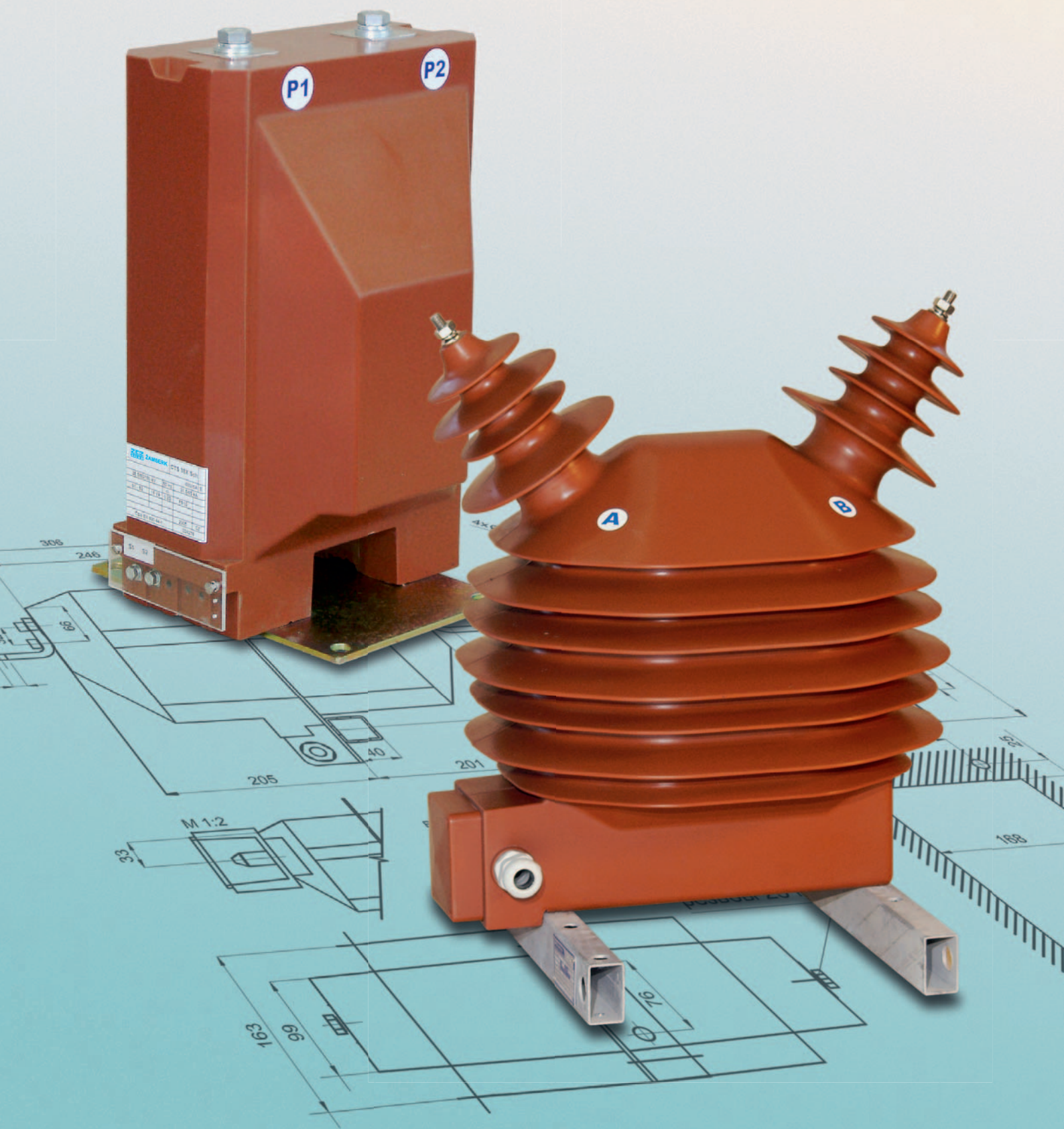




INSTRUMENT TRANSFORMERS





CTS 12.S



CTS 12.L



CTS 25



CTS 25 Sch



CTS 25X



CTS 25X Sch



CTS 38



CTS 38X



CTS 38X Sch

Supporting current instrument transformers CTS are designed for the measurement and protection of the distributing facilities of high voltage for inner settings. Current transformers CTS 12 are produced in two arrangements: CTS 12.S and CTS 12.L. The difference of these two arrangements is only the length of the instrument (see the picture). (Dimension in brackets is for CTS 12.L.) The bigger dimensions of CTS 12.L allow to fulfill the more demanding tasks of the customer for the parameters of the instrument (3-cores arrangement, higher performance, higher overcurrent number, etc.).

Supporting current instrument transformers CTS 25 Sch, CTS 25X Sch and CTS 38X Sch are arranged for the using in the distributors SM6 of the firm SCHNEIDER ELECTRIC.

The value of the secondary current is 5 A or 1 A with the possibility of combination. The classes of accuracy for the circuits of measurement are 0.2, 0.5, 1.3, for the circuit of protection are 5P, 10P. The transformers comply with the required class of accuracy within the values from 25% to 100% of rated load.

The limiting working current is 120% of I_N , according to the agreement of producer and customer it is possible to supply other values, for example 200% of I_N .

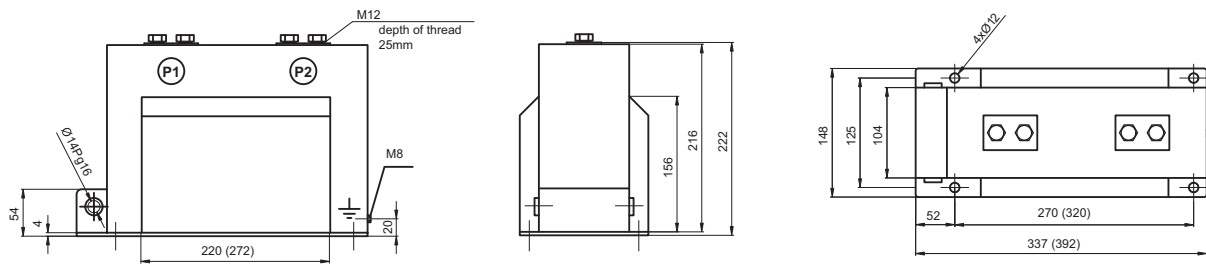
Transformers CTS are constructed as transformers with single-turn or multi-turn primary winding. The up-to-date construction of these transformers allows the switching not only on the secondary side but also on the primary one. The primary switching can be easily mounted by the means of connection of two jumpers to the circuit by the means of two screws M8 (See "The Instructions for the operation and mounting". Screws and jumpers are the part of the transformer). The secondary winding is wound on the magnetic core made of directed plates, eventually

made of the alloy of nickel, iron and copper "permalloy". The number of cores can be from 1 to 3 according to the request of customer. All active parts of transformer are compound-insulated with epoxy-mixture. This material performs both the electrical insulating and the mechanical functions. The mounting position of transformers is arbitrary. Transformers are fixed by the means of four screws in the holes in the basic plate. The primary terminals of transformers are provided with screws M12x35 mm. We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with the cover with sealing screw. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring. (See "The Instructions for the operation and mounting").

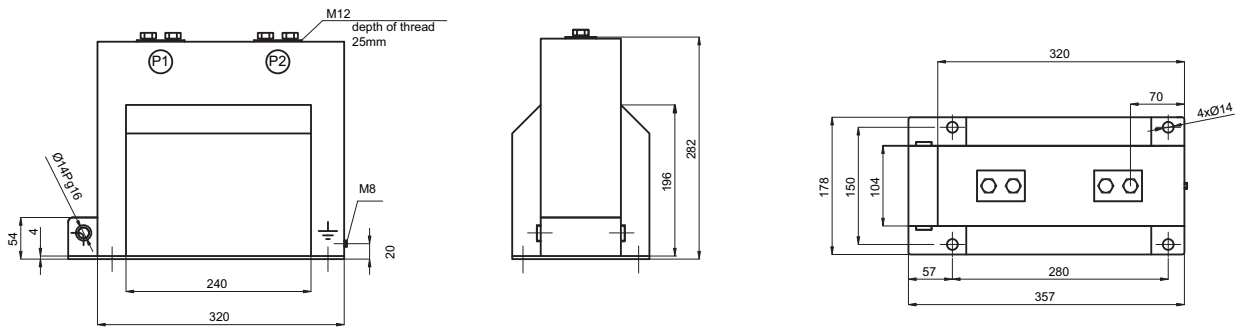
For the use of the transformers CTS 12 and CTS 25 in distributors VH-IRODEL we produce and supply epoxy adapter, pin and special basic plate (see photo). In cases, where the supplement for the older types of transformers (by various producers) is required, we supply instruments CTS on the modified basic plates that have identical mounting spacing to spacing of the substituted types.

Transformers CTS complied with all the tests according to ČSN EN 6044-1 and GOST 15 150 for U3 and T3. For the customer's request we provide official calibration.

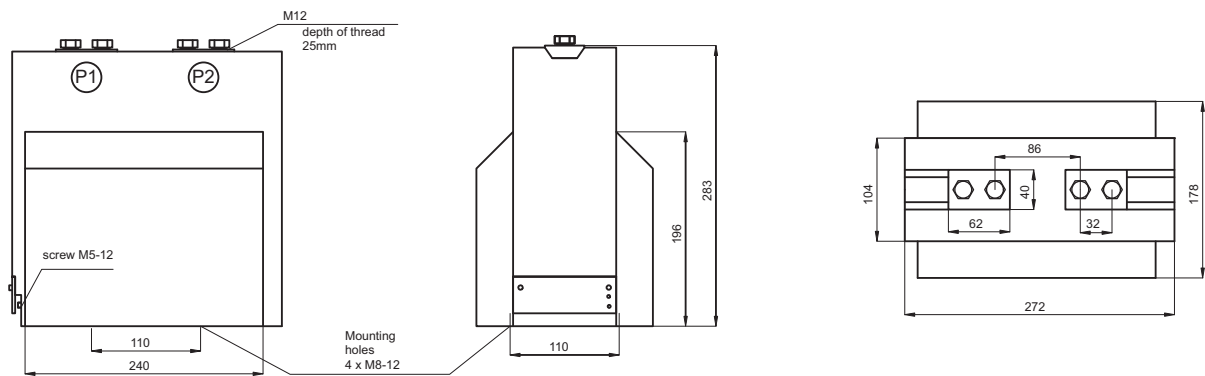
Type	CTS 12	CTS 25	CTS 25X CTS 25X Sch	CTS 25 Sch	CTS 38	CTS 38X CTS 38X Sch
Insulation voltage	15 kV	25 kV			40.5 kV	40.5 kV
Test voltage	28 kV	50 kV			95 kV	95 kV
Test impulse voltage	75 kV	125 kV			185 kV	185 kV
Nominal primary current	5–3200 A	5–3200 A	5–600 A	5–1250 A	5–1250 A	5–600 A
Nominal secondary current	5 (1) A					
Nominal frequency	50 Hz					
Power	5–60 VA					
Accuracy class	0.2, 0.5, 0.2S, 0.5S, 1, 3, 5P, 10P					
Weight	22 (25) kg	28 kg	18 kg	24 kg	40 kg	28 kg
Approval	TCM 212/96-2415	TCM 212/96-2416	TCM 212/05-4311 TCM 212/05-4312	TCM 212/96-2416	TCM 212/98-2786	TCM 212/06-4347 TCM 212/06-4346



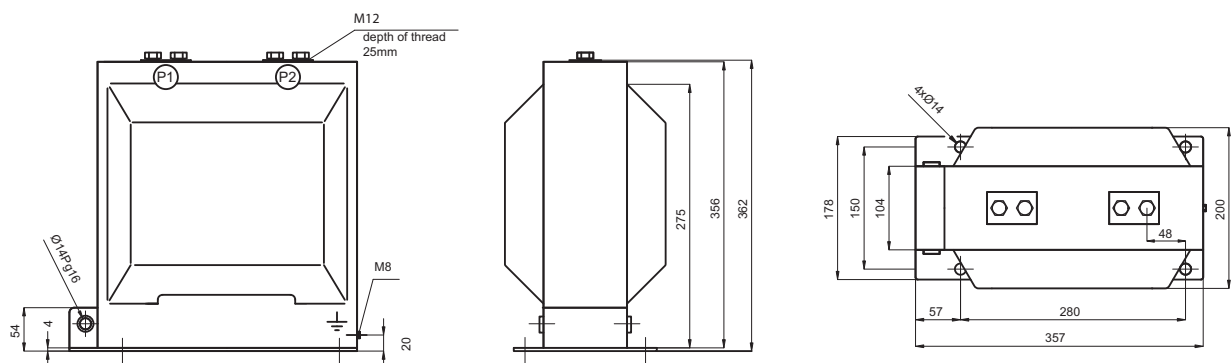
CTS 12



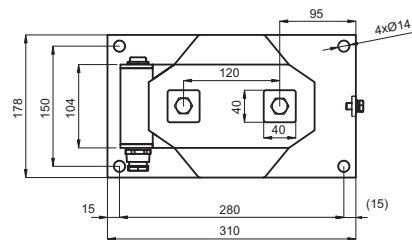
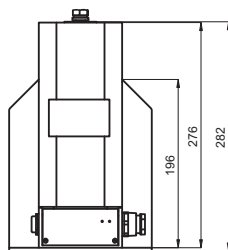
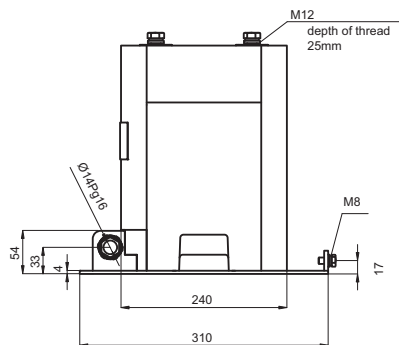
CTS 25



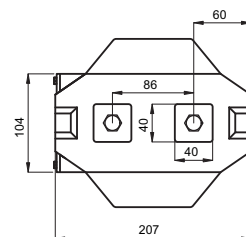
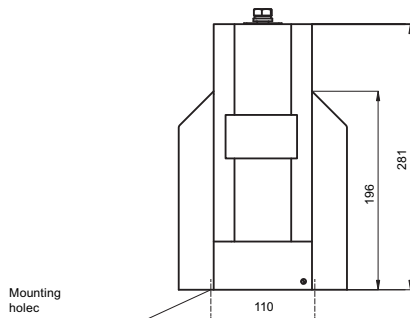
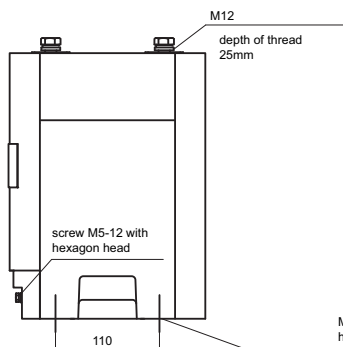
CTS 25 Sch



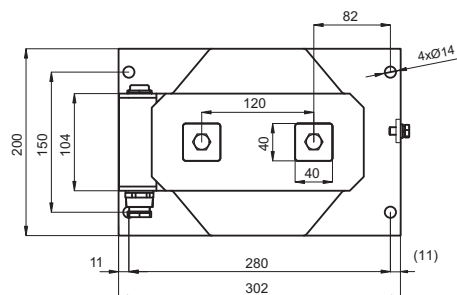
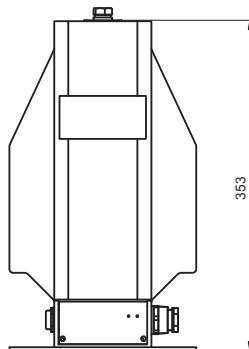
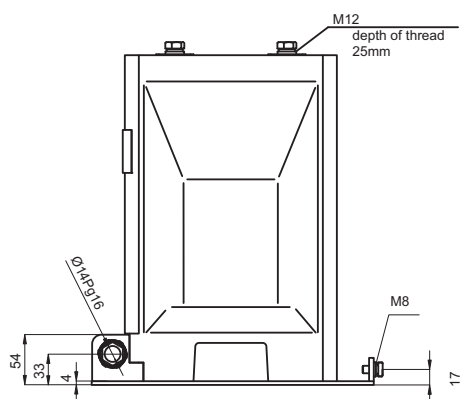
CTS 38



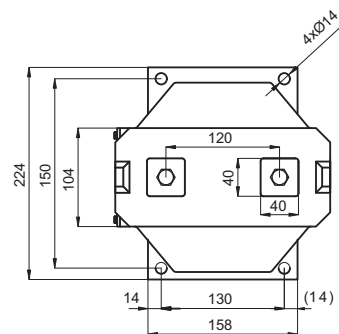
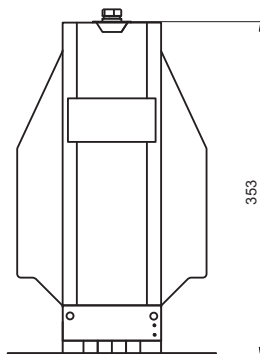
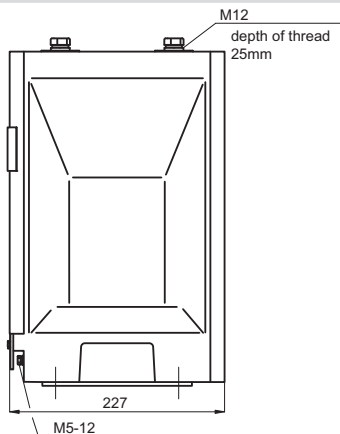
CTS 25X



CTS 25X Sch



CTS 38X



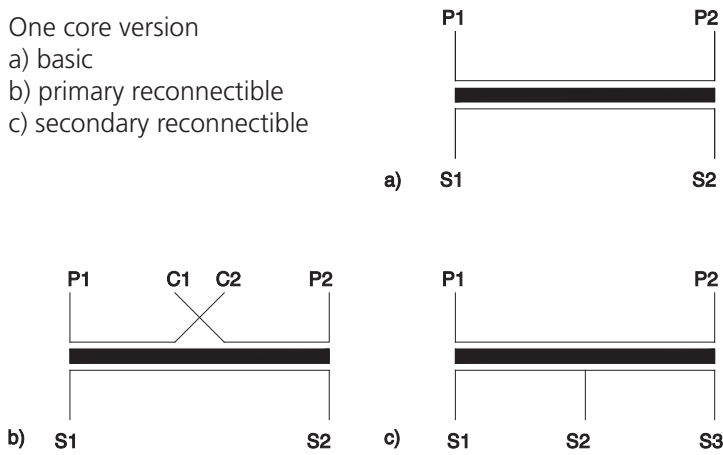
CTS 38X Sch

Transformers CTS 25 Schneider and CTS 38 are only made with terminals up to 1250 A.
Transformers CTS 25X (Sch) and CTS 38X (Sch) are only made with terminals up to 600 A.

