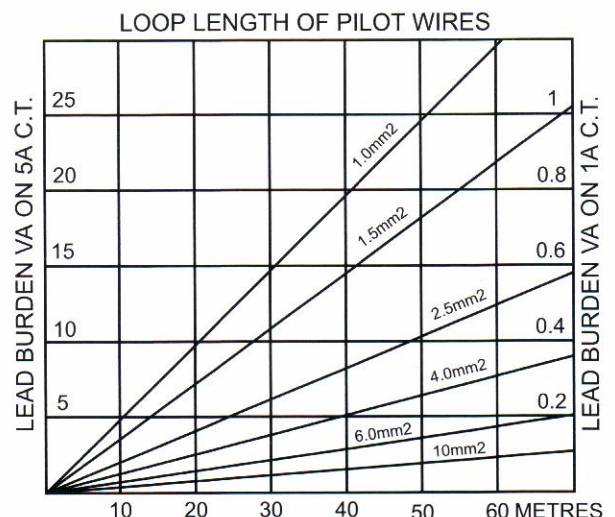
In the case of metering CTs, accuracy class is typically, 0.2,0.5,1 or 3 . This means that the errors have to be within the limits specified in the standards for that particular accuracy class. The metering CT has to be accurate from 5% to 120% of the rated primary current, at 25% and 100% of the rated burden at the specified power factor.

Accuracy class for various types of measurement are set out in IEC44-1 and VDE0414 as follows. It will be seen that the class designation is an approximate measure of the accuracy,e.g.,class 1 current transformers have ratio error within 1% of rated current. Phase difference is important when power measurements are involved, i.e., when using kilowatt-hours meters, wattmeters, VARmeters and power factor meters.

Accuracy class	Percentage current error at percentage of rated current shown below				Phase displacement (minute) at percentage of rated current shown below				Application
	5	20	100	120	5	20	100	120	
% of rated current	5	20	100	120	5	20	100	120	
0.2	0.75	0.35	0.2	0.2	30	15	10	10	Precision Testing & Measurement
0.5	1.5	0.75	0.5	0.5	90	45	30	30	Tarrif KWH & Current Metering
1.0	3.0	1.5	1.0	1.0	180	90	60	60	Commercial KWH & Current Metering

Burden

Burden is the load imposed on the secondary of the CT at rated current and is measured in VA (product of volts and amps). The accuracy class applies only to load at rated VA and below, down to one quarter VA. The burden on the secondary of a CT includes the effect of pilot leads, connections etc., as well as the instrument burden itself. The diagram shows the burden imposed on the CT due to a run of pilot wire. It will be seen that a pilot loop of 2.5 mm² wire, 60 meters long (30 meters distance) has a resistance of 12.5 VA on a 5 amp CT but only 0.5 VA on a 1 amp CT.



Phase Displacement

Is the angle of the phase shift between the secondary and the primary current. This angle is specified in angle minutes and positively calculated if the secondary size goes after the primary one.

Thermic Current (I_{th})

Thermic current is the highest primary current (effective value) that the CT can support for 1 second, without damage, owing to excessive overloads, with secondary short circuited.

Dynamic Current (I_{dyn})

Dynamic current is the highest primary current (peak value) that the CT can support for 1 second, without damage, owing electromagnetic efforts, with secondary short circuited.

Highest Voltage Limit Range

Is the standardized highest permanent permitted r.m.s. value for the phase-to-phase voltage for which a transformer is designed in respect of its insulation. It is denoted as a number which describes the voltage in KV, e.g. 0.6 meaning a highest permanent delta voltage of 850 V.

Instrument security factor (f_s):

This typically takes a value of less than 5 or less than 10 though it could be much higher if the ratio is very low. If the factor of security of the CT is 5, it means that the composite error of the metering CT at 5 times the rated primary current is equal to or greater than 10%. This means that heavy currents on the primary are not passed on to the secondary circuit and instruments are therefore protected. In the case of double ratio CTs, FS is applicable for the lowest ratio only.

Knee point voltage

That point on the magnetizing curve where an increase of 10% in the flux density (voltage) causes an increase of 50% in the magnetizing force (current).

Open-Circuit-Voltage

The outputs of current transformers are **constant current sources**. If the burden is increased the output voltage simultaneously increases too (according to the relation $U=R.I$) as long as magnetic saturation occurs. Above the saturation the peak voltage increases while the deformation of the secondary current is growing until the maximum at an almost infinitely high load (that means open secondary circuit).

Thus high voltage spikes may occur which can be dangerous to human beings and which can damage the CT. There are configurations of CT which are protected against damaging because they have a higher insulation of the winding. But that does not mean, that the **open-circuit-operation** is harmless to human beings. Consequently an open-circuit-operation is to be avoided. Unloaded CTs have to be short-circuited secondarily.

Harris Measuring Current Transformer

This compact range of current transformers is designed to comply with IEC 44-1 and VDE 0414 regulations. The units are clean and uniform in appearance and are entirely enclosed in impact and heat resisting housings. The moulded apertures allow the transformers to be rapidly and firmly clamped or wedged to metric or inch busbars. Alternatively, transformers can be supplied with mounting feet. All terminal fittings are manufactured from plated brass and are grooved to ensure excellent contact pressure. Current transformers are available in accuracy classes ranging from 0.5 to 3 and are fully tested using modern and highly accurate test equipment prior to despatch. Test certificates are available on request.

Harris Protection Current Transformers

Protective current transformers are designed to measure the actual currents in power systems and to produce proportional currents in their secondary windings which are isolated from the main power circuit. These replica currents are used as inputs to protective relays which will automatically isolate part of a power circuit in the event of an abnormal or fault condition therein, yet permit other parts of the plant to continue in operation.