WIRING DIAGRAM

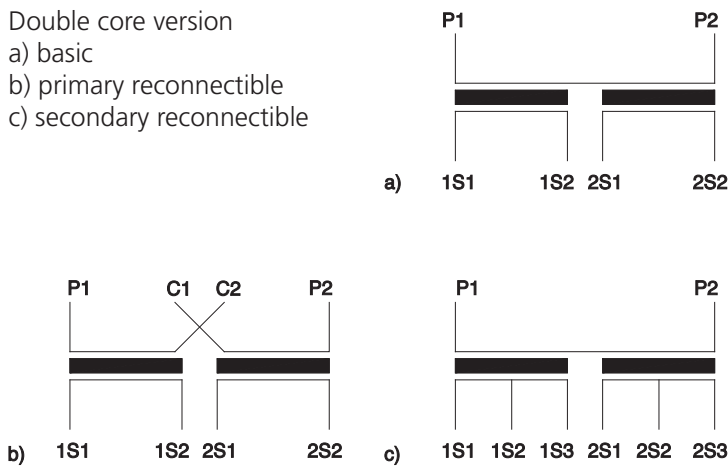
One core version

- a) basic
- b) primary reconnectable
- c) secondary reconnectable



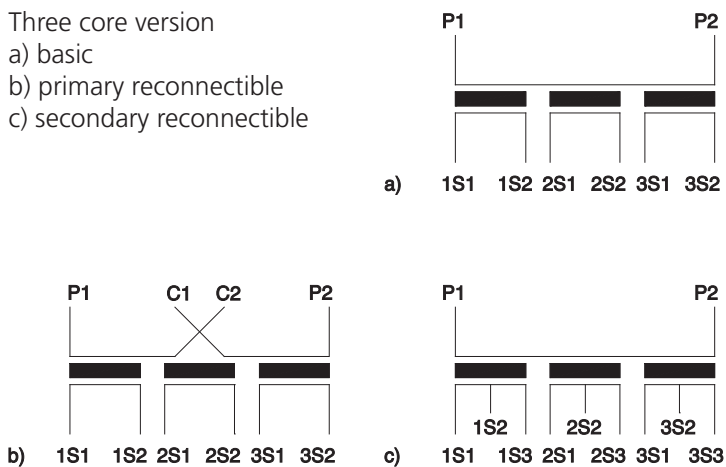
Double core version

- a) basic
- b) primary reconnectable
- c) secondary reconnectable



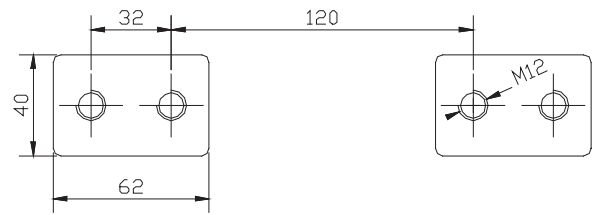
Three core version

- a) basic
- b) primary reconnectable
- c) secondary reconnectable

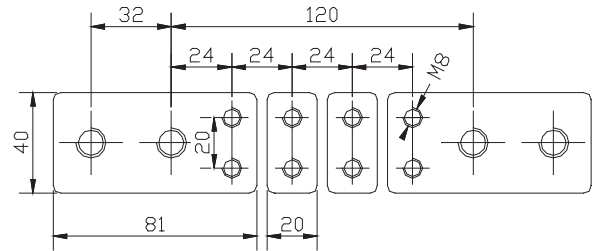


Primary terminals

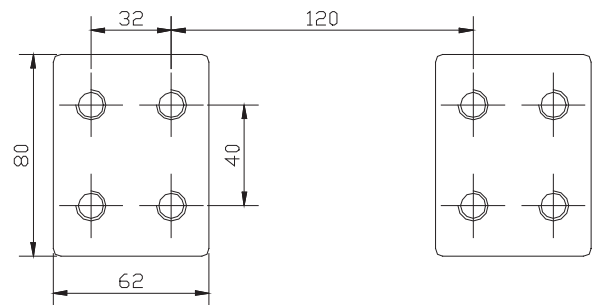
Basic Version up to 1250 A



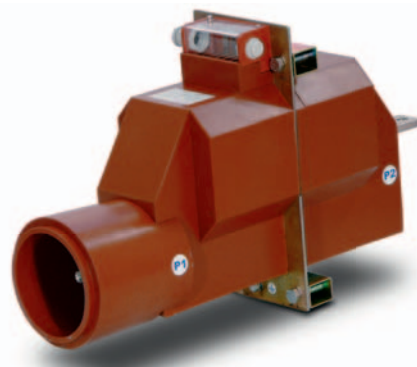
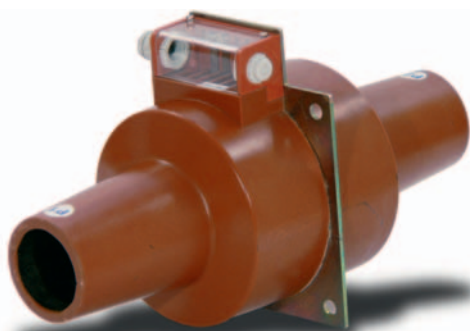
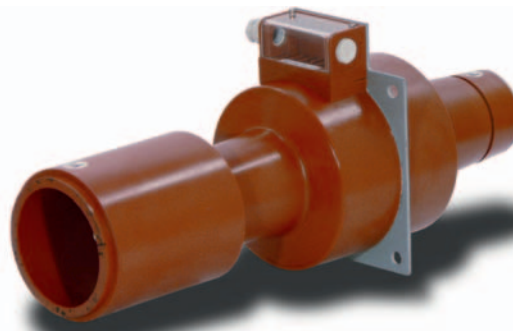
Reconnectable Version up to 1250 A



Version 1250–3200 A



It is possible to consult other technical parameters with the producer.

**CTB 25****CTB 25****CTT 25****CTT 25**

Current instrument transformers CTB 25 and CTT 25 are designed for measurement and protection of high voltage distributing equipment for indoor design for the highest voltage of system of 25 kV.

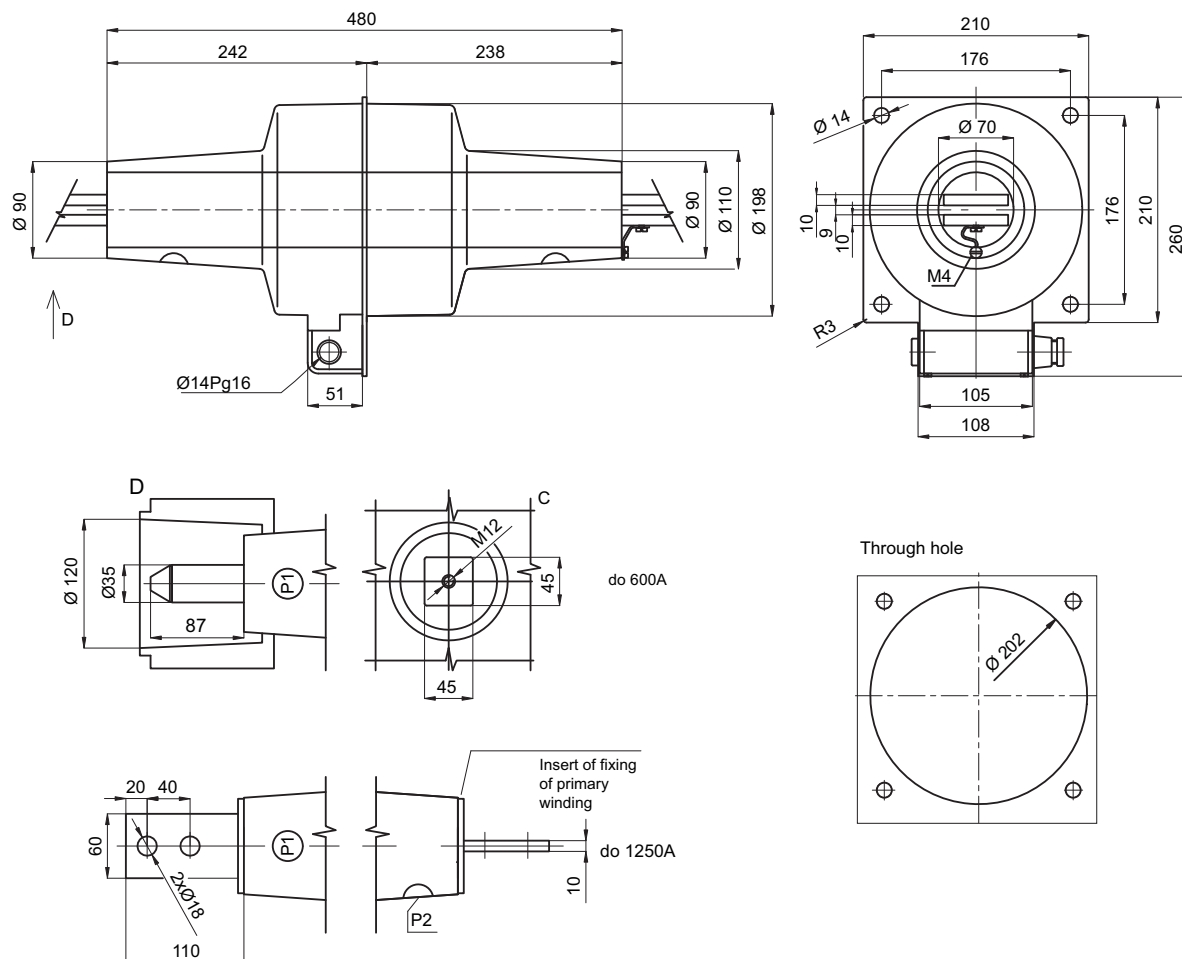
The value of secondary current is 5 A or 1 A with the possibility of combination. The accuracy classes for the circuits of measurement are 0.2, 0.5, 1, 3, for the circuits of protection are 5P, 10P. The transformers fulfill the required accuracy class at intervals from 25 % to 100 % of rated load. The terminal working current is 120 % I_N , in case of the agreement of the producer and the customer it is possible to deliver also the other values, for example 200 % I_N .

Transformers CTB 25 are designed as passing, where the primary conductor is made by two and more windings, according to the required parameters. The primary terminals of transformers are provided with the screws M12x35mm. The special parts with the holes of diameter of 14mm, eventually pin with epoxy adapter (see dimensional sketch), can be supplied for the connection of lead-in passes along the horizontal axis of the instrument. Transformers CTT 25 are constructed as bushing transformers. They can be supplied with the accessory equipment (the primary conductor and fixation enclosures) and so they can serve as the passing design (see dimensional sketch). The primary winding (drawing die) must be

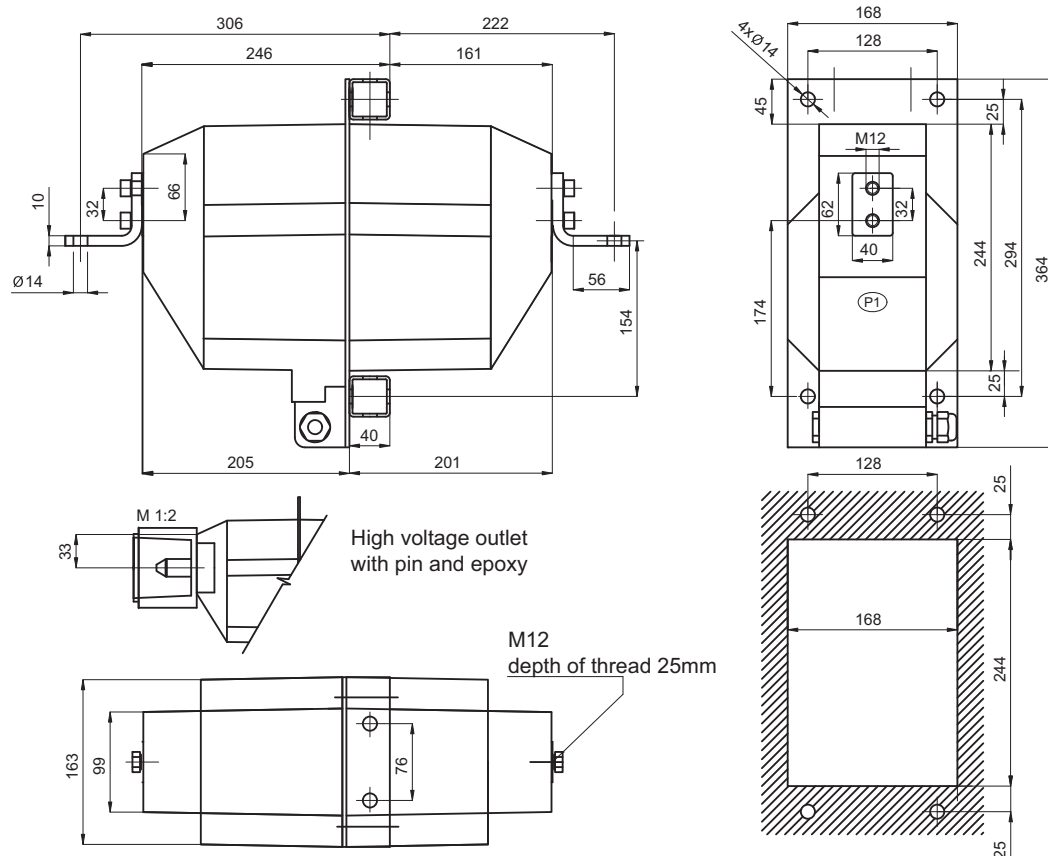
connected to the inner shielding by the means of Cu wire strand and by the means of the screw M4 (see dimensional sketch).

The secondary winding is wound on the magnetic core made of directed plates, eventually made of the alloy of nickel, iron and copper "permalloy". The maximum number of cores can be from 1 to 3 according to the request of customer. The construction of transformers allows the switching of ranges of the primary current on the secondary side. All active parts of transformer are compound-insulated with epoxy-mixture. This material performs both the electrical insulating and the mechanical functions. The mounting position of transformers is arbitrary. Transformers are fixed by the means of four screws M12 in the holes in the basic plate. We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with cover with sealing screw. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring. (See "The Instructions for the operation and mounting").

Transformers CTB 25 and CTT 25 fulfilled all the tests according to the ČSN EN 60044-1 and GOST 15 150 for U3 and T3. We provided the official approval on the request of our customer.



CTT 25



CTB 25

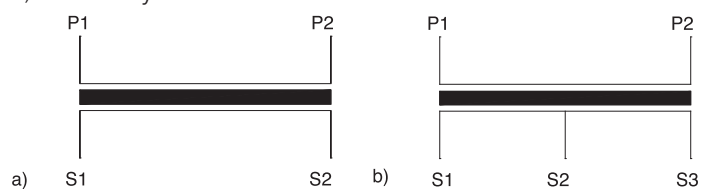
Type	CTB 25	CTT 25
Insulation voltage	25 kV	25 kV
Test voltage	50 kV	50 kV
Test impulse voltage	125 kV	125 kV
Nominal primary current	5–1250 A	5–1250 A
Nominal secondary current	5 (1) A	5 (1) A
Nominal frequency	50 Hz	50 Hz
Power	5–60 VA	5–60 VA
Accuracy class	0.2, 0.5, 0.2S, 0.5S, 1, 3, 5P, 10P	0.2, 0.5, 0.2S, 0.5S, 1, 3, 5P, 10P
Weight	22 kg	17 kg
Approval	TCM 212/00-3343	TCM 212/00-3342

WIRING DIAGRAM

One core version

a) basic

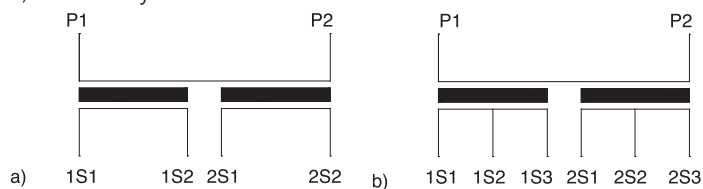
b) secondary reconnectable



Double core version

a) basic

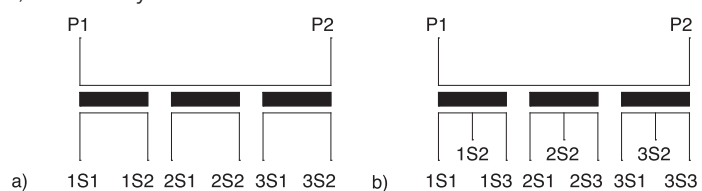
b) secondary reconnectable



Three core version

a) basic

b) secondary reconnectable



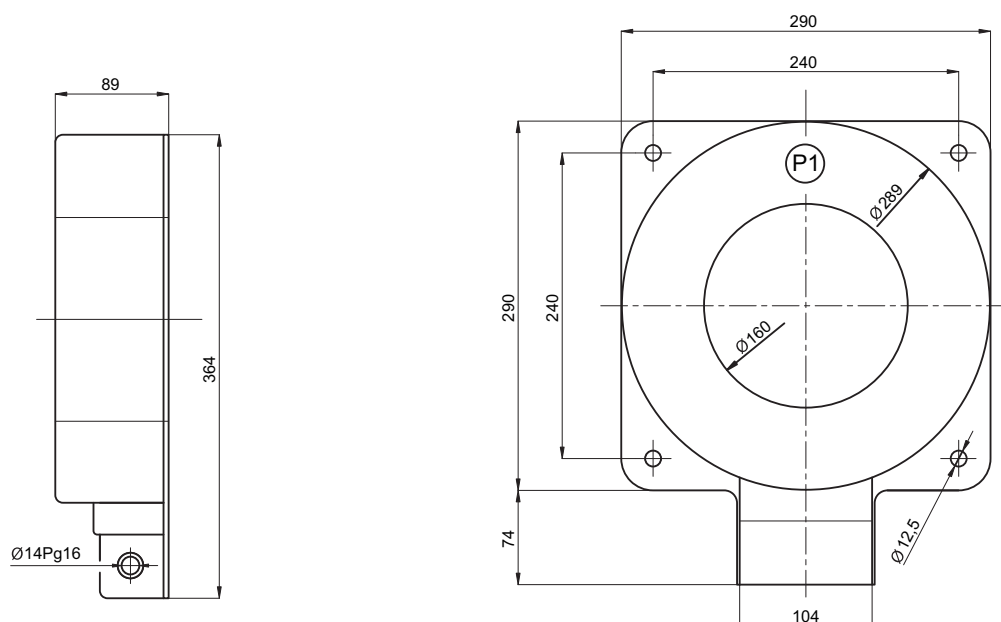
It is possible to consult other technical parameters with the producer.

Cumulative instrument transformer CTR-1

Drawing cumulative instrument current transformer CTR-1 is designed for the protection of distributive arrangement of high voltage of the inner design. The primary currents are currents of difference of the individual parts within the states of disorders, for example earth connection. The primary currents can have the value of 10 A and more according to the request of customer. The value of the secondary current is min. 0.08 A (it can be higher according to the request of customer). The transformers CTR-1 are designed as drawing transformers. The inner hole of cavity has diameter 160 mm. The secondary winding is wound on the magnetic core made of orientated plates.



CTR-1



The highest voltage in net	0.72 kV
Insulation voltage 50Hz 1min.	3 kV
Nominal ratio	10/>0.08 A
Nominal frequency	50 Hz
Power	0.1 VA (15 Ω)
Weight	18 kg

All active parts of the transformer are filled with the epoxy mixture. This mixture has both the electro-insulating and mechanical functions. The mounting position of the transformers is arbitrary. Transformers are fitted by the means of four screws M12 in the holes in the basic plate. We recommend use terminal ends corresponding to the

used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with the cover with sealing screw. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring. (See "The Instructions for the operation and mounting").

It is possible to consult other technical parameters with the producer.

For outside application – GSKF, for inside application – GSK

- Primary current from 50 A up to 10 kA
- For measurement, protection and billing purposes
- Very flexible in dimensions
- Split-core, applicable in existing installations
- Various window sizes Ø 90....350 mm

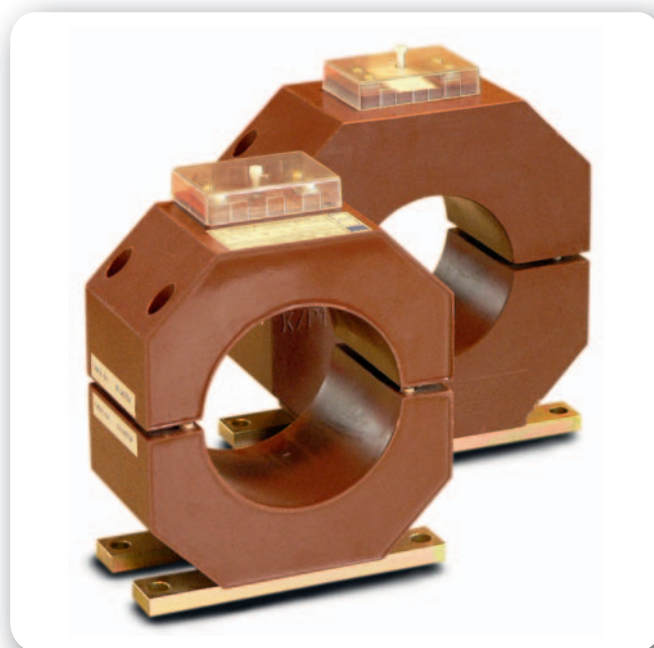
Model range GSKF: 170, 200, 250, 300, 350 and 400.

Model range GSK: 100, 125, 135, 150, 200, 260, 300, 400 and 500.

Detail information on

<http://www.kpbintra.cz/eu/produkty/GSKF.html>

and <http://www.kpbintra.cz/eu/produkty/GSK.html>



GSK

TYPE	Ø window (mm)
GSK 100	60
	90
	120
GSK 120	60
	90
	120
GSK 135	60
	90
	120
	200
GSK150	60
	90
	120
GSK 170	90
	120
	150
GSK 200	90
	120
	150
	200
GSK 250	90
	120
	150
	200
GSK 300	90
	120
	150
	200
GSK 350	90
	120
	150
	200
	250
	300

TYPE	Ø window (mm)
GSK 400	90
	120
	150
	200
	250
GSK 500	200
	250
	300
GSKF 170	90
	120
	150
GSKF 200	90
	120
	150
	200
GSKF 250	90
	120
	150
	200
GSKF 300	90
	120
	150
	200
GSKF 350	90
	120
	150
	200
	250
GSKF 400	300
	90
	120
	150
	200
	250



VTS 12



VTS 12



VTS 25



VTS 25



VTS 25 Sch



VTS 38 (38.5 kV)



VTS 25 Sch



VTS 38 (40.5 kV)

Voltage instrument transformers VTS are single-phase transformers isolated with one pole. They are designed for the use in the high voltage systems. They are designed for measuring and protection of high voltage distributing equipment for indoor design. The instruments can be equipped with high voltage fuse protecting the surrounding distributing system. The instrument transformers VTS 25 Sch are modified for the use in the distributors SM6 of the firm SCHNEIDER ELECTRIC.

The values of secondary voltage are $100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$, 100/3, 110/3, 120/3 V. The accuracy classes for measuring winding are 0.2, 0.5, 1, 3, for the securing winding are 3P and 6P. The transformers satisfy required accuracy class at intervals from 25% to 100% of rated load. Transformers VTS with fuse are provided with epoxy extender, holder and fuse enclosure of type JT 6 (0.3 A or 0.6 A). Extender with fuse can be dismantled. Magnetic circuit of voltage transformers VTS is made of oriented transformer strips in the shape of "C" of core.

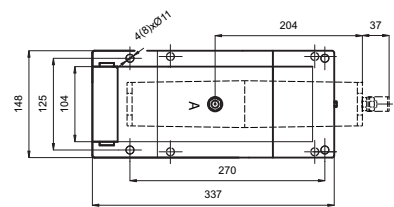
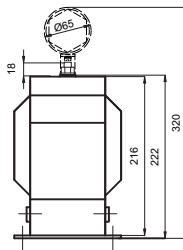
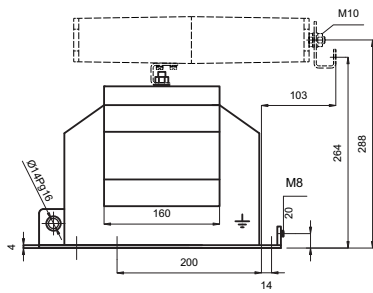
All active parts of transformer are compound-insulated with epoxy-mixture. This material performs both the electrical insulating and the mechanical functions. Transformers are fixed by the means of four screws M12 in the holes in the basic plate. The outlet of primary winding "A" is brought out by the means of bolt M10. We recommend for contacting VTS 38 for the reason of spring mounting of the dynamic strengths and vibration to use leading wires of maximum cross section of 6 mm² and cable sockets.

ATTENTION: The isolators must not be pre-stressed mechanically in the direction away from the body of transformer during the other way of contacting.

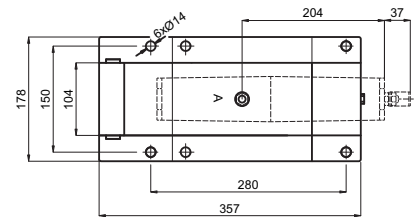
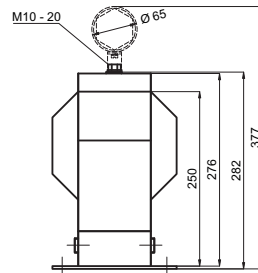
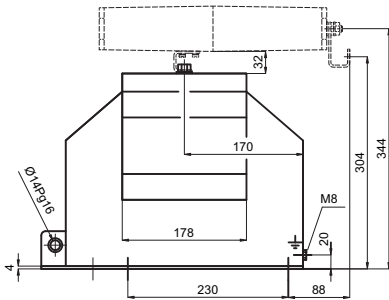
We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with the cover with sealing screw. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring. (See "The Instructions for the operation and mounting"). In cases where the substitution for the older types of transformers (various producers) is required, we supply transformers VTS with modified basic plates that have identical mounting spacing to spacing of the substituted types. Voltage instrument transformers VTS 12 and VTS 25 complied with all the tests according to ČSN EN 600 44-2 and GOST 15 150 for U3 and T3. Voltage instrument transformers VTS 38 comply additionally with GOST 1983-89.

For the customer's request we provide official calibration.

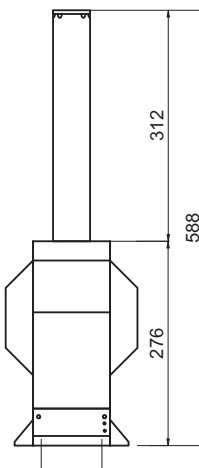
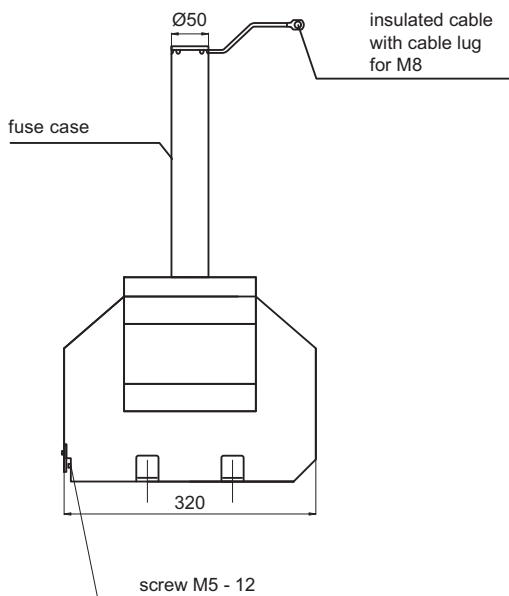
Type	VTS 12	VTS 25 / VTS 25 Sch	VTS 38	
			short insulator	long insulator
Insulation voltage	3,6–17,5 kV	3,6–25 kV	3,6–38.5 kV	3,6–40.5 kV
Test voltage	10–38 kV	10–50 kV	10–80 kV	10–95 kV
Test impulse voltage	40–95 kV	40 –125 kV	40–180 kV	40–200 kV
Nominal primary voltage	$3000/\sqrt{3}$ – $15000/\sqrt{3}$ V	$3000/\sqrt{3}$ – $22000/\sqrt{3}$ V	$3000/\sqrt{3}$ – $35000/\sqrt{3}$ V	
Nominal secondary voltage	$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V	$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V	$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V	
Nominal auxiliary voltage	100/3, 110/3, 120/3 V	100/3, 110/3, 120/3 V	100/3, 110/3, 120/3 V	
Nominal frequency	50 Hz	50 Hz	50 Hz	
Power	10,30,50,75,100,150 VA	10,30,50,75,100,150 VA	10,30,50,75,100,150 VA	
Accuracy class	0.2, 0.5, 1, 3P, 6P	0.2, 0.5, 1, 3P, 6P	0.2, 0.5, 1, 3P, 6P	
Extreme power	400 VA	500 VA	500 VA	
Weight	21 kg	29 kg	33 kg	
Approval	TCM 212/98-2908	TCM 212/97-2656	TCM 212/98-2963	



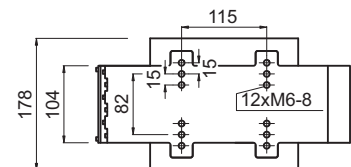
VTS 12



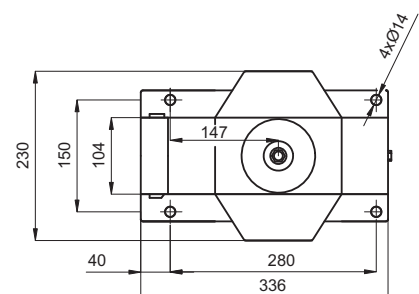
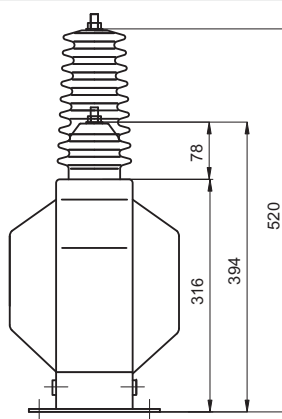
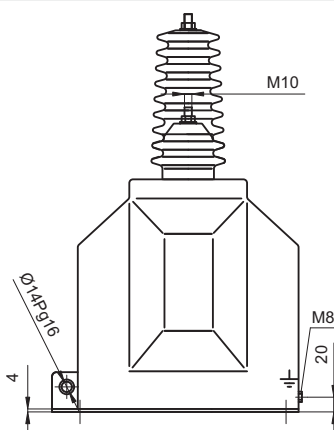
VTS 25



view from below:

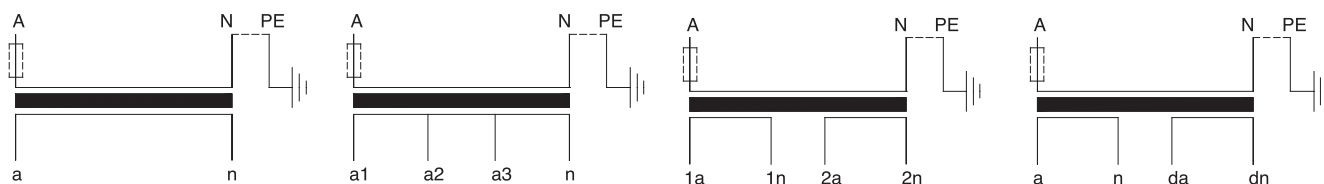


VTS 25 Sch



VTS 38

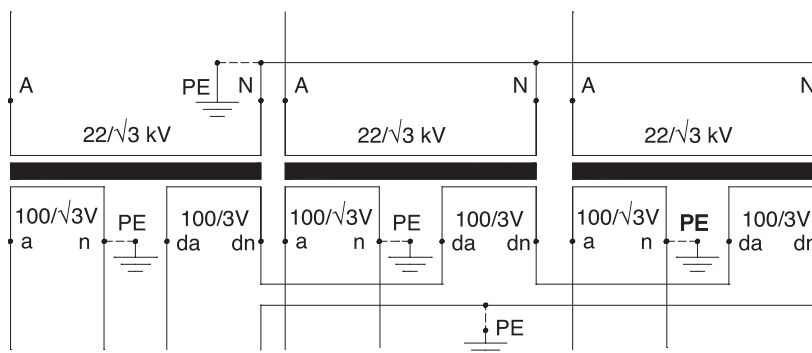
WIRING DIAGRAM



One end of primary winding is isolated from ground, the other is earthed during the operation. Before starting of the operation it is necessary to assure the earth connection of one of the secondary terminals of every outlet (See

„The Instructions for the operation and mounting“). In case of connection of auxiliary winding in the open triangle terminal has to be earthed at only one instrument out of the triplet.

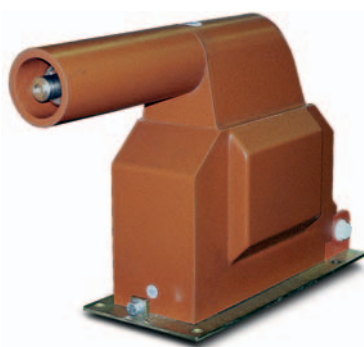
The diagram of connection of three single-poled transformers



ATTENTION! After every connection it is necessary to check if the secondary winding is not earthed by the means of one terminal at the terminal box of the instrument and by the means of the second terminal in outlet in the

low-voltage part. On the other case the instrument is connected in the shortcircuit and after the connection of high voltage there will be the destruction.

It is possible to consult other technical parameters with the producer.



VTS 12 P

Instrument voltage transformers VTS 12P.1, VTS 12P.2, VTS 38P.1X and VTS 38P.2X are single-phase single-pole insulated transformers designed for usage in high-voltage networks from 1 kV to 38.5 kV.

They are designed for the measuring and protection of distribution devices of internal construction. The devices are equipped with an HV fuse to protect the surrounding distribution system.

Values of the secondary voltages are $100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$, 100/3, 110/3, 120/3 V. Accuracy classes of the measuring coils are 0.2, 0.5, 1, 3 and accuracy classes of the protective coils are 3P and 6P. The transformers fulfil the required accuracy class within the range of 25 % to 100 % of the rated burden.

The body of transformers contains an epoxy adapter with fuse. The Transformers VTS 12P can have fuse JT 6 (0.3 A or 0.6 A) or VPO T32 or T50 (32 or 50mA). The transformers VTS 38P have fuse WBP-30 0.40A or VPO-T32. The fuse can be removed or inserted using a screw-able epoxy tube (see the Installation instructions). The HV contact can be floppy for installation in a distributing board (version VTS 12P.1, VTS 38P.1X) or fixed using an M6 screw (VTS 12P.2, VTS 38P.2X), see the drawing. (It



VTS 38 P

is necessary to accurately specify the version in the order.) If the fixed contact is used, a cable eye is recommended according to the cross section of the used conductor.