Satisfactory operation of protective relays can depend on accurate representation of currents ranging from small leakage currents to very high overcurrents, requiring the protective current transformer to be linear, and therefore below magnetic saturation, at values up to perhaps 20 times full load current. This wide operating range means that protective current transformers require to be constructed with larger cross-sections resulting in heavier cores than equivalent current transformers used for measuring duties only. For space and economy reasons, equipment designers should however avoid over-specifying protective current transformers Harris technical staff are always prepared to assist in specifying protective CT's but require some or all of the following information:

- (a) Ratio (b) Accuracy class (c) Burden or pilot wire resistance, or length of run and pilot wire used
(d) Primary conductor diameter or busbar dimensions (e) System voltage level

This compact range of protection current transformers is designed to comply with IEC 44-1 and VDE 0414 regulations and to follow international trends in control gear/switchgear design. Protection current transformers are available in 5P or 10P accuracy classes for each transformer ratio thereby enabling the designer to select a transformer suitable for applications ranging from magnetic trips or thermal overload relays to IDMT overcurrent or earth fault relays.

The units are clean and uniform in appearance and are entirely enclosed in impact and heat resisting housings. The moulded apertures allow the transformers to be rapidly and firmly clamped or wedged to metric or inch busbars. Alternatively, transformers can be supplied with mounting feet. All terminal fixings are manufactured from nickel plated brass and are grooved to ensure excellent contact pressure.

Accuracy Class

Accuracy classes are defined as 5P or 10P with limits according to the following table extracted from IEC 60044-1.

Accuracy class	Current error at rated primary current	Phase displacement at rated primary current		Composite error at rated accuracy limit primary current
		mins	centiradians	
5P	±1	±60	±1.8	5
10P	±3			10

Composite error

The rms value of the difference between the instantaneous primary current and the instantaneous secondary current multiplied by the turns ratio, under steady state conditions.

Accuracy limit factor

The value of primary current upto which the CT complies with composite error requirements. This is typically 5, 10 or 15, which means that the composite error of the CT has to be within specified limits at 5, 10 or 15 times the rated primary current.

Features

- Conform to IEC 44-1 and VDE 0414
- Clean, uniform appearance
- Rapidly fitted to metric or inch busbars
- All transformers are fully tested using modern and highly accurate test equipment prior to despatch
- Test certificates available on request
- All standard primary current ranges available
- Totally enclosed in tough, self extinguishing mouldings
- Available in accuracy classes to suit application

Current Transformer Range

Ratio	Power (VA)	Type													
		H0		H1		H2		H3		H4		H5		H α	
		Class		Class		Class		Class		Class		Class		Class	
		0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	3	
5 / 5	2.5	●	●												
	5	●	●												
10 / 5	2.5	●	●												
	5	●	●												
15 / 5	2.5	●	●												
	5	●	●												
20 / 5	2.5	●	●												
	5	●	●												
25 / 5	2.5	●	●												
	5	●	●												
30 / 5	2.5	●	●												
	5	●	●												
40 / 5	2.5	●	●												
	5	●	●												
50 / 5	2.5	●	●	●	●									●	
	5	●	●	●	●									●	
75 / 5	2.5			●	●									●	
	5			●	●									●	
100 / 5	2.5			●	●									●	
	5			●	●									●	
150 / 5	2.5			●	●									●	
	5			●	●									●	
200 / 5	2.5			●	●									●	
	5			●	●									●	
250 / 5	2.5			●	●									●	
	5			●	●									●	
300 / 5	2.5			●	●									●	
	5			●	●									●	
400 / 5	2.5			●	●									●	
	5			●	●	●	●							●	
500 / 5	5					●	●								
600 / 5	5					●	●	●	●						
800 / 5	5					●	●	●	●						
1000 / 5	10							●	●						
1200 / 5	10							●	●						
1500 / 5	10							●	●	●	●				
2000 / 5	20									●	●				
2500 / 5	20									●	●				
3000 / 5	20									●	●				
4000 / 5	20									●	●				
5000 / 5	50											●	●		
6000 / 5	50											●	●		
8000 / 5	50											●	●		
10000 / 5	50											●	●		
12000 / 5	50											●	●		
15000 / 5	50											●	●		

* Current transformers outside the above list can be design and manufactured on request.

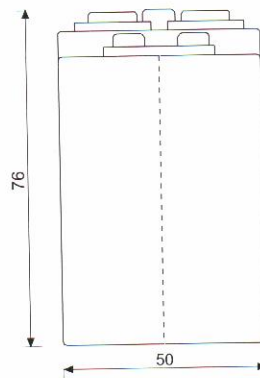
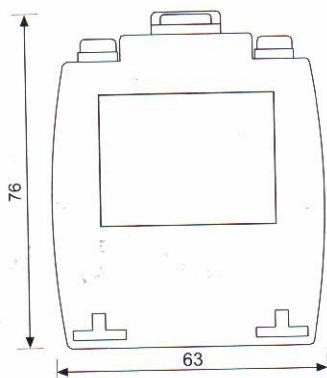


Type H0

**HARRIS
CURRENT
TRANSFORMER**



DIMENSIONS:



* Dimensions in mm

PRODUCT LIST OF TYPE H0

TYPE	RATIO	POWER (VA)	CLASS
H0	5 / 5 , 5 / 1	2.5 , 5	0.5
			1
	10 / 5 , 10 / 1	2.5 , 5	0.5
			1
	15 / 5 , 15 / 1	2.5 , 5	0.5
			1
	20 / 5 , 20 / 1	2.5 , 5	0.5
			1
	25 / 5 , 25 / 1	2.5 , 5	0.5
			1
	30 / 5 , 30 / 1	2.5 , 5	0.5
			1
	40 / 5 , 40 / 1	2.5 , 5	0.5
			1
50 / 5 , 50 / 1	2.5 , 5	0.5	
		1	

* Current transformers outside the above list can be design and manufactured on request.