The magnetic circuit of the voltage transformers is made of oriented transformer strips in the shape of the "C" core.

All active parts of transformer are compound-insulated with epoxy-mixture. This material performs both the electrical insulating and the mechanical functions.

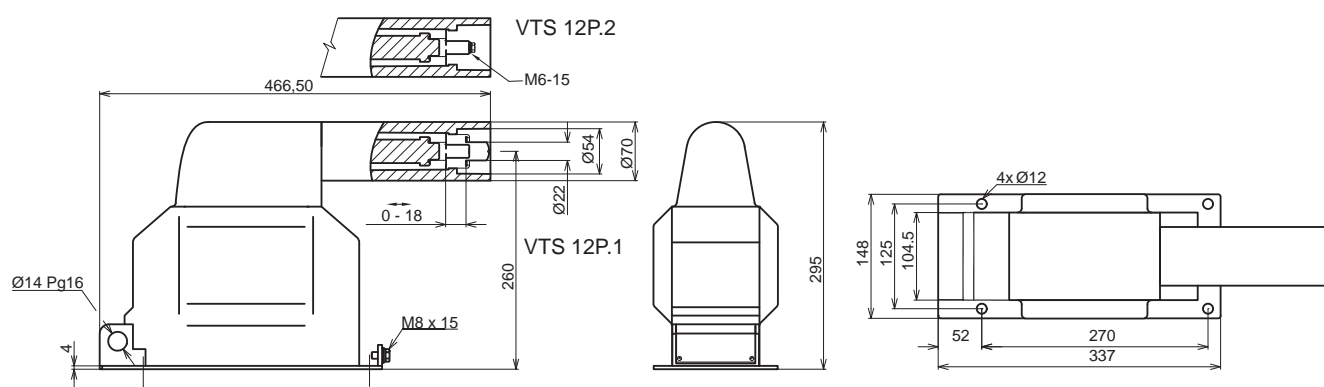
The secondary terminal board is equipped with a cover and a sealing screw. There is an additional pack inside which contains jumpers and screws to earth the coil. (See "The Instructions for the mounting and operation").

In cases where the replacement of an older transformer (different producers) is required, we provide VTS 12P devices on modified base plates that have the same installation dimensions as the replaced type.

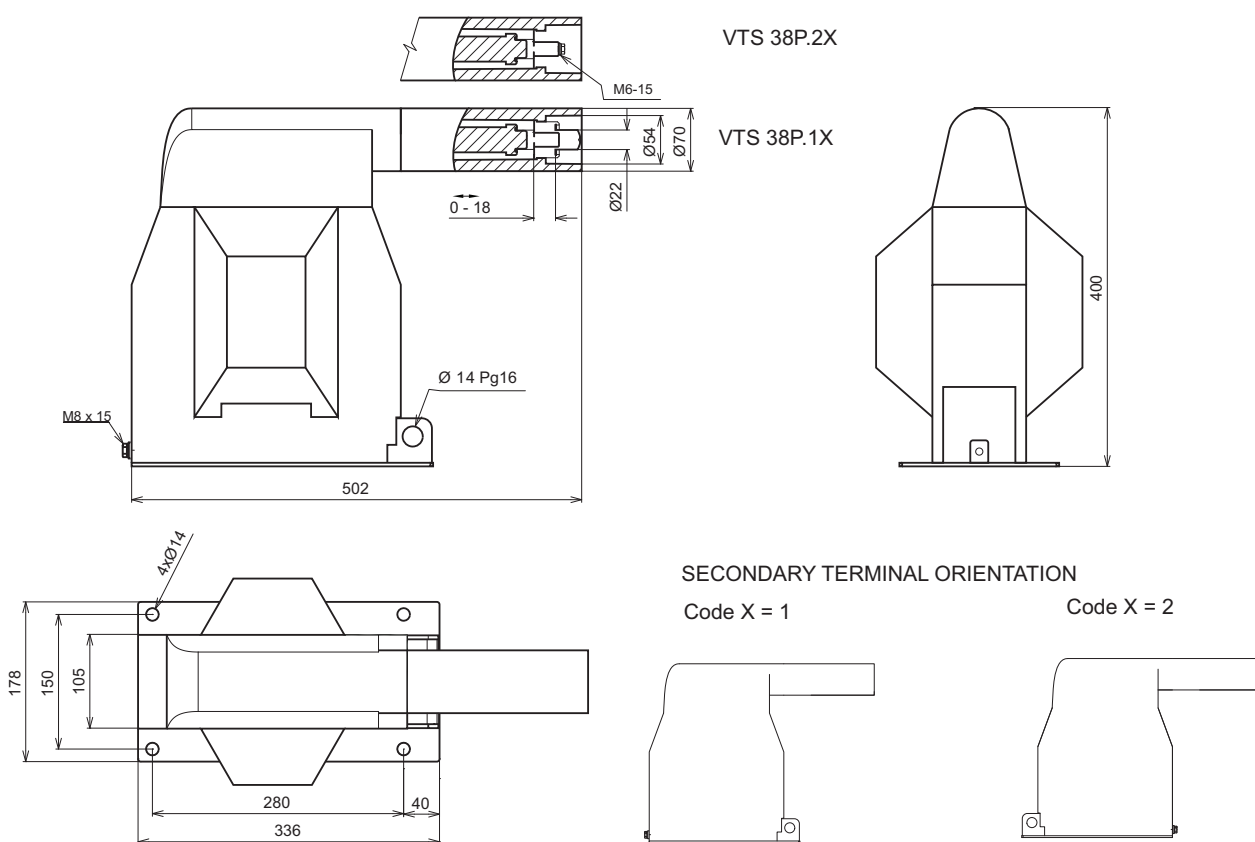
The transformers VTS 38P can have secondary terminal under fuse (code X=1) or opposite side (code X=2). It is necessary to accurately specify the version in the order.

We can provide official calibration if so required by the customer.

Type	VTS 12 P	VTS 38 P
Insulation voltage	0,72–17,5 kV	17,5–38,5 kV
Test voltage	3–38 kV	do 95 kV
Test impulse voltage	20–95 kV	do 180 kV
Nominal primary voltage	$1000/\sqrt{3}$ – $15000/\sqrt{3}$ V	$15000/\sqrt{3}$ – $35000/\sqrt{3}$ V
Nominal secondary voltage	$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V	$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V
Nominal auxiliary voltage	100/3, 110/3, 120/3 V	100/3, 110/3, 120/3 V
Nominal frequency	50 Hz	50 Hz
Power	10, 30, 50, 75, 100, 150 VA	10, 30, 50, 75, 100, 150 VA
Accuracy class	0.2, 0.5, 1, 3P, 6P	0.2, 0.5, 1, 3P, 6P
Extreme power	400 VA	400 VA
Weight	23 kg	35 kg

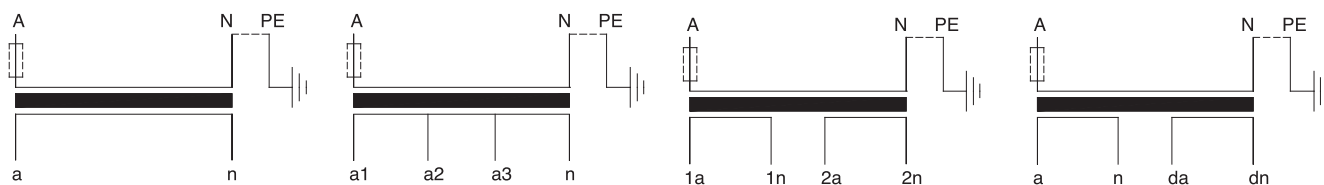


VTS 12 P



VTS 38 P

WIRING DIAGRAM



Instrument voltage transformers VTS 12P and VTS 38P comply with all tests according to ČSN EN 60044-2 and GOST 15 150 for U3 and T3.

It is possible to consult other technical parameters with the producer.


VTD 12

VTD 12

VTD 25

VTD 25

Voltage instrument transformers VTD 12 and VTD 25 are single-phase transformers isolated with double-poles. They are designed for the use in the high voltage systems. They are designed for measuring and protection of high voltage distributing equipment for indoor design. The instruments can be provided with high voltage protectors protecting the surrounding distributing system. The values of second-

dary voltage are 100, 110, 120 V. The accuracy classes for measuring winding are 0.2, 0.5, 1, for the securing winding is 3P. The transformers satisfy required accuracy class at intervals from 25% to 100% of rated load. Transformers VTD 25 with fuses are provided with epoxy extenders, holders and fuse enclosures of type JT 6 (0.3 A or 0.6 A). Extenders with fuses can be dismantled.

Type	VTD 12	VTD 25
Insulation voltage	3.6–17.5 kV	3.6–25 kV
Test voltage	10–38 kV	10–50 kV
Test impulse voltage	40–95 kV	40–125 kV
Nominal primary voltage	3000–15000 V	3000–22000 V
Nominal secondary voltage	100, 110, 120 V	100, 110, 120 V
Nominal frequency	50 Hz	50 Hz
Power	10, 30, 50, 75, 100, 150 VA	10, 30, 50, 75, 100, 150 VA
Accuracy class	0.2, 0.5, 1, 3P, 6P	0.2, 0.5, 1, 3P, 6P
Extreme power	400 VA	500 VA
Weight	22 kg	29 kg
Approval	TCM 212/98-2907	TCM 212/98-2978

Magnetic circuit of voltage transformers is made of oriented transformer strips in the shape of "C" of core.

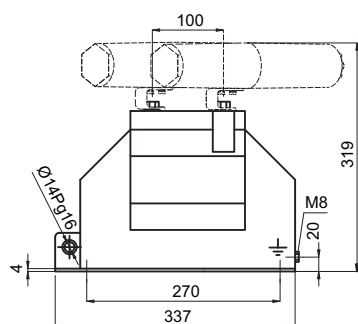
All active parts of transformer are compound-insulated with epoxy-mixture. This material performs both the electrical insulating and the mechanical functions.

Transformers are fixed by the means of four screws M10 in the holes in the basic plate. The primary terminals of transformers are brought out by the means of nuts M10. We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with the cover with sealing screw. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring.

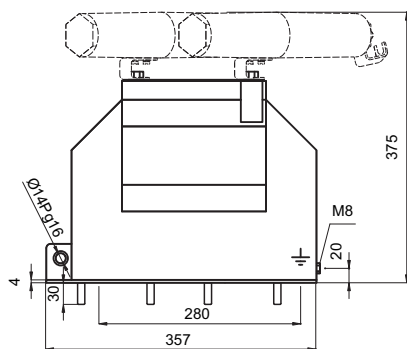
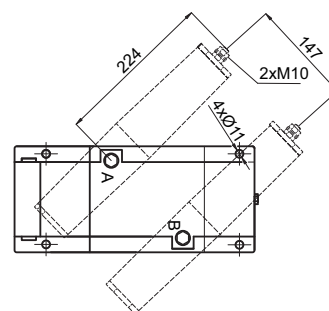
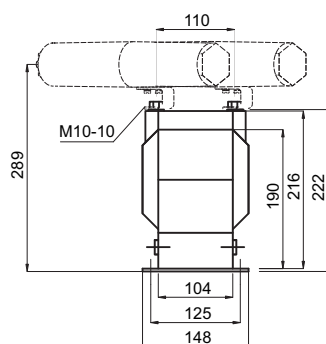
(See "The Instructions for the operation and mounting"). In cases where the substitution for the older types of transformers (various producers) is required, we supply transformers VTD with modified basic plates that have identical mounting spacing to spacing of the substituted types.

Voltage instrument transformers VTD 12 and VTD 25 complied with all the tests according to ČSN EN 60044-2 and GOST 15 150 for U3 and T3.

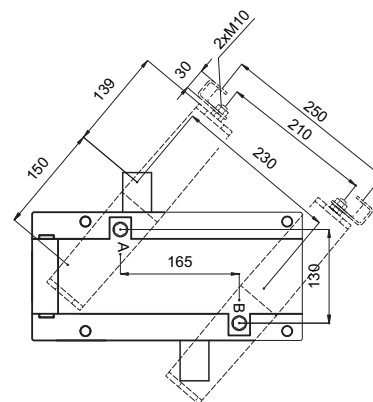
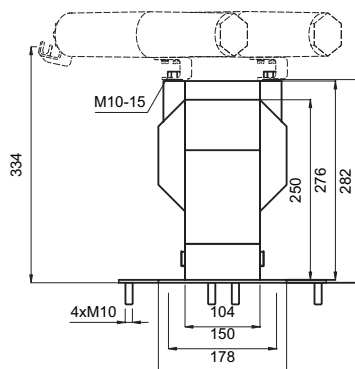
For the customer's request we provide official calibration.



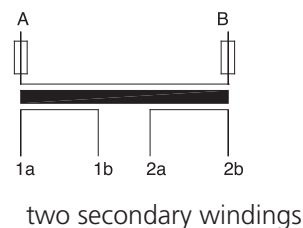
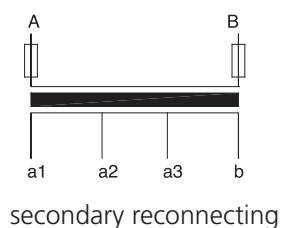
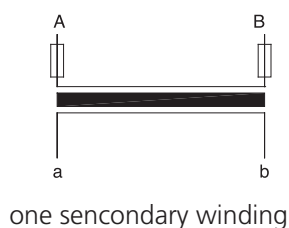
VTD 12



VTD 25



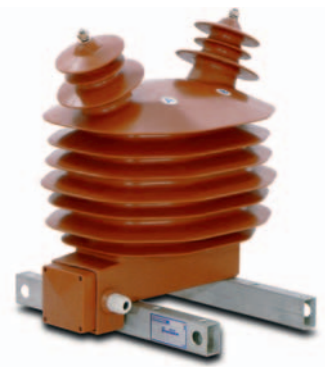
WIRING DIAGRAM



Before starting of the operation it is necessary to assure the earth connection of one of the secondary terminals of every outlet (See "The Instructions for the operation and mounting"). Attention! This is not applied for the circuit of the "V-type").

It is possible to consult other technical parameters with the producer.

Outdoor voltage instrument transformers



VPT 25



VPT 38

Voltage instrument transformers VPT and VTO are single-phase transformers. They are designed for the use in the high voltage systems. They are designed for measuring and protection of high voltage distributing equipment for outdoor design.

They are suitable for supplying of drives of remote-controlled section switches.

The accuracy classes for measuring winding are 0.2, 0.5, 1, 3, for the securing winding of 3P and 6P. The transformers satisfy required accuracy class at intervals from 25% to 100% of rated load. Magnetic circuit of voltage transformers VPT and VTO is made of oriented transformer strips in the shape of "C" of core. The outlets of primary winding are brought out by the means of bolts M10. For contacting them we recommend use conductors of maximum diameter of 6 mm² and terminal ends by reason of suspension of dynamic forces and vibrations within the system.

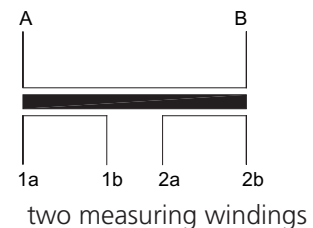
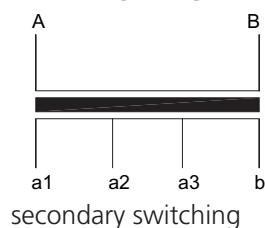
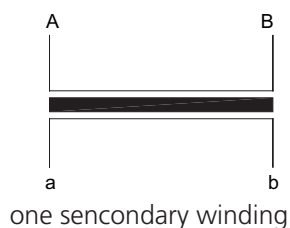
ATTENTION! The isolators must not be pre-stressed mechanically in the direction away from the body of transformer during the other way of contacting.



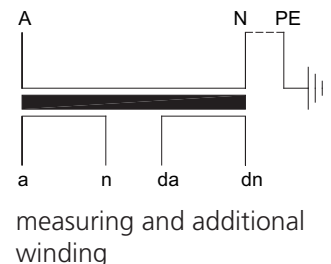
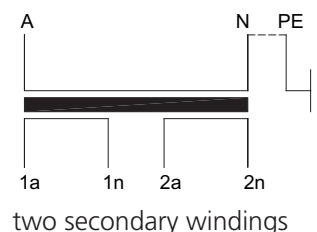
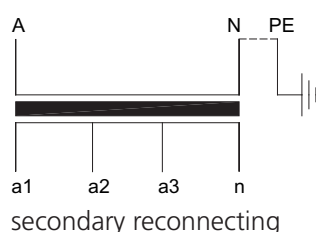
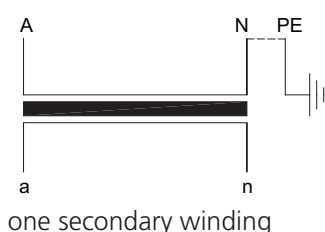
VTO 38

The value of secondary current is 5 A or 1 A with the possibility of combination. The accuracy classes for the circuits of measurement are 0.2, 0.5, 1, 3, for the circuits of protection are 5P, 10P. The transformers fulfill the required accuracy class at intervals from 25 % to 100 % of rated load. The terminal working current is 120 % I_N , in case of the agreement of the producer and the customer it is possible to deliver also the other values, for example 200% I_N .