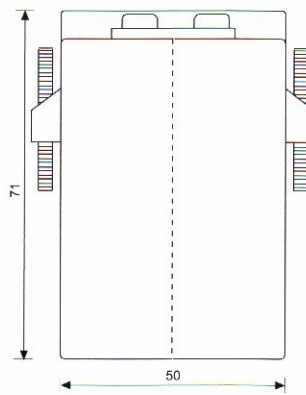
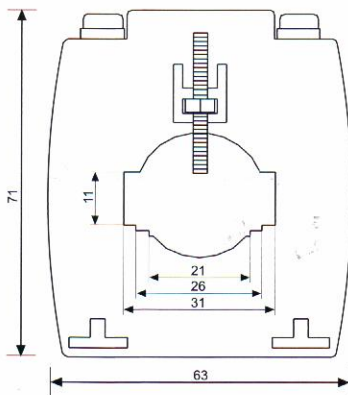


Type H1

**HARRIS
CURRENT
TRANSFORMER**



DIMENSIONS:



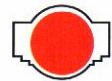
* Dimensions in mm

WINDOW SIZES :

BARS :
30x10 MM
20x10 MM



**ROUNDED
CONDUCTORS :**
UP TO 25 MM



PRODUCT LIST OF TYPE H1

TYPE	RATIO	POWER (VA)	CLASS
H1	50 / 5 , 50 / 1	2.5 , 5	0.5
			1
	75 / 5 , 75 / 1	2.5 , 5	0.5
			1
	100 / 5 , 100 / 1	2.5 , 5	0.5
			1
	150 / 5 , 150 / 1	2.5 , 5	0.5
			1
	200 / 5 , 200 / 1	2.5 , 5	0.5
			1
	250 / 5 , 250 / 1	2.5 , 5	0.5
			1
	300 / 5 , 300 / 1	2.5 , 5	0.5
			1
	400 / 5 , 400 / 1	2.5 , 5	0.5
			1

* Current transformers outside the above list can be design and manufactured on request.

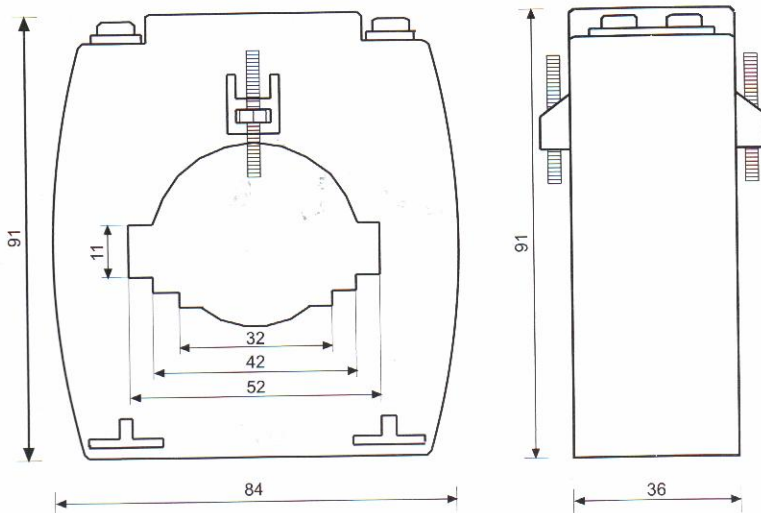


Type H2

**HARRIS
CURRENT
TRANSFORMER**



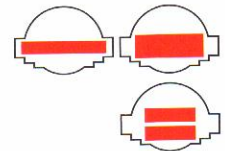
DIMENSIONS:



* Dimensions in mm

WINDOW SIZES :

BARS :
50x10 MM
40x15 MM
2x(30x10)MM



**ROUNDED
CONDUCTORS :**
UP TO 37 MM



PRODUCT LIST OF TYPE H2

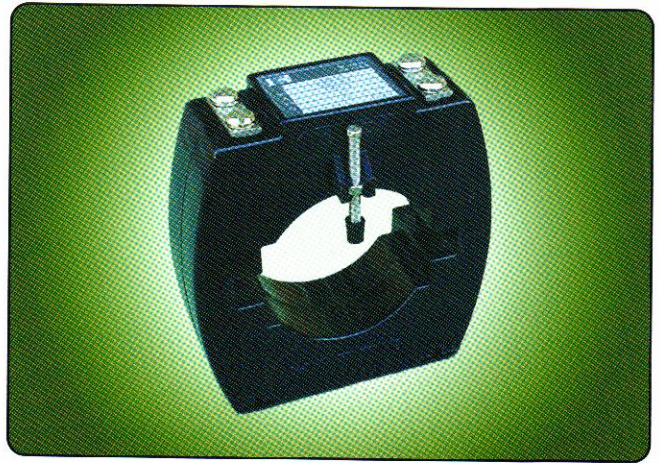
TYPE	RATIO	POWER (VA)	CLASS
H2	400 / 5 , 400 / 1	5	0.5
			1
	500 / 5 , 500 / 1	5	0.5
			1
	600 / 5 , 600 / 1	5	0.5
			1
	800 / 5 , 800 / 1	5	0.5
			1

* Current transformers outside the above list can be design and manufactured on request.

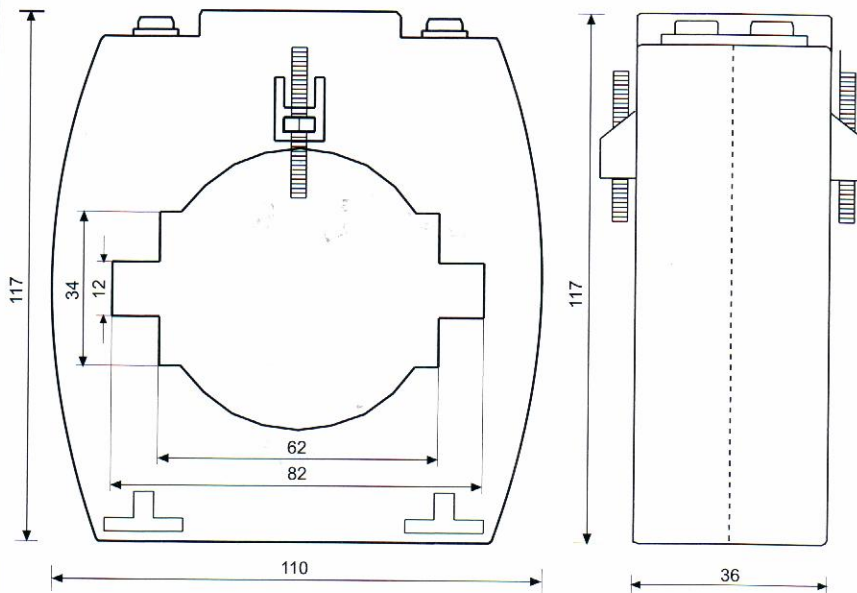


Type H3

**HARRIS
CURRENT
TRANSFORMER**



DIMENSIONS:

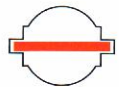


*Dimensions in mm

WINDOW SIZES :

BARS :

80x10 MM



3x(60x10) MM



**ROUNDED
CONDUCTORS :
UP TO 60 MM**



PRODUCT LIST OF TYPE H3

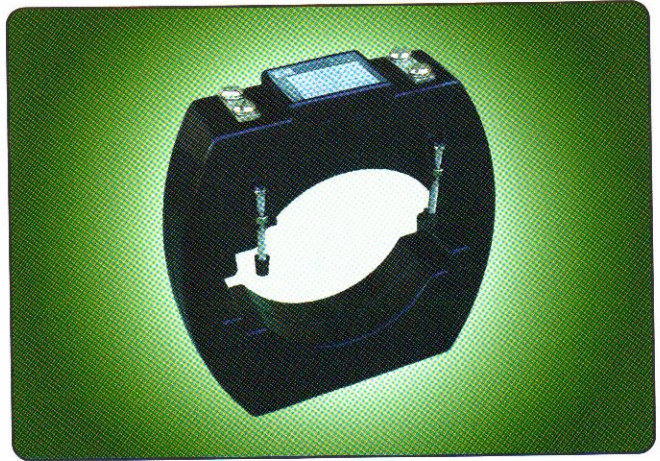
TYPE	RATIO	POWER (VA)	CLASS
H3	600 / 5 , 600 / 1	5	0.5
			1
	800 / 5 , 800 / 1	5	0.5
			1
	1000 / 5 , 1000 / 1	10	0.5
			1
	1200 / 5 , 1200 / 1	10	0.5
			1
	1500 / 5 , 1500 / 1	10	0.5
			1

* Current transformers outside the above list can be design and manufactured on request.

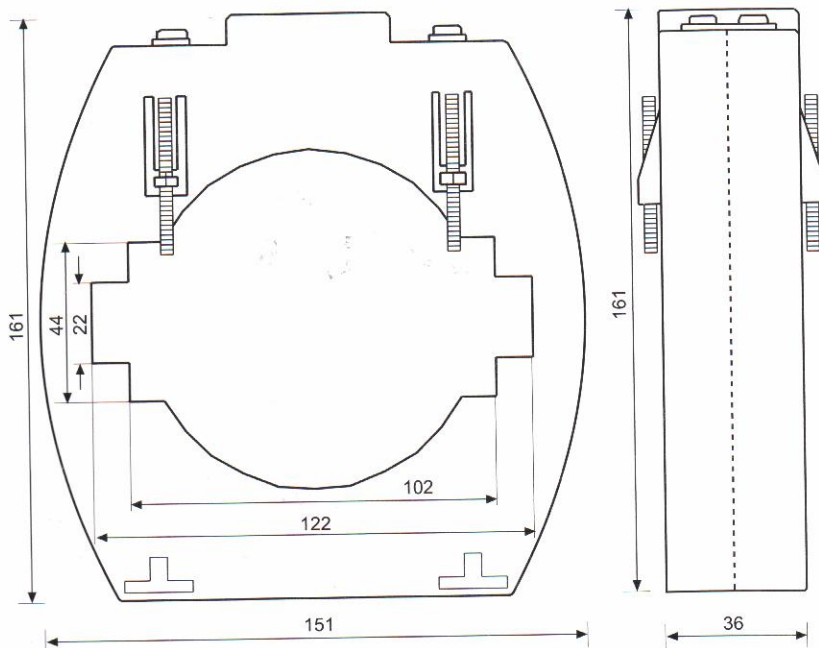


Type H4

HARRIS CURRENT TRANSFORMER



DIMENSIONS:

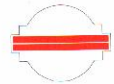


* Dimensions in mm

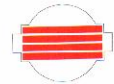
WINDOW SIZES :

BARS :

2x(120x10) MM



4x(100x10) MM



ROUNDED
CONDUCTORS :
UP TO 94 MM



PRODUCT LIST OF TYPE H4

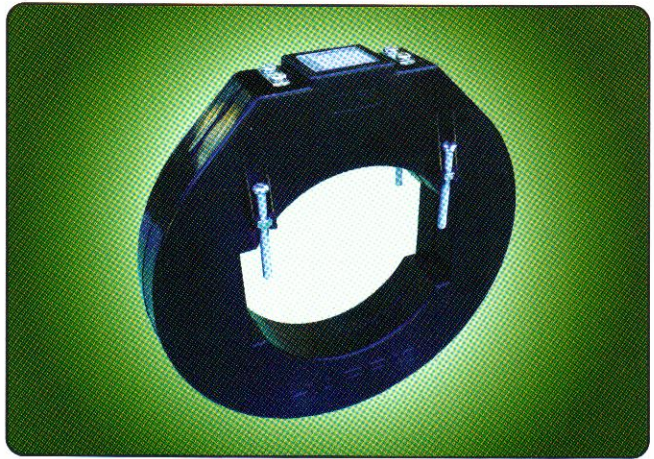
TYPE	RATIO	POWER (VA)	CLASS
H4	1500 / 5 , 1500 / 1	20	0.5
	2000 / 5 , 2000 / 1	20	0.5
	2500 / 5 , 2500 / 1	20	0.5
	3000 / 5 , 3000 / 1	20	0.5
	4000 / 5 , 4000 / 1	20	0.5

* Current transformers outside the above list can be design and manufactured on request.