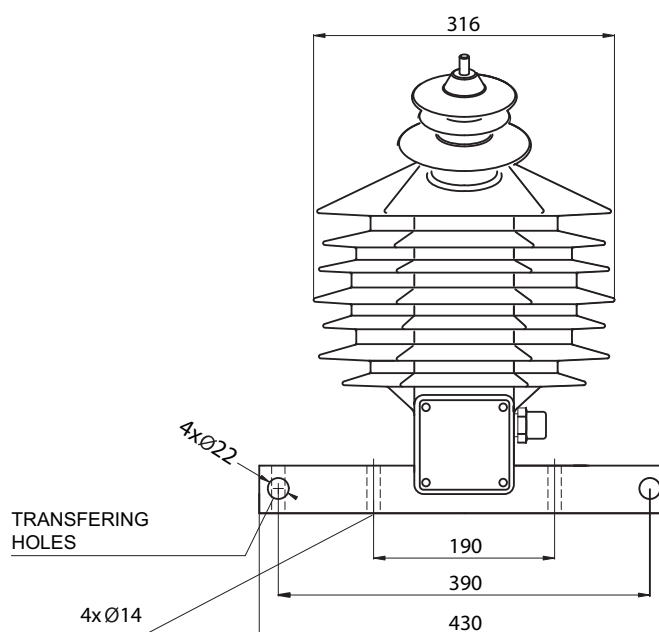
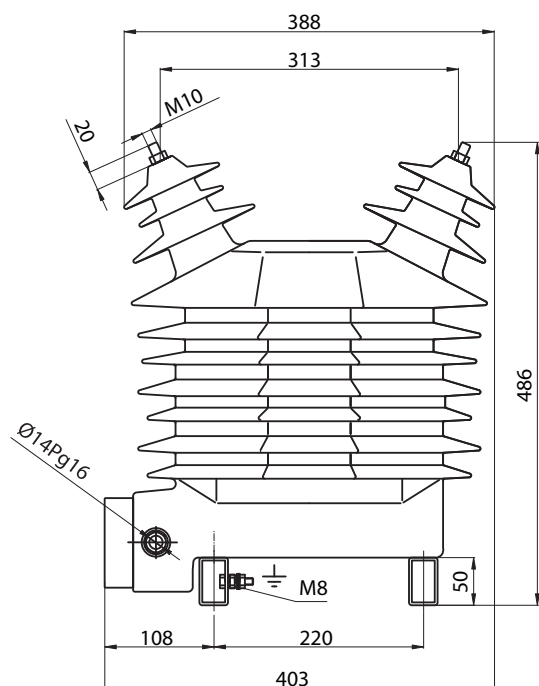
WIRING DIAGRAM

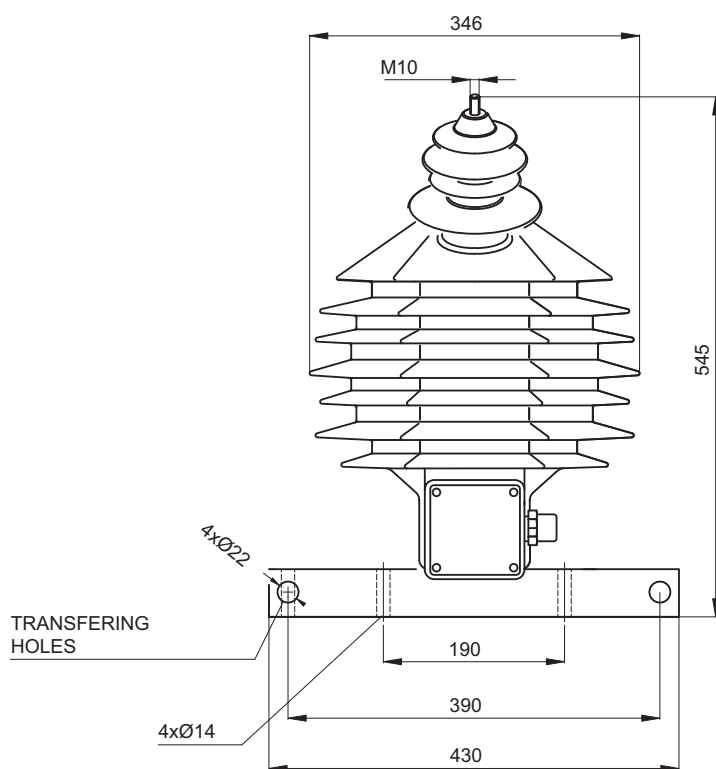
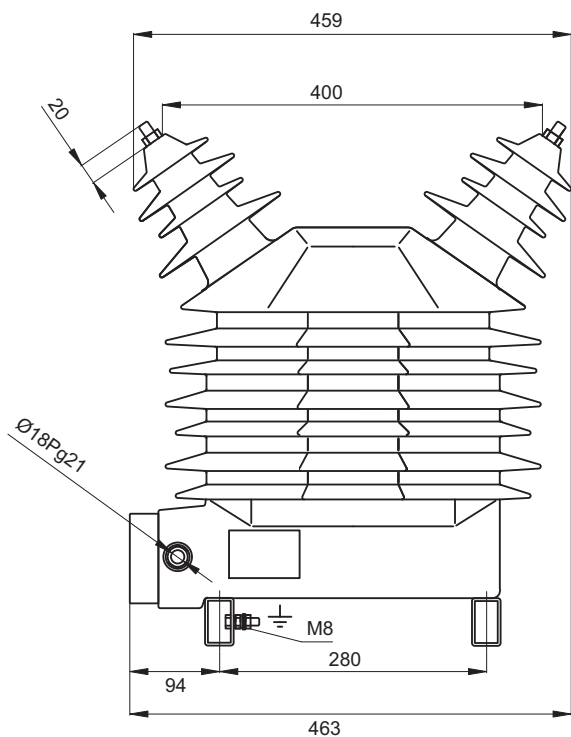


WIRING DIAGRAM

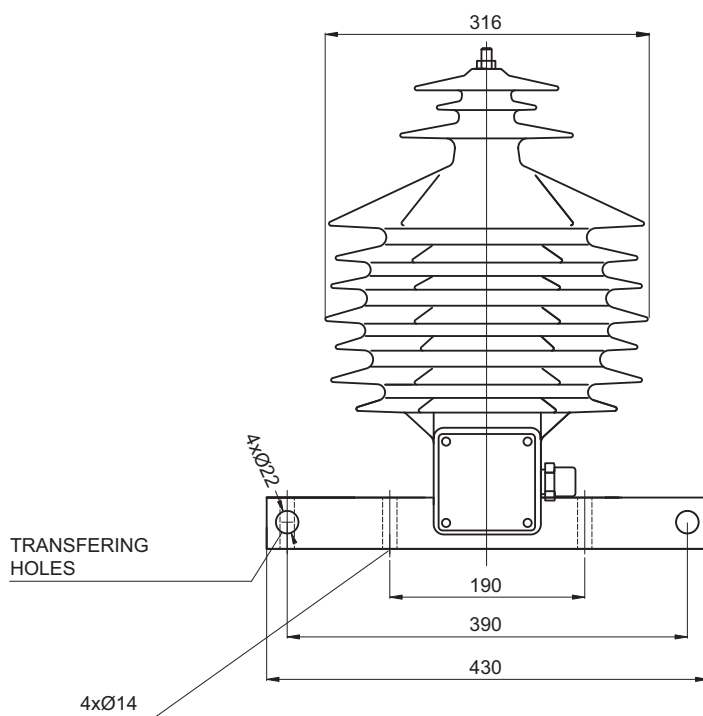
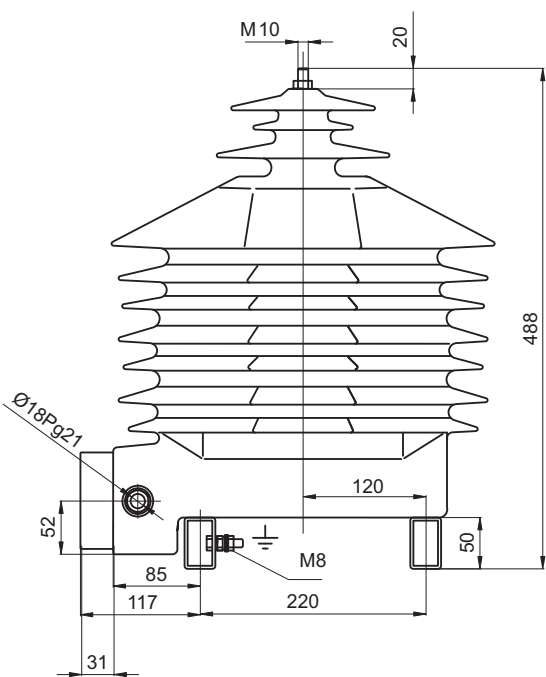


Type	VPT 25	VPT 38	VTO 38
Insulation voltage	3,6–25 kV	3,6–40,5 kV	up to 40,5 kV
Test voltage	10–50 kV	up to 95 kV	up to 95 kV
Test impulse voltage	40–125 kV	up to 220 kV	up to 200 kV
Nominal primary voltage	3000–22000 V	3000–35000 V	$3000/\sqrt{3}$ – $35000/\sqrt{3}$ V
Nominal primary current	–		–
Nominal second. voltage	100,110, 120 V		$100/\sqrt{3}$, $110/\sqrt{3}$, $120/\sqrt{3}$ V
Nominal auxiliary voltage	–		100/3, 110/3, 120/3 V
Nominal second. current	–		–
Nominal frequency	50 Hz		50 Hz
Power	10, 30, 50, 75, 100, 150 VA		10, 30, 50, 75, 100, 150 VA
Accuracy class	0,2, 0,5, 1		0,2, 0,5, 1, 3P, 6P
Extreme power	500 VA		500 VA
Creepage distance	930 mm	1210 mm	1230 mm
Weight	49 kg	62 kg	49 kg
Approval	TCM 212/ 02-3636	TCM212/ 02-3749	TCM 212/05-4239





VPT 38



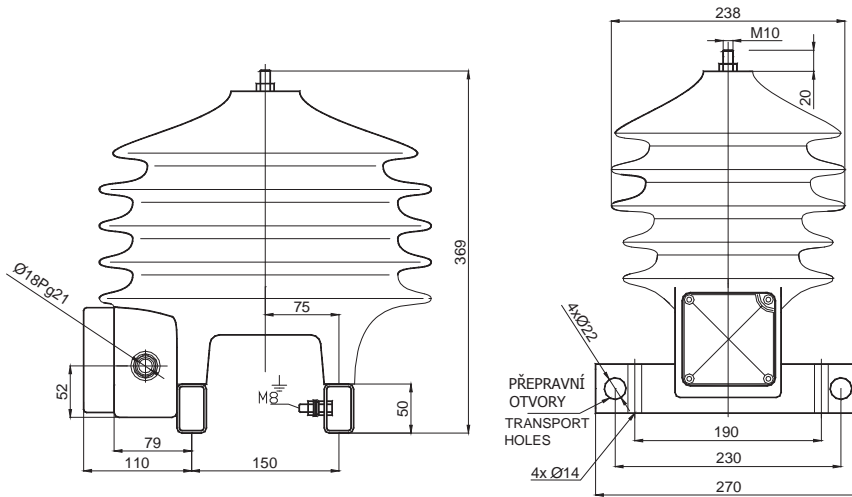
VTO 38

Voltage instrument transformers VPT and VTO complied all the tests according to the ČSN EN 60044-2 and GOST 15 150 for T1 and UCHL1.

For the customer's request we provide official calibration.

It is possible to consult other technical parameters with the producer.

Voltage instrument transformer VTO 15



VTO 15

Insulating voltage	1.2 to 17.5 kV	Nominal auxiliary voltage	100/3, 110/3, 120/3 V
Test voltage	6 to 38 kV	Nominal frequency	50 Hz
Test impulse voltage	20 to 95 kV	Power	30, 50, 75, 100, 150 VA
Nominal primary voltage	1000/ $\sqrt{3}$ -15000/ $\sqrt{3}$ V	Accuracy class	0.2, 0.5, 1, 3P, 6P
Nominal secondary voltage	100/ $\sqrt{3}$, 110/ $\sqrt{3}$, 120/ $\sqrt{3}$ V	Extreme power	500 VA
		Weight	24 kg

Voltage instrument transformers VTO 15 are single-phase transformers isolated with one pole. They are de-signed for the use in the high voltage systems from 3.6 kV to 38.5 kV. They are designed for measuring and protection of high voltage distributing equipment for out-door design.

The values of secondary voltage are 100/ $\sqrt{3}$, 110/ $\sqrt{3}$, 120/ $\sqrt{3}$, 100/3, 110/3, 120/3 V. The accuracy classes for measuring winding are 0.2, 0.5, 1, 3, for the securing winding are 3P and 6P. The transformers satisfy required accuracy class at intervals from 25% to 100% of rated load.

Magnetic circuit of voltage transformers VTO 15 is made of oriented transformer strips in the shape of "C" of core. Creepage distance is 650 mm.

All active parts of transformer are compound-insulated with epoxy-mixture resistant to the external effects (UV radiation, humidity, etc.). This material performs both the electrical insulating and the mechanical functions.

Transformers are fixed by the means of four screws M12 in the holes in the basic frame. The outlet of primary winding „A” is brought out by the means of bolt M10.

We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal plate is provided with the waterproof cover. The cover can be sealed. Inside, there is the set with jumpers and small screws for the possibility of earth connection and short circuiting of the wiring. (See “The Instructions for the operation and mounting”).

In cases where the substitution for the older types of transformers (various producers) is required, we supply transformers VTO 15 with modified basic plates that have identical mounting spacing to spacing of the substi-tuted types.

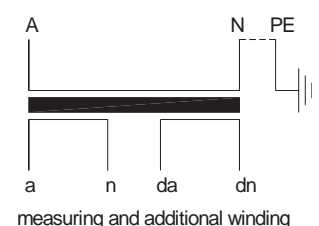
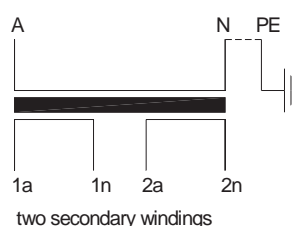
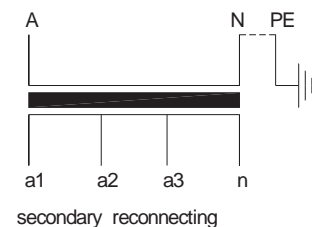
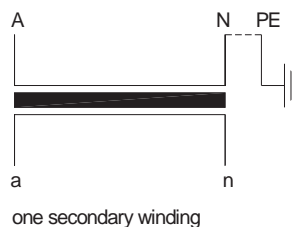
Voltage instrument transformers VTO 15 complied with all the tests according to IEC 60044-2, GOST 1516.3-96 up to the altitude up to 2000m and climatic conditions “T1 and UCHL1” by GOST 15 150.

For the customer's request we provide official calibration.

One end of primary winding is isolated from ground, the other is earthed during the operation. Before starting of the operation it is necessary to assure the earth connection of one of the secondary terminals of every outlet (See “The Instructions for the operation and mounting”).

In case of connection of auxiliary winding in the open triangle terminal has to be earthed at only one instrument out of the triple.

WIRING DIAGRAM



It is possible to consult other technical parameters with the producer.



CTO 15



CTSO 38

Current instrument supporting transformer CTO 15 and CTSO 38 are designed for measurement and protection of high voltage distributing equipment for outdoor design for nominal primary currents of 5-1250 A and for the highest voltage of system of 38.5 kV.

The value of secondary current is 5 A or 1 A with the possibility of combination. The accuracy classes for the circuits of measurement are 0.2, 0.5, 1, 3, for the circuits of protection are 5P, 10P. The transformers fulfill the required accuracy class at intervals from 25 % to 100 % of rated load. The terminal working current is 120 % I_N , in case of the agreement of the producer and the customer it is possible to deliver also the other values, for example 200% I_N .

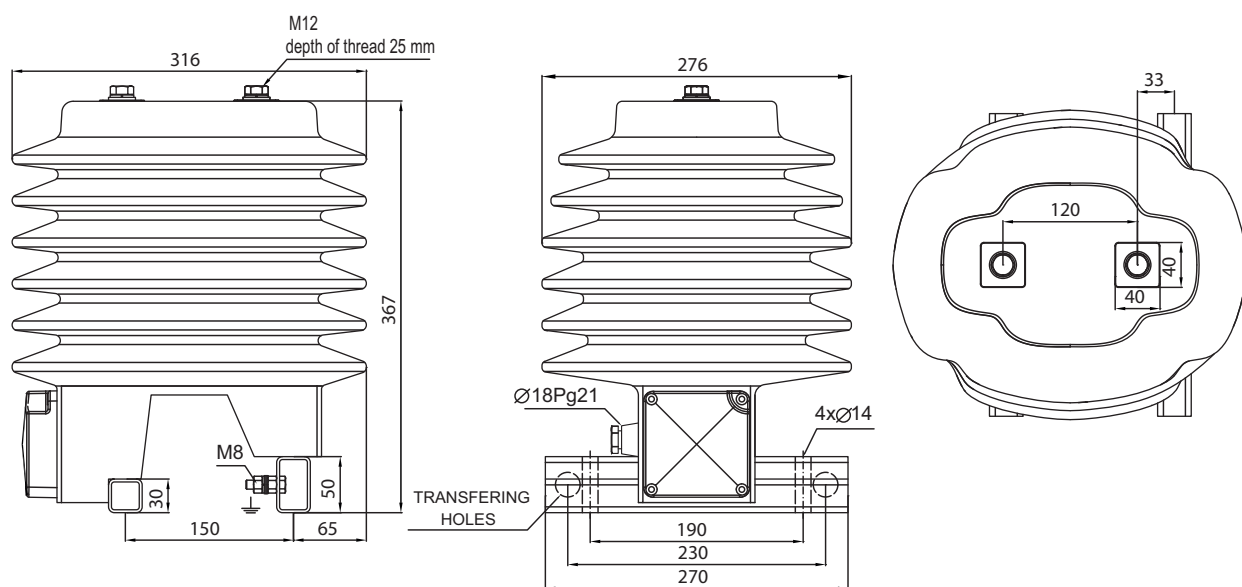
Transformers CTO 15 and CTSO 38 are constructed as transformers with single-turn or multi-turn primary

winding. The up- -to-date construction of these transformers allows the switching not only on the secondary side, but also on the primary side. The advantage of the primary switching is the easy mounting by the means of connecting two jumpers into the circuit by the means of screws M8 (both the screws and jumpers are the parts of the transformer).