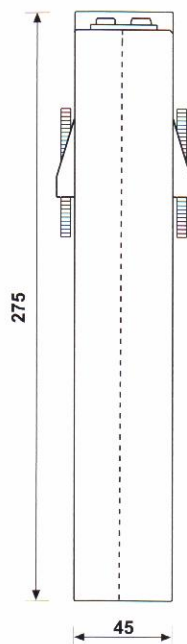
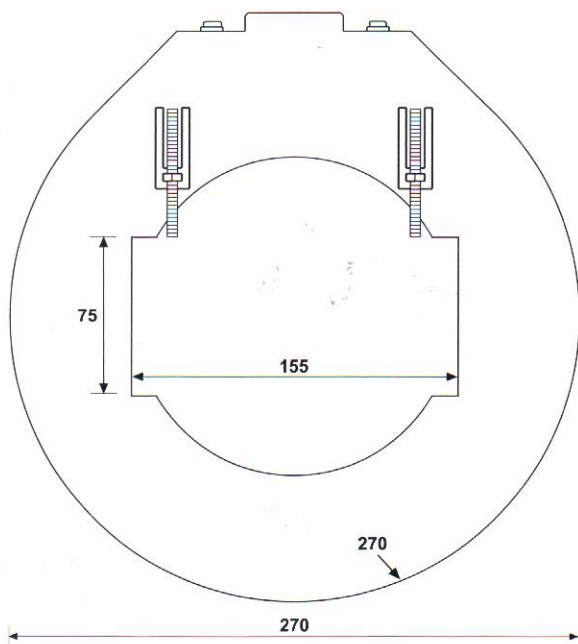


Type H5

HARRIS CURRENT TRANSFORMER



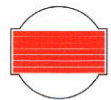
DIMENSIONS:



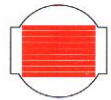
WINDOW SIZES :

BARS :

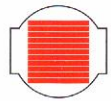
7x(150x10) MM



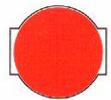
9x(120x10) MM



11x(100x10) MM



ROUNDED
CONDUCTORS :
UP TO 150 MM



* Dimensions in mm

PRODUCT LIST OF TYPE H5

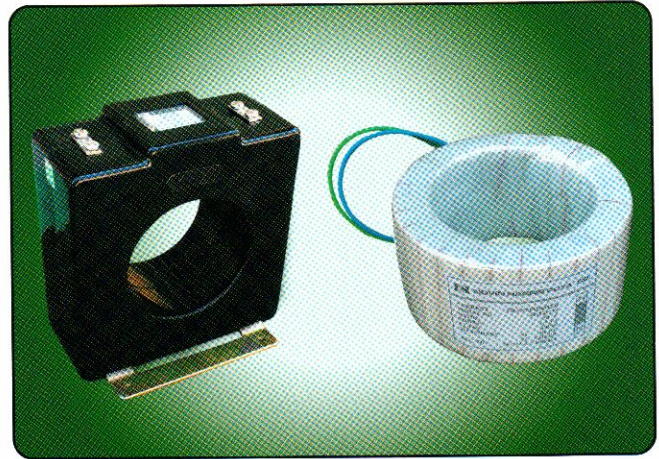
TYPE	RATIO	POWER (VA)	CLASS
H5	5000 / 5	50	0.5
	6000 / 5	50	0.5
	8000 / 5	50	0.5
	10000 / 5	50	0.5
	12000 / 5	50	0.5
	15000 / 5	50	0.5

* Current transformers outside the above list can be design and manufactured on request.

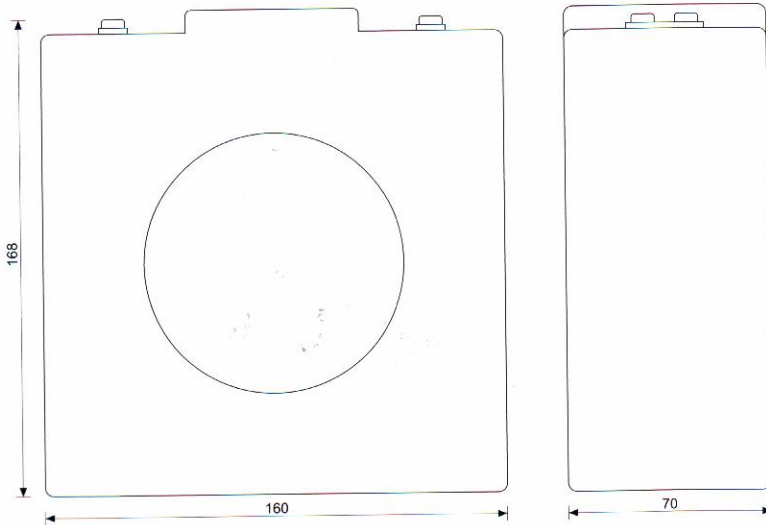


Type H6

HARRIS CURRENT TRANSFORMER



DIMENSIONS:



WINDOW SIZES :

**ROUNDED
CONDUCTORS :
UP TO 90 MM**



*Dimensions in mm

PRODUCT LIST OF TYPE H6

TYPE	RATIO	POWER (VA)	CLASS
H6	50 / 5 , 50 / 1	1	5P10
	75 / 5 , 75 / 1		
	100 / 5 , 100 / 1		
	150 / 5 , 150 / 1	2.5	10P10
	200 / 5 , 200 / 1	5	
	250 / 5 , 250 / 1	7.5	5P20
	300 / 5 , 300 / 1	10	10P20
	400 / 5 , 400 / 1	15	
	600 / 5 , 600 / 1		

* Current transformers outside the above list can be design and manufactured on request.

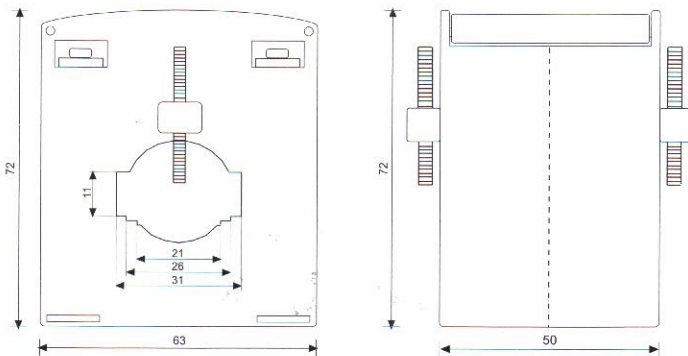


Type H1

WITH SPECIAL COVER



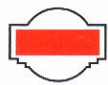
DIMENSIONS:



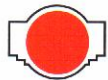
* Dimensions in mm

WINDOW SIZES :

BARS :
30x10 MM
20x10 MM



ROUNDED CONDUCTORS :
UP TO 25 MM

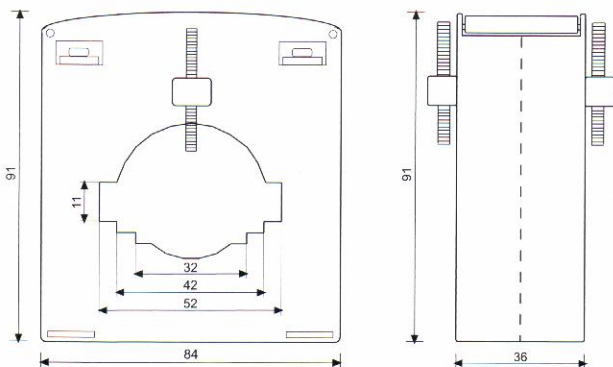


Type H2

WITH SPECIAL COVER



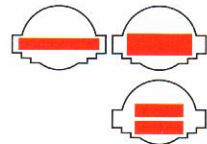
DIMENSIONS:



* Dimensions in mm

WINDOW SIZES :

BARS :
50x10 MM
40x15 MM
2x(30x10) MM



ROUNDED CONDUCTORS :
UP TO 41 MM

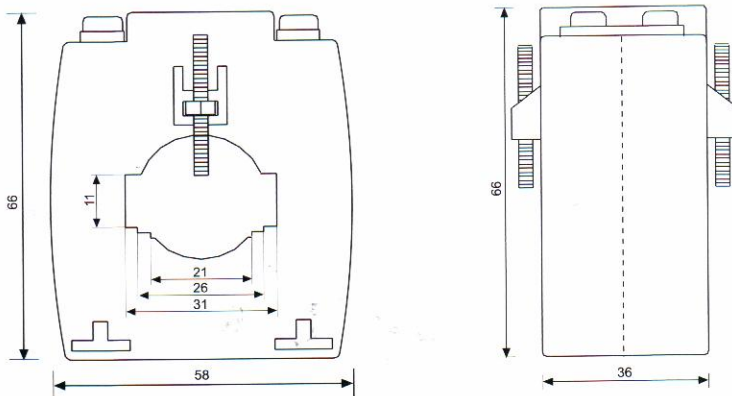


H Type H α

HARRIS CURRENT TRANSFORMER



DIMENSIONS:



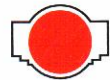
* Dimensions in mm

WINDOW SIZES :

BARS :
30x10 MM
20x10 MM



ROUNDED
CONDUCTORS :
UP TO 25 MM



PRODUCT LIST OF TYPE H α

TYPE	RATIO	POWER (VA)	CLASS
Hα	50 / 5 , 50 / 1	2.5 , 5	3
	75 / 5 , 75 / 1	2.5 , 5	3
	100 / 5 , 100 / 1	2.5 , 5	3
	150 / 5 , 150 / 1	2.5 , 5	3
	200 / 5 , 200 / 1	2.5 , 5	3
	250 / 5 , 250 / 1	2.5 , 5	3
	300 / 5 , 300 / 1	2.5 , 5	3
	400 / 5 , 400 / 1	2.5 , 5	3

* Current transformers outside the above list can be design and manufactured on request.

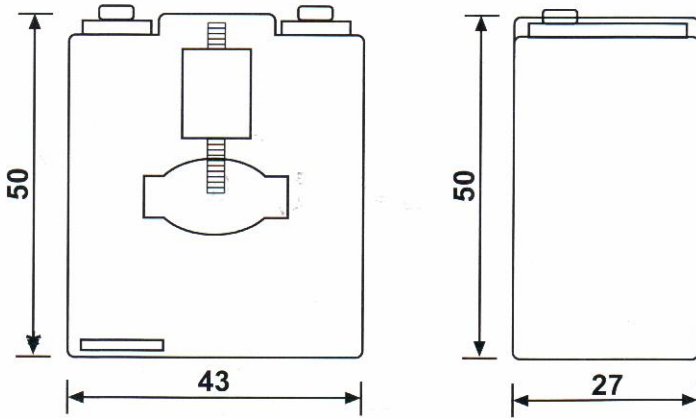


Type H β

HARRIS
CURRENT
TRANSFORMER



DIMENSIONS:



* Dimensions in mm

WINDOW SIZES :

BARS :
20x10 MM



PRODUCT LIST OF TYPE

H β

TYPE	RATIO	POWER (VA)	CLASS
Hβ	150 / 0.2	0.5	0.5
			1
	200 / 0.2	0.5	0.5
			1
	250 / 0.2	0.5	0.5
			1
	300 / 0.2	0.5	0.5
			1

* Current transformers outside the above list can be design and manufactured on request.



Type HSCT

HARRIS
CURRENT
TRANSFORMER



Summation Current Transformer

When the current in a number of feeders need not be individually metered but summated to a single meter or instrument, a summation current transformer can be used. In consumer installation where there are more than one feeder it is more economical to use summation metering and for this purpose, summation CT is required. The summation CT consists of two or more primary windings which are connected to the feeders to be summated, and a single secondary winding which feeds a current proportional to the summated primary current. A typical ratio would be $5+5+5 / 5$ A, which means that three primary feeders of 5 Amps are to be summated to a single 5 Amps meter.

The correct meter ratio must be used for summation metering to take the sum of the feeders. As an example, if in a 2-way summation, each of the CTs are rated at 600/5A, then the meter should have a ratio of 1200/5A in order to give the true reading of both feeders.

Current addition in summation CTs is always performed by vector addition, which means that it is done under consideration of both vector magnitude and vector phase angle. Under special circumstances the sum of all input currents therefore may even result in zero, a phenomenon which is being used in fault-current measurement. Only when adding unidirectional vectors (vectors having equal phase angle) does the general vector-addition transform to the special case of an arithmetic addition of vector magnitudes (current amounts). Summation CTs are principally used for the summation of currents in the same phase belt.

PRODUCT LIST OF TYPE HSCT

TYPE	RATIO	POWER (VA)	CLASS
HSCT	$5 + 5 / 5$	2.5 - 15	0.5
	$5 + 5 + \dots / 5$	2.5 - 15	1
	$1 + 1 / 1$	2.5 - 15	0.5
	$1 + 1 + \dots / 1$	2.5 - 15	1
	$5 + 5 / 1$	2.5 - 15	0.5
	$5 + 5 + \dots / 1$	2.5 - 15	1
	$1 + 1 / 5$	2.5 - 15	0.5
	$1 + 1 + \dots / 5$	2.5 - 15	1

* Current transformers outside the above list can be design and manufactured on request.