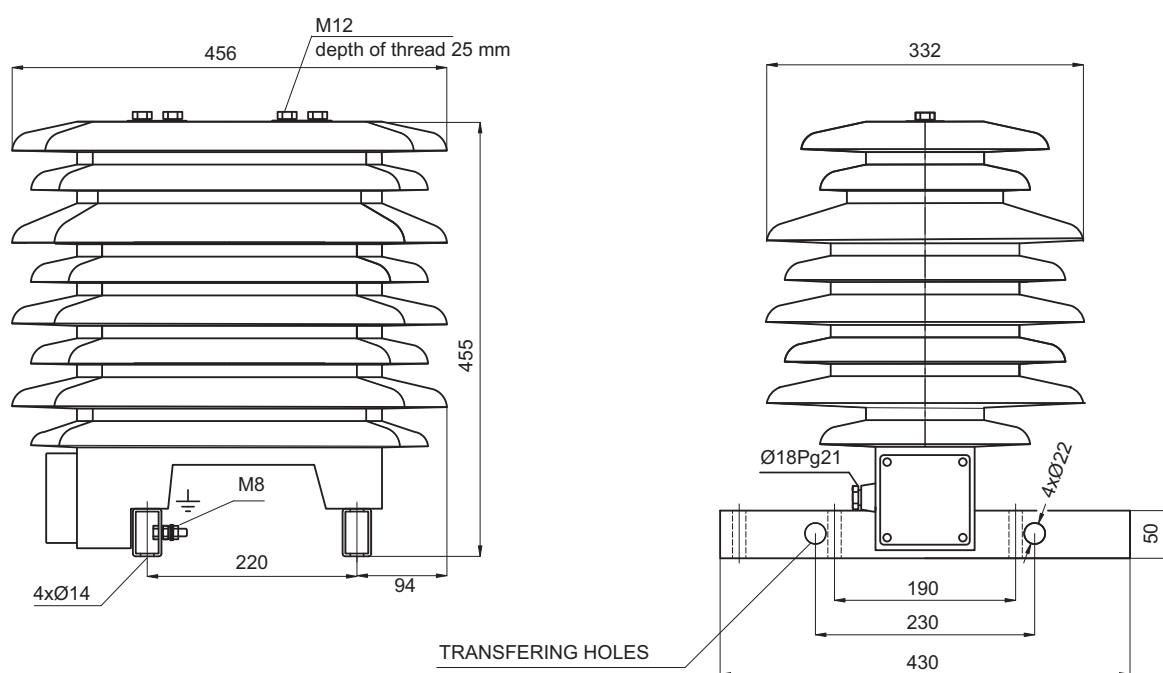
The secondary winding is wound on the magnetic core made of directed magnetic materials, eventually made of the alloy of nickel, iron and copper "permalloy". The maximum number of cores can be from 1 to 3 according to the request of customer.

Current instrument transformers CTO 15 and CTSO 38 complied all the tests according to the ČSN EN 60044-1 and GOST 15 150 for T1 and UCHL1.

Type	CTO 15	CTSO 38
Insulation voltage	25 kV	40.5 kV
Test voltage	60 kV	95 kV
Test impulse voltage	145 kV	220 kV
Nominal primary current	5–600 A	5–2000 A
Nominal frequency	5 (1) A	5 (1) A
Nominal auxiliary voltage	50 Hz	50 Hz
Power	5–60 VA	5–60 VA
Accuracy class	0.2, 0.5, 1, 3, 5P, 10P	0.2, 0.5, 0.2S, 0.5S, 1, 5P, 10P
Creepage distance	750 mm	1257 mm
Weight	30 kg	62 kg
Approval	TCM 212/08-4640	TCM 212/98-2963



CTSO 38

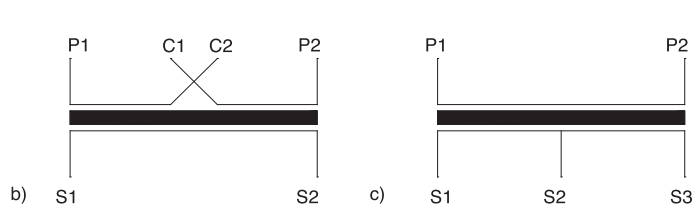


CTSO 38

WIRING DIAGRAM

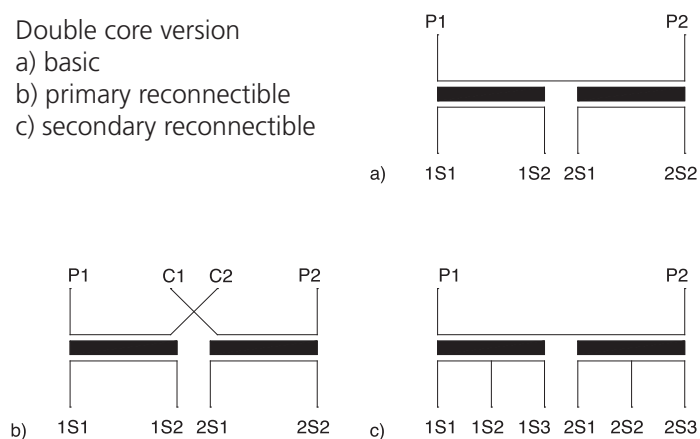
One core version

- a) basic
- b) primary reconnectable
- c) secondary reconnectable



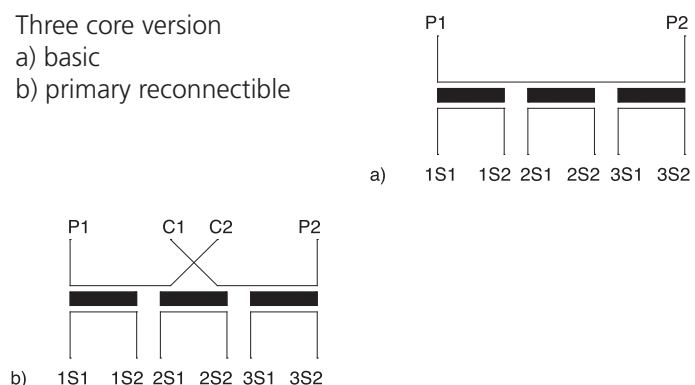
Double core version

- a) basic
- b) primary reconnectable
- c) secondary reconnectable



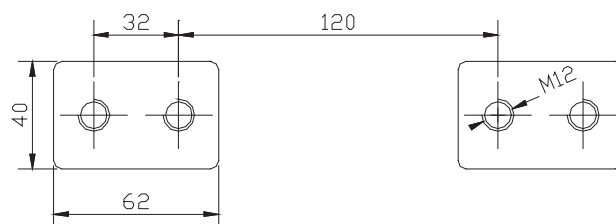
Three core version

- a) basic
- b) primary reconnectable

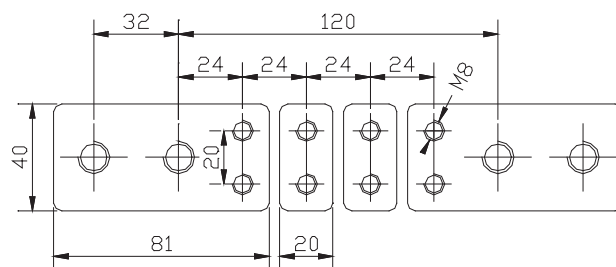


Primary terminals

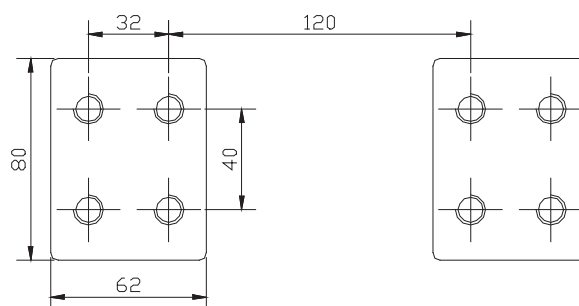
Basic Version up to 1250 A



Reconnectable Version up to 1250 A



Version 1250–3200 A



Current instrument transformers CTSO 38 complied all the tests according to the ČSN EN 60044-1.

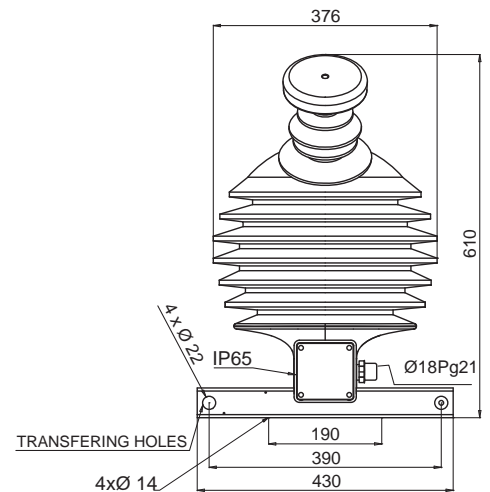
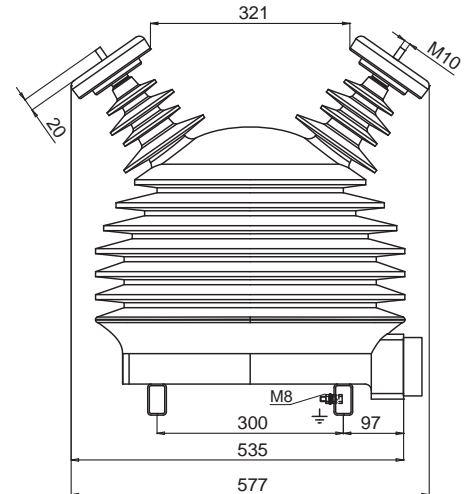
For the customer's request we provide official calibration.

It is possible to consult other technical parameters with the producer.

Voltage transformers VPPT 38.2 are single-phase double-pole insulated transformers designed for outdoor usage in high-voltage networks from 1 kV to 38.5 kV. They are designed to supply automation and distribution devices and drives of remotely-controlled section switches.



VPPT 38.2



Insulation voltage	3,6–40,5 kV	Nominal frequency	50 Hz
Test voltage	up to 95 kV	Ultimate output	Max. 2kVA, for 35 kV max. 1.5kVA
Test impulse voltage	up to 200 kV	Accuracy class	6%
Nominal primary voltage	3 000–35 000 V	Weight	85 kg
Nominal secondary voltage	100, 110, 120, 230 V	Temperature class	E (75°C temperature rise)
Creepage distance	1 240 mm		

The magnetic circuit of VPPT 38.2 voltage transformers is made of oriented transformer strips in the shape of the „C“ core.

All active parts of the transformer are embedded in an epoxy compound that withstands external influences (UV radiation, humidity, etc.). This material fulfils not only an electro-insulating function, but also a mechanical function. The length of the surface path is 1240mm.

The transformers are attached using four M12 screws through the holes in the basic frame. Primary winding „A“ and „B“ endings are brought out using M10 bolts. It is recommended to use conductors maximally 6 mm² in

cross-section and cable eyes to spring dynamic forces and vibrations in the network.

Cable eyes can be used to connect secondary endings (for 10 mm² conductor they are included). The secondary terminal board has a watertight cover (IP 65). The cover can be sealed.

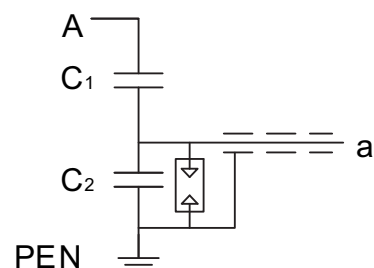
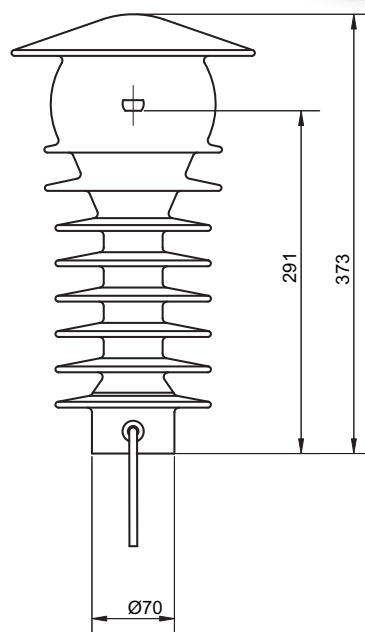
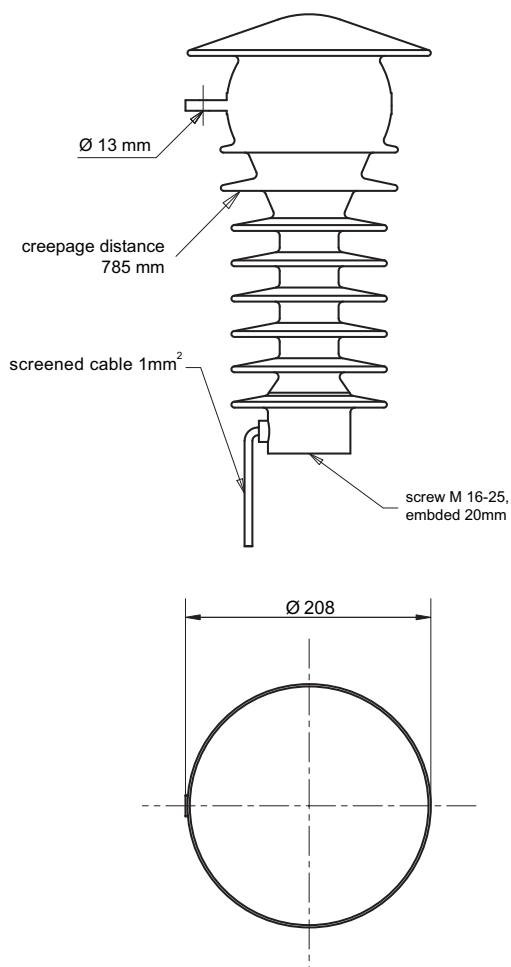
There is an additional pack inside which contains jumpers and screws to earth the coil (see the “Installation and operating instructions”).

The devices fulfil the chosen condition from the following standards: ČSN EN 600 76-1 to 600 76-11, ČSN EN 600 44-2 and GOST.

Other technical parameters can be consulted with the producer.

Capacitive voltage sensor VSO 25 is for outdoor networks of 22 kV. Sensor is suitable for protection purposes or signalling. Creepage distance corresponds to highest voltage 25 kV in cases of exceptional pollution severity (31mm/1 kV).

Insulating voltage	25 kV
Test voltage	50 kV
Test impulse voltage	125 kV
Nominal primary voltage	$22/\sqrt{3}$ kV
Nominal secondary voltage	0-230 V (130V \pm 15% for burden 1M Ω)
Nominal frequency	50 Hz
Sensing capacity C1	50 až 60 pF
Capacity of screened cable per meter of length C2	280pF/m

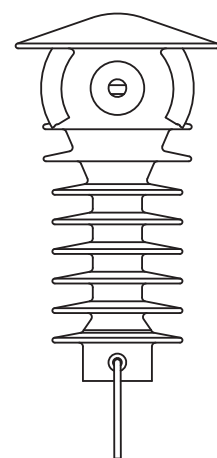
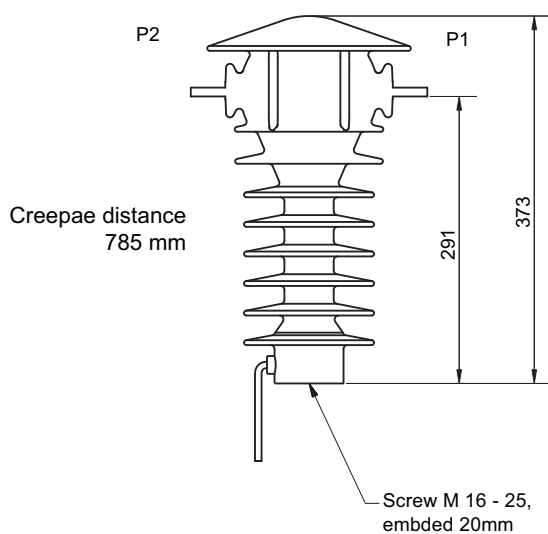
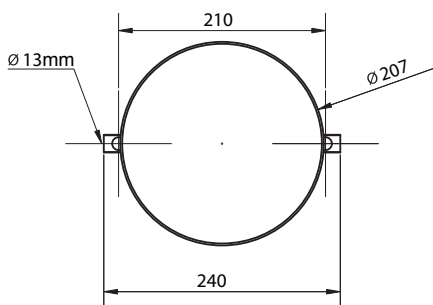

VSO 25


Voltage sensor is designed by the standard ČSN EN 600 44-2 and GOST 15 150 for T1 and UCHL1.
It is possible to consult other technical parameters with the producer.


CSO 25

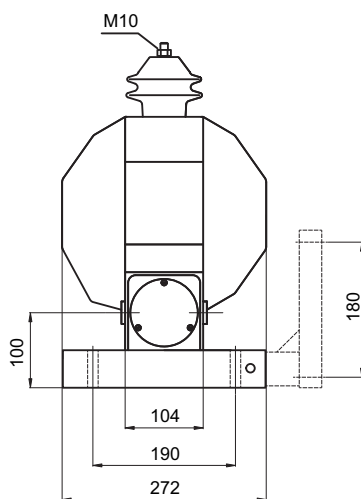
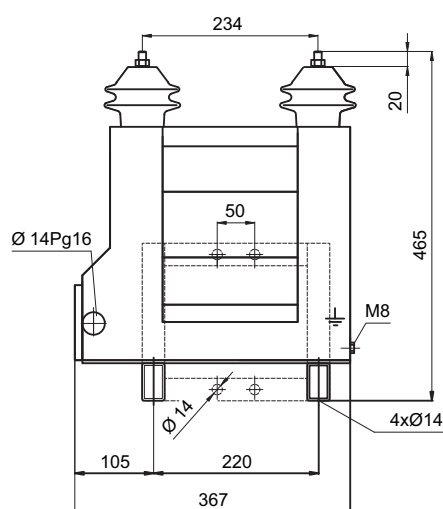
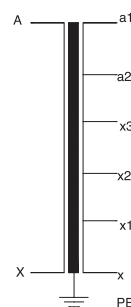
Current sensor CSO 25 is designed for outdoor networks of 22 kV. Sensor is suitable for protection purposes or signalling. Creepage distance corresponds to highest voltage 25 kV in cases of exceptional pollution severity (31mm/1 kV).

Insulating voltage	25 kV
Test voltage	50 kV
Test impulse voltage	125 kV
Nominal primary current	100–400 A
Overcurrent class Ith/Idyn	16/40 kA
Nominal secondary current	1,5 A
Nominal frequency	50 Hz
Power	2VA
Accuracy class	3%
Overcurrent factor	>5


S1 - blue, S2 - brown


Current sensor is designed by the standard IEC 600 44-1 and GOST 15 150 for T1 and UCHL1.
 It is possible to consult other technical parameters with the producer.

Voltage transformers VTDOR 38 are single-phase transformers isolated with double-poles. They are designed for outdoor mounting in the high voltage systems of 6 kV. They are designed above all for power supply of automatic track safety appliances with power take-off of 220 V, 0-1.2 kVA at 50-75 Hz and furthermore as the sources for general use. The construction of instrument is based on the requirements of Czech Railways for the transformers supplying safety appliances and also on the measuring transformers. The instruments satisfy the tests of standards ČSN EN 60044-2 and GOST 15 150 for T3 and U3. Technical parameters are listed in the following table.


VTDOR 38

Connection diagram

Table of marking of terminals and corresponding voltage

VN	[V]	NN	[V]
A-X	6300	a2-x3	230
	6000	a2-x2	
	5700	a2-x1	
	5400	a1-x2	
	5150	a1-x1	

Insulating voltage	7.2 kV	Nominal frequency	50-75 Hz
Test voltage	22 kV	Power	0-1.2 kVA
Test impulse voltage	60 kV	Short-circuit voltage	4.5%
Nominal primary voltage	5150-6300 V	Extreme power	1.2 kVA
Nominal secondary voltage	230 V	Weight	51 kg

Transformers are fixed by the means of four screws M12 in the holes in the basic frame. For the mounting of transformers into the transformation stations that have already been built it is possible to use auxiliary suspension frame. This frame can be supplied as fixings. Metal parts of transformer are cold-galvanized, electrically conductive areas are nicked. The outlets of primary windings "A" and "X" are brought out by the means of screw bolts M10. For contacting them we recommend use conductors of maximum diameter of 6 mm² and terminal ends by reason of suspension of dynamic forces and vibrations within the system.

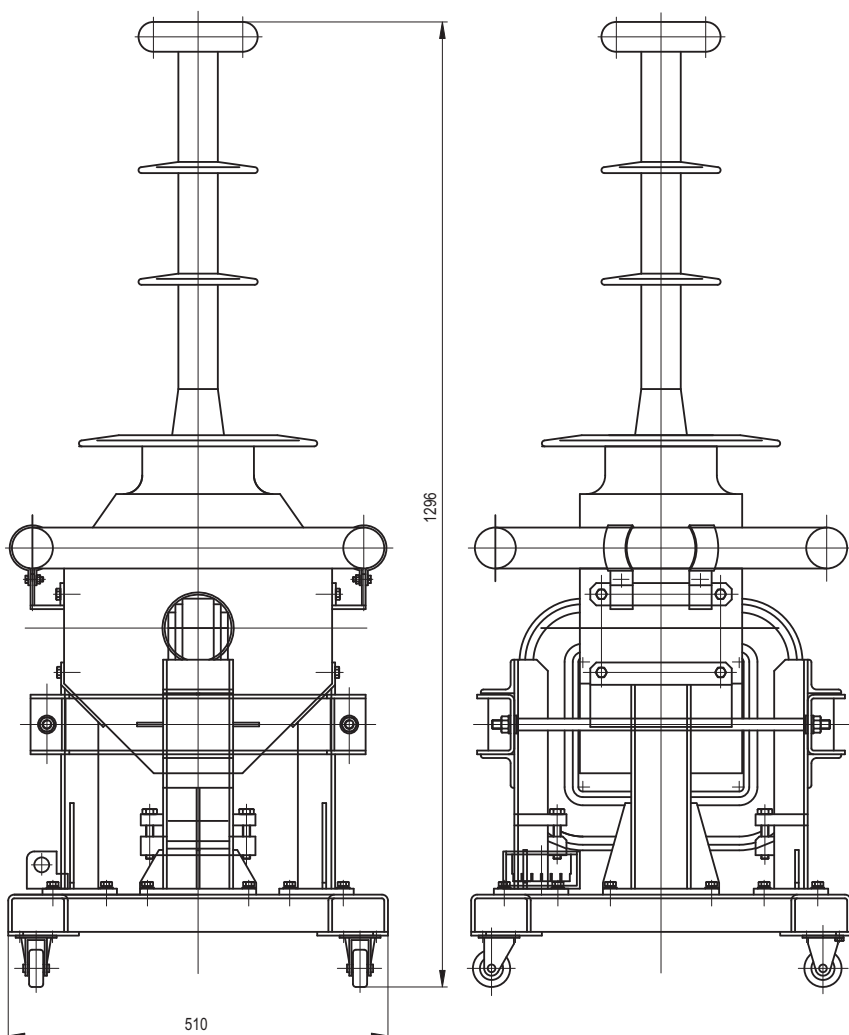
ATTENTION! The isolators must not be pre-stressed mechanically in the direction away from the body of transformer during the other way of contacting.

We recommend use terminal ends corresponding to the used cross-section of the conductor for attaching to the secondary outlets. The secondary terminal board is covered with the waterproof cover. It is possible to seal the cover.

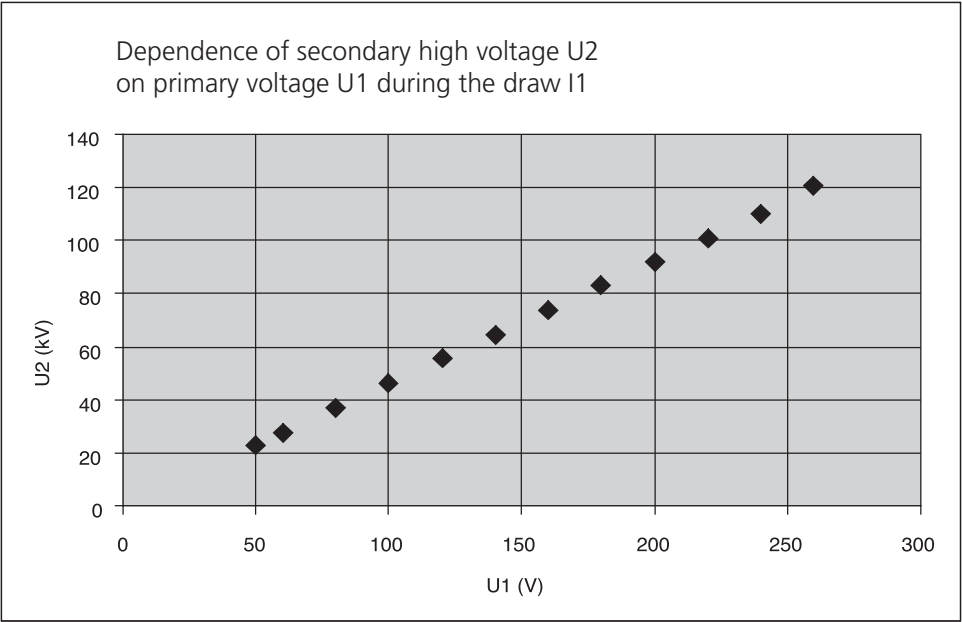
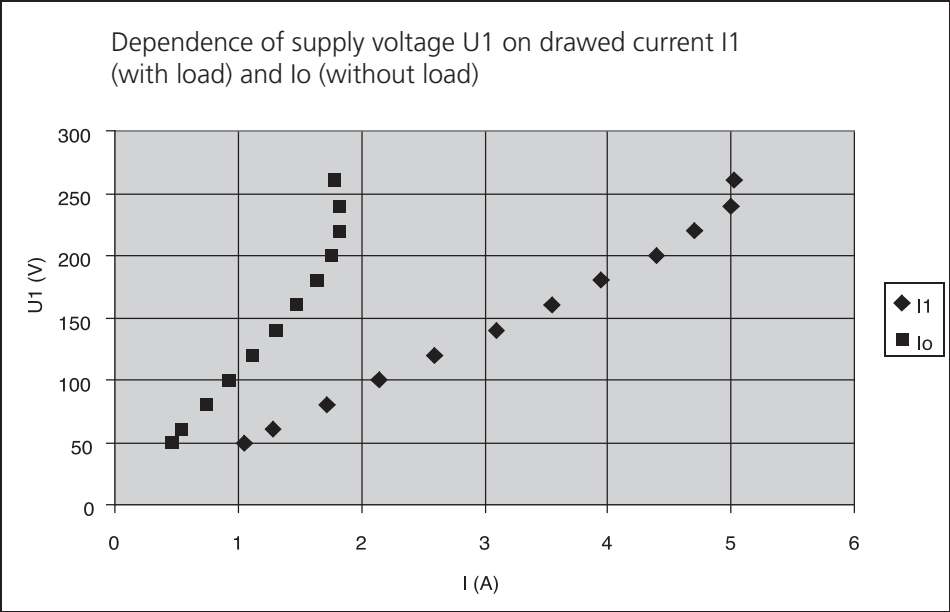
Table of marking of the terminals Connection diagram and relevant voltage


VPT 100

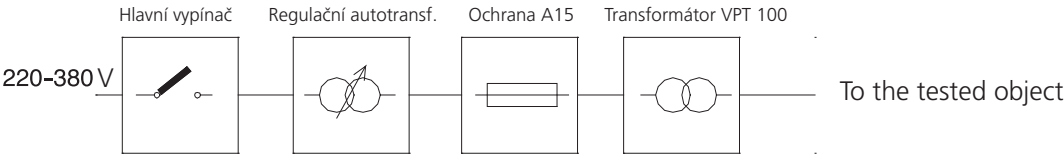
Voltage transformers VPT 100 are single-phase transformers isolated with single pole. They are designed as the sources of high voltage with the ratio 0.22/100kV or 0.38/100kV. The power of voltage transformers VPT 100 is 3kVA, in the short time it can be up to 7kVA. It is possible according to the request of customer to make the limitation of the secondary current by the means of resistor, if is the case the limitation of the current highlights by the means of choke placed in the bushing. Magnetic circuit of voltage transformers VPT 100 is made of oriented transformer strips in the shape of "C" of core. All active parts of transformer are compound-insulated with epoxy-mixture. The transformers are supplied with the undercarriage that allows movement of transformer. The weight of transformer including undercarriage is 125 kg.



Picture No.1 The characteristics of the source



Picture No. 2 Block diagram



The Instructions for the mounting and operation of the current instrument transformers

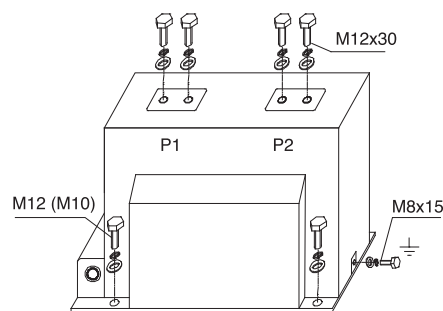
The mounting position of the instrument transformers CTS, CTT and CTB is arbitrary. The transformers CTSO 38 and CTO are mounted in the vertical position. The transformers are fixed by the means of four screws M10 (CTS 12) or M12 (CTS 25, CTS 25X, CTS 25X Sch, CTS 38, CTS 38X, CTS 38X Sch, CTSO 38, CTB 25, CTT 25) in the holes in the basic plate or in the profiles. The connection of the power circuit to the primary terminals is done by the means of the screws M12 (See picture No.1) with max. torque module 30Nm. We recommend use terminal ends corresponding to the used cross-section of the conductor (its maximum size is 10 mm²) for attaching to the secondary outlets. Metal functional parts of the transformer are coated against corrosion. The primary terminals are galvanized with nickel or silver-plated. The secondary terminals are galvanized with nickel. The basic plates are cold galvanized (transformers for the indoor settings) or hot galvanized (transformers for the outdoor settings).

We recommend clean transformers from dirt and draw close the connections in case of shut down.

Before starting-up it is necessary to earth the metal base of transformer (earthling "cube" with screw M8x15 with max. torque module 10Nm see picture No. 1) and one secondary terminal of every outlet (See picture No. 2). The secondary outlets, that were not used, are necessary to be short connected and earthed (See the examples in pictures No. 3-5). The earthing of the secondary outlets is done by the means of screws M5x16 and jumpers (See picture No. 2) that are the parts of the set of each supplied transformer.

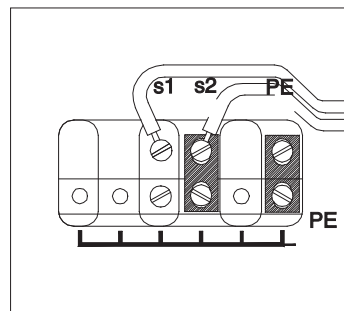
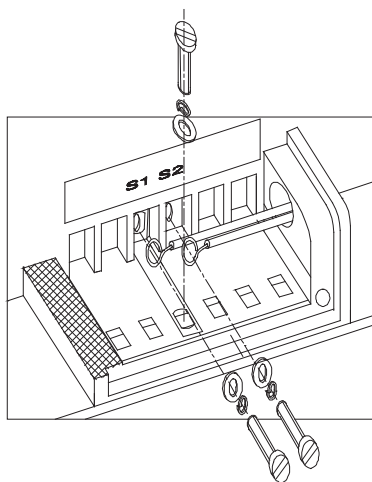
Picture 1: Mounting system of transformer CTS

		Tightening torque max.
Test voltage	M12	30 Nm
Ground terminal	M8	10 Nm
Secondary terminal	M5	2.7 Nm



The construction of transformers allows the switching of the ranges on both the secondary and primary sides. The secondary switching is made by the means of switching of branches on the secondary coil. See the examples in pictures No. 6-9. The primary switching has easy mounting, connecting two jumpers into the circuit by the means of screws M8 (both the screws and jumpers are the part of the set of the transformer). See the examples of interconnection in pictures No. 10-13.

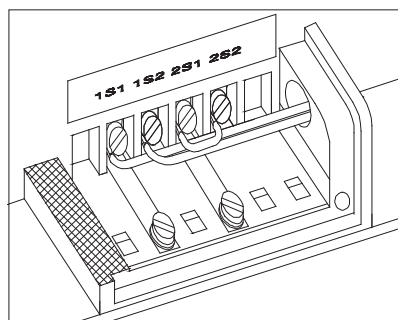
Picture 2: The way of connection of conductors to the secondary terminals, including of the earthing of one terminal for the transformers for the indoor and outdoor settings.



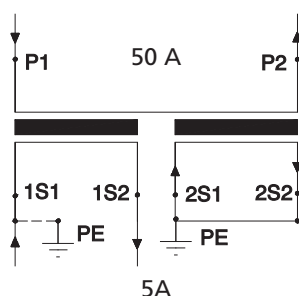
The secondary terminal board is provided with the plastic cover with sealing cover and also, on the sides, with the threads Pg16 with screwed blinding and jumper for the drawing die of the secondary conductors. The secondary terminal board of the transformers for the outdoor settings (type CTSO) is provided with the waterproof cover with sealing screw and waterproof bushing for the connection of the secondary conductors.

The examples of circuit of the secondary terminal board of measuring current transformers, including special cases
 There is the example of circuit of two-cored transformer with ratio 50//5/5 A in the picture No. 3. The terminals of the first secondary winding (symbols 1S1 and 1S2) are connected to the external load and one terminal (in this case 1S1) is earthed. The second secondary winding (symbols 2S1 and 2S2) is not connected to the external load and so the terminals have to be interconnected in the short circuit and they have to be earthed. The wiring diagram is in picture No. 4. The mounting of the terminal board is in picture No. 5.

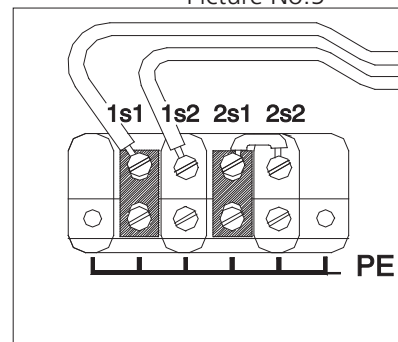
Picture No.3



Picture No.4

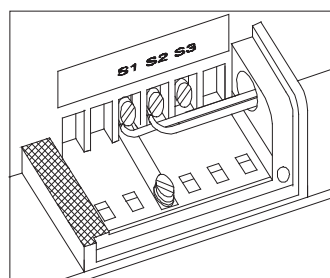


Picture No.5

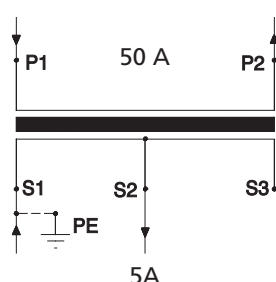


The example of mounting of the secondary terminal board of one-core transformer with the ratio 50-100//5 A and with the switching on the secondary side you can see in the following pictures. Picture No. 6 describes the connection for the ratio 50//5 A. Terminals S1 and S2 are brought out to the external load and one terminal (in this case S1) is earthed. The electric scheme is in picture No. 7. The mounting for the ratio 100/5 you can see in picture No. 8. Terminals S1 and S3 are brought out to the external load and terminal S1 has to stay earthed. Terminal S2 remains unassigned. Wiring diagram is in picture No. 9.