Ring Type Current Transformers

This comprehensive range of ring-type measuring and protection current transformers enables a CT to be selected to exactly match the duty and application. All transformers are constructed from high grade materials and are individually tested for compliance with IEC 60044-1. A variety of different patterns & secondary terminations are available. Transformers are constructed in a range of burdens & accuracy classes for each transformer ratio thereby enabling the designer to select a transformer suitable for applications ranging from local or remote current monitoring to high precision kilowatt hour.

Ordering Information

The following information is required when ordering Ring Type Current Transformers :

- (a) Transformer Ratio
- (b) The VA burden
- (c) Accuracy Class
- (d) Minimum ID

Rectangular Current Transformers

This range of rectangular CT's is designed for applications where busbar centres are close together, thereby prohibiting the use of the standard ring type transformers. A typical application for rectangular CT's is for current monitoring in switch fuses where space is restricted. Rectangular measuring current transformers are available to match a range of busbar dimensions and may be supplied with terminals on the long side or short side to suit the busbar configuration. Transformers can be supplied with pilot wires.

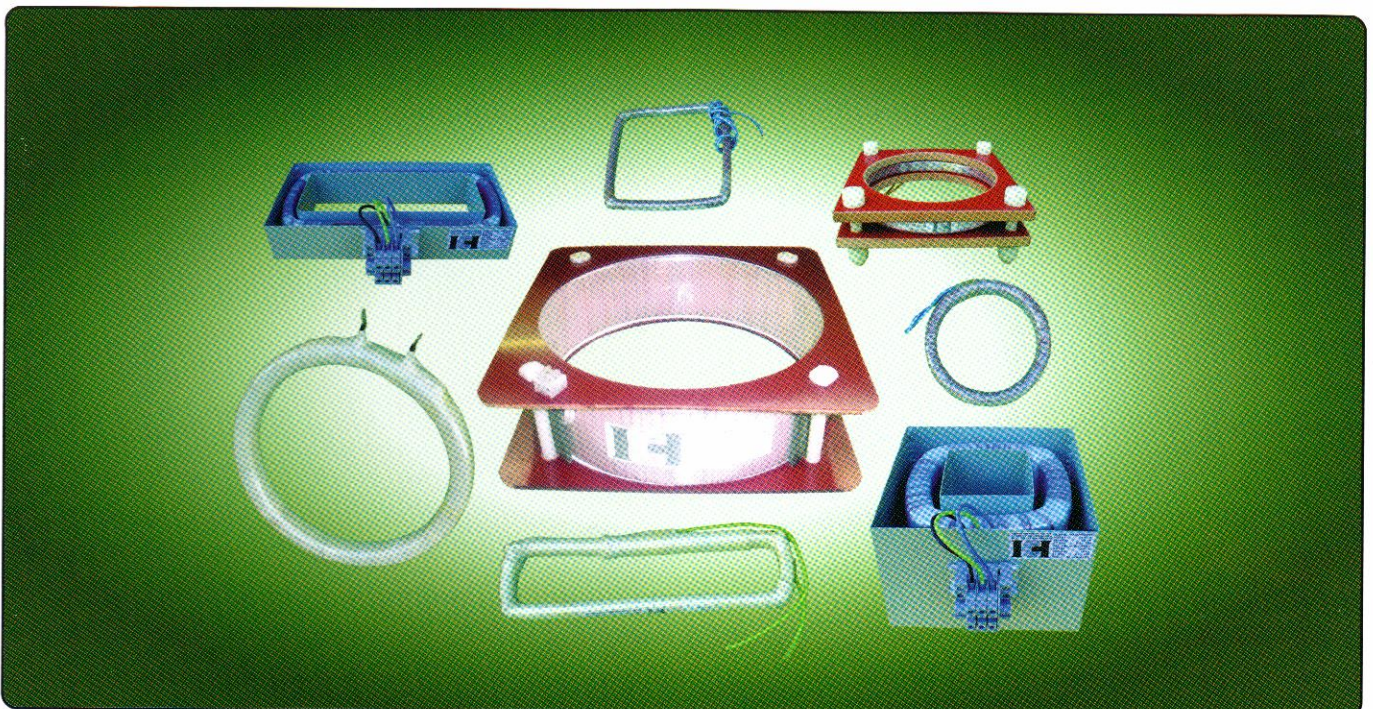
Ordering Information

The following information is required when ordering Rectangular Current Transformers :

- (a) Transformer Ratio
- (b) The VA burden
- (c) Accuracy Class
- (d) Busbar Dimensions
- (e) Terminal Location (long or short side)

Current Transformers with Secondary Taps

Have secondary on or more taps in order to use them for realising various ratings. The connections which are not used have to be open. On principle the taps have to be connected to the 1-side terminals.



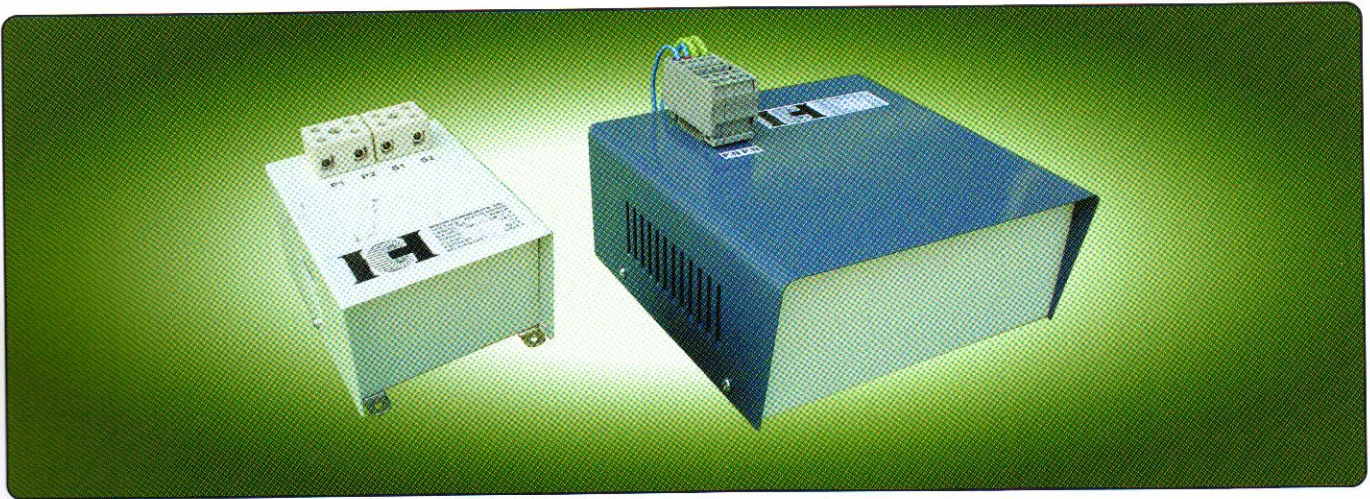
Harris Voltage Transformers (VT,IVT)

The standards define a voltage transformer as one in which “the secondary voltage is substantially proportional to the primary voltage and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections.”

This, in essence, means that the voltage transformer has to be as close as possible to the “ideal” transformer. In an “ideal” transformer, the secondary voltage vector is exactly opposite and equal to the primary voltage vector, when multiplied by the turns ratio.

In a “practical” transformer, errors are introduced because some current is drawn for the magnetization of the core and because of drops in the primary and secondary windings due to leakage reactance and winding resistance. One can thus talk of a voltage error, which is the amount by which the voltage is less than the applied primary voltage, and the phase error, which is the phase angle by which the reversed secondary voltage vector is displaced from the primary voltage vector.

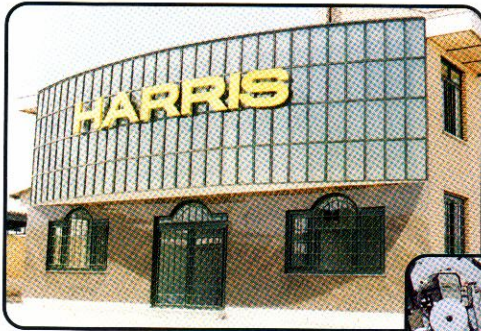
Harris designs its VT's so that the resistance and reactance drops are minimized. It also uses the best grades of cold rolled grain oriented electrical steels which enables operation at optimum levels of magnetic induction, thus reducing both the size and the cost of the VT.



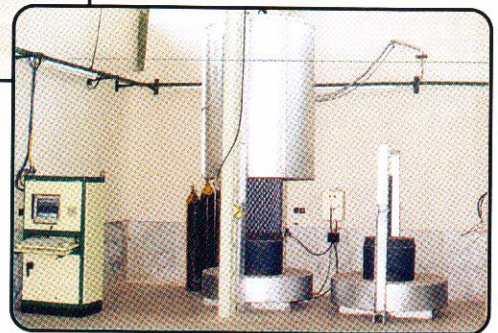
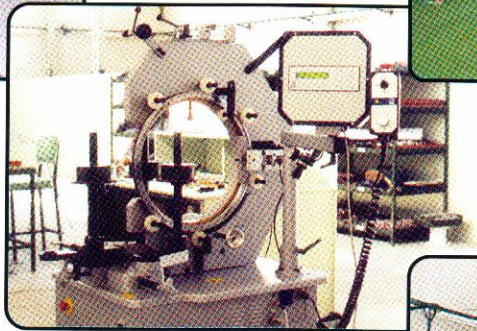
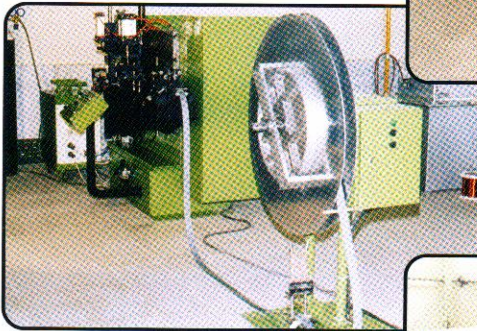
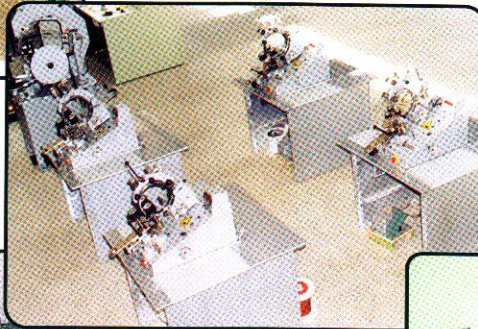
PRODUCT LIST OF TYPE HVT , HIVT

TYPE	PRIMARY VOLTAGE	SECONDARY VOLTAGE	POWER (VA)	CLASS
HVT HIVT	$110 / \sqrt{3}$	$110 / \sqrt{3}$	2.5	0.5
	110 / 3	110 / 3		
	110	110		
	$100 / \sqrt{3}$	$100 / \sqrt{3}$	10	0.5 + 3P
	100 / 3	100 / 3		
	100	100	15	1
	$400 / \sqrt{3}$	$400 / \sqrt{3}$	20	3
	400	400		

* voltage transformers outside the above list can be design and manufactured on request.



**3 YEARS
GUARANTEE**



Company

Novin Harris Puya is an established company specialising in the design and manufacture of current and voltage transformers for measurement and protection of electrical plant and equipment. The company has gained a reputation for quality, product reliability and prompt delivery. Novin Harris Puya produces a comprehensive standard range of transformers, but small quantity and custom-built transformers are a regular and essential aspect of the company's service.

Design Capability

Novin Harris Puya are able to offer clients the benefit of substantial details knowledge in transformer design. Our engineers welcome discussion with clients to identify the electrical and mechanical criteria, and convert these into a reliable and economical unit.

Manufacturing Capability

Plant layout, production and handling equipment ensure a smooth flow from winding through assembly to final testing. A variety of toroidal coil and core winding machines permit production of a range of current and voltage transformers from miniature units to bushing transformers.

Quality Assurance

Novin Harris Puya has implemented a quality assurance scheme in accordance with IEC 44-1 and VDE 0414, thus maintaining control of materials and workmanship at all stages. Finally, each transformer is tested to ensure compliance with IEC 44-1 and VDE 0414. Test certificates or certificates of conformance are provided if required.

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