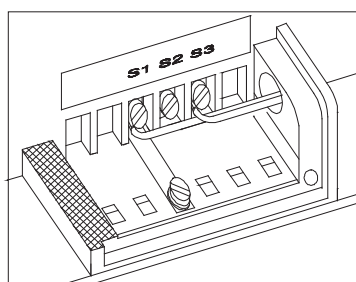
Picture No.6



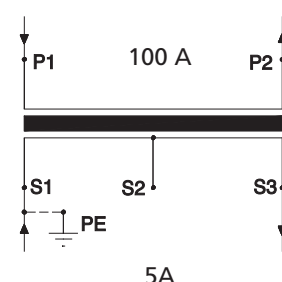
Picture No.7



Picture No.8

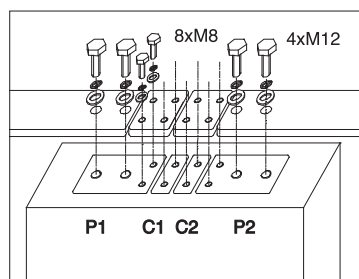


Picture No.9

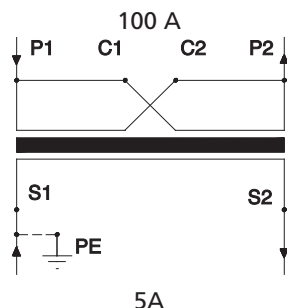


In the following case you can see the example of mounting of the primarily switchable transformer with the ratio 50-100//5 A. In picture No. 10 is shown the connection for the primary current of 100 A. Terminals P1, C1 and P2, C2 are interconnected by the means of the special connector and screws M8. Wiring diagram is in picture No. 11. The way of contacting for the primary current of 50 A is in picture No. 12. Terminals C1 and C2 are interconnected by the means of both connectors and screws M8. Scheme is in picture No. 13..

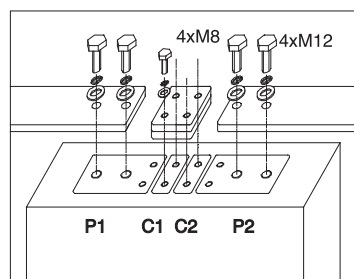
Picture No.10



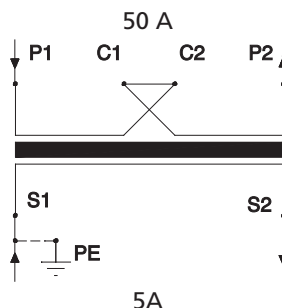
Picture No.11



Picture No.12



Picture No.13



Note: The above-mentioned connections are recommended by the producer only in the cases where the expert designer does not determine other way.

The instructions for the mounting and operation of the voltage instrument transformers

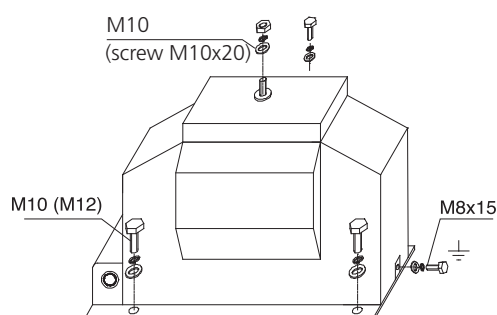
The mounting position of the instrument transformers VTS and VPT is arbitrary. The transformers VTO and VPT are only mounted in the vertical position. The transformers are fixed by the means of four screws M10 (VTS 12 and VTD 12) or M12 (VTS 25, VTS 38, VTD 25, VTO 38, and VTDOR 38) in the holes in the basic plate or in the profile. The connection of high voltage to the primary side is recommended by the means of the terminal ends with 10 mm and screws M10 with max. torque module 20 Nm. The example of mounting system of transformer is shown in picture No. 1 (VTS 12). For the contacting on the high voltage side of transformers with isolators we recommend to use the conductors of maximum diameter of 6 mm² and terminal ends by the reason of springing of the dynamic forces within the system.

ATTENTION: The isolators must not be pre-stressed mechanically in the direction away from the body of transformer during the mounting process. We recommend clean transformers from dirt and draw close the connections in case of shut down.

Before starting-up it is necessary to earth the metal base of transformer (earthling "cube" with screw M8x15 with max. torque module 10 Nm see picture No.1).

Picture 1: The example of mounting system of transformer (VTS 12)

		Tightening torque max.
Primary terminal	M10	20 Nm
Ground terminal	M8	10 Nm
Secondary terminal	M5	2.7 Nm

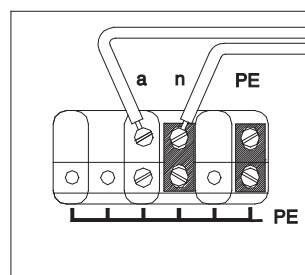
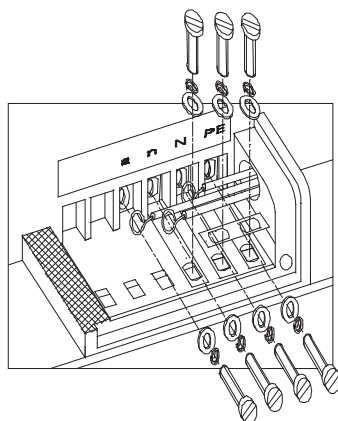


The earthing of the secondary outlets is done by the means of screws M5x16 and jumpers (See picture No.2) that are the parts of the set of each supplied transformer. The example of mounting is shown in picture No. 2. The construction of transformers allows the switching of the ranges on the secondary branches of transformer. The examples are shown on the following page.

The secondary terminal board is provided with the plastic cover with sealing cover and also, on the sides, with the threads Pg16 with screwed blinding and jumper for the drawing die of the secondary conductors. The secondary terminal board of the transformers for the outdoor settings (types VTO and VPT) is provided with the waterproof cover with sealing screw and waterproof bushing for the connection of the secondary conductors.

ATTENTION! It is necessary to check after each starting-up whether the secondary winding is not earthed by one terminal on the terminal board and by the second terminal by the outlet in the low voltage part. Otherwise the instrument is connected in short way and after the starting-up of high voltage the destruction of the instrument occurs.

Picture 2: The way of connection of the secondary outlet and outlet of primary winding in earth of indoor and outdoor type of VTS and VTO

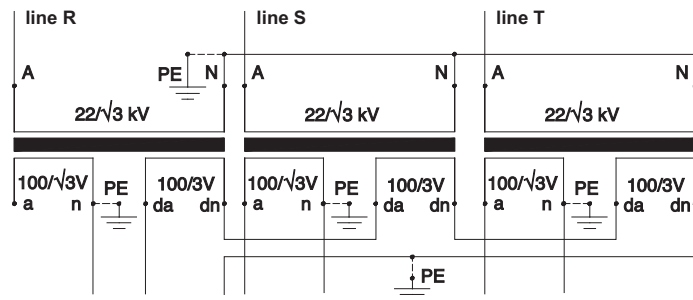


The examples of circuit of the secondary terminal board of measuring voltage transformers, including special cases

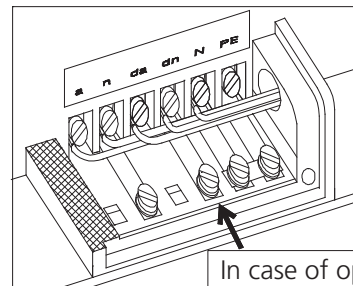
Single-pole instrument transformers of type VTS for the use of three-phased, inefficiently earthed systems are usually provided with two secondary windings. The first of these windings is used for the measurement or protection, the second for signaling of earth connection. They are linked up in three phases - the primary and secondary windings are star-connected, auxiliary winding in open triangle (See wiring diagram in picture No.3).

Terminal "N" of the primary winding, one terminal of the secondary winding and one of the end terminals of the open triangle have to be earthed during the operation. (ATTENTION! In case of earthing of the open triangle on two terminals there is the danger of instrument destruction.) The example of circuit of terminal board is shown in picture No. 4.

Picture 3: Wiring diagram of triple of single-poled transformers



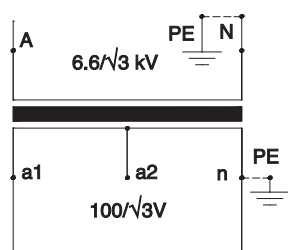
Picture No.4



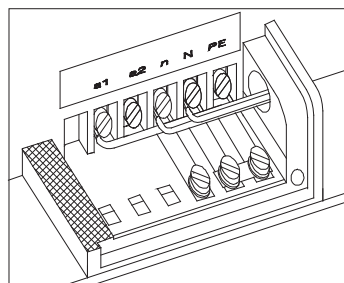
In case of open delta-connection is terminal connector grounded only on one transformer out of triplet

In the following case you can see the example of switchable single-poled transformer with the ratio $6600-11000/\sqrt{3}/100/\sqrt{3}$ V. The switching is possible due to branch on the secondary winding. Picture No. 5 shows the scheme for the ratio $\sqrt{3}/100/\sqrt{3}$ V. The measuring outlet is between the terminals a1 - n, terminal a2 remains unassigned. The mounting of terminal board is shown in picture No. 6. The scheme for the ratio $11000/\sqrt{3}/100/\sqrt{3}$ V is shown in picture No. 7. The measuring outlet is here between terminals a2 - n, terminal a1 remains unassigned. The mounting of terminal board is shown in picture No. 8.

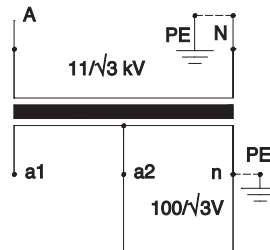
Picture No.5



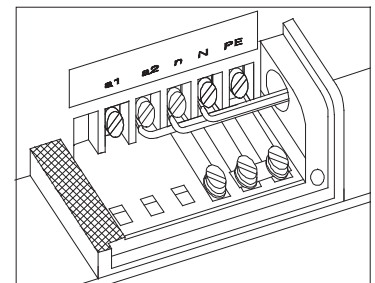
Picture No.6



Picture No.7



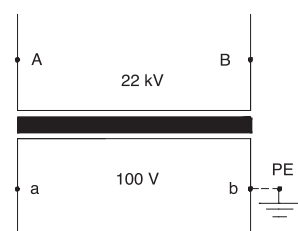
Picture No.8



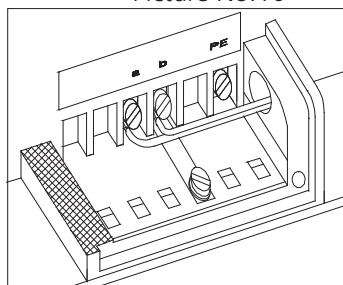
Double-poled instrument transformers VTD and VPT have all parts of primary winding, including terminals, isolated from earth. The isolation is dimensioned on the level of testing voltages according to the corresponding nominal voltage. One of the secondary terminals must be earthed during the operation (it is not the case of the so called "V- connection").

Wiring diagram of transformer is shown in picture No. 9. The connection of terminal board for indoor setting is shown in picture No. 10 and for outdoor setting in picture No. 11.

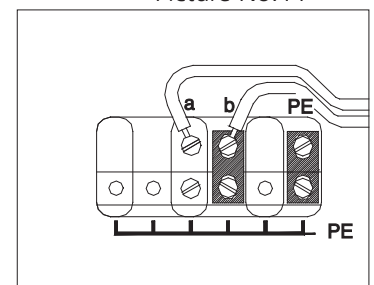
Picture 9: Wiring diagram of double-poled transformer



Picture No.10



Picture No.11



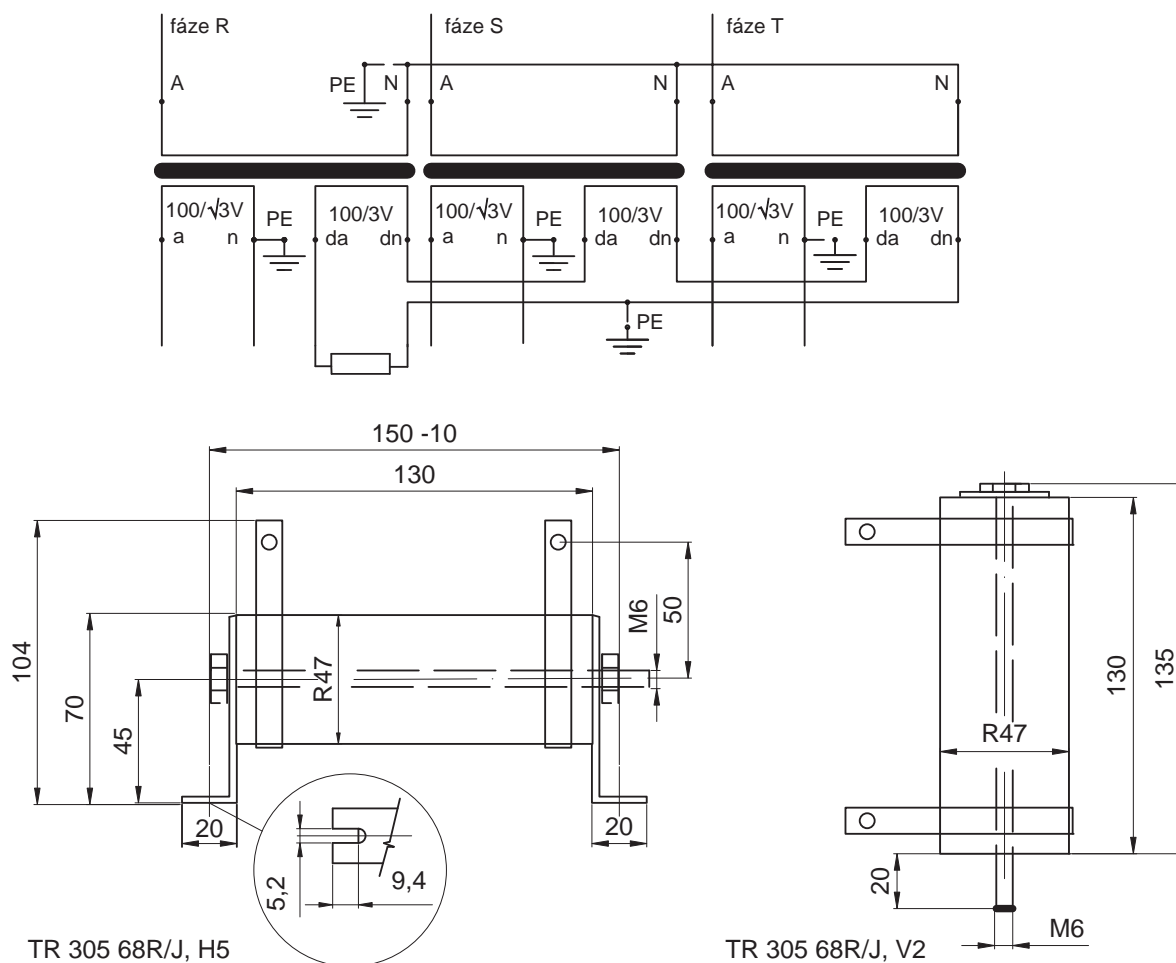
Note: The above-mentioned connections are recommended by the producer only in the cases where the expert designer does not determine other way.

Protection of voltage transformers against ferroresonance

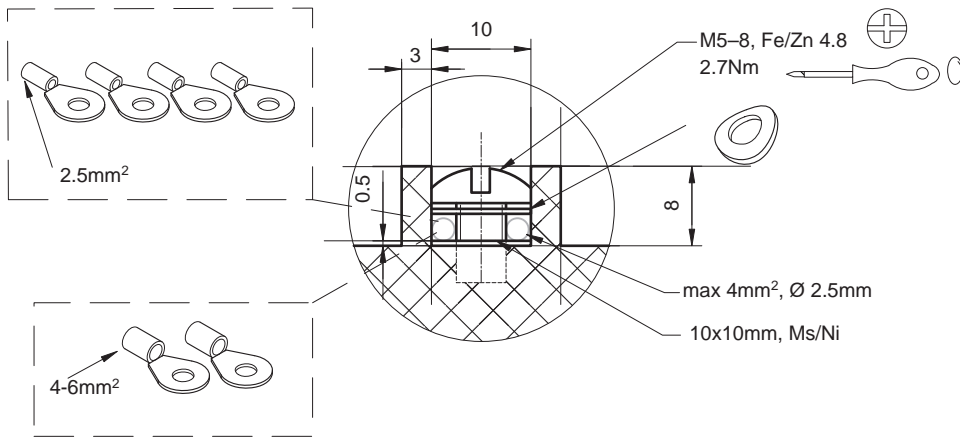
The phenomenon of „ferroresonance “ can occur in single –pole voltage transformers in HV inadequately earthed cable networks. The impedance of transformer and the earthing capacity of the cable create a potentially oscillating RLC circuit. When an overvoltage come by the case of earth connection or some switching, the phenomenon of ferroresonance can appear. The consequences are overheating of magnetic core and coil, damage of insulation and burst.

To prevent HV equipment we recommend to use connection of dump resistor in open delta of additional secondary windings (see picture 12 below). Mounting dimensions are in the picture 13. The value of resistance is 68 Ohm/ 200W (type of TR305 producer is „ Tesla Blatná“). Resistor is available to order in our firm and we can deliver it single or with other transformers.

We recommend to use it in new installations as prevention.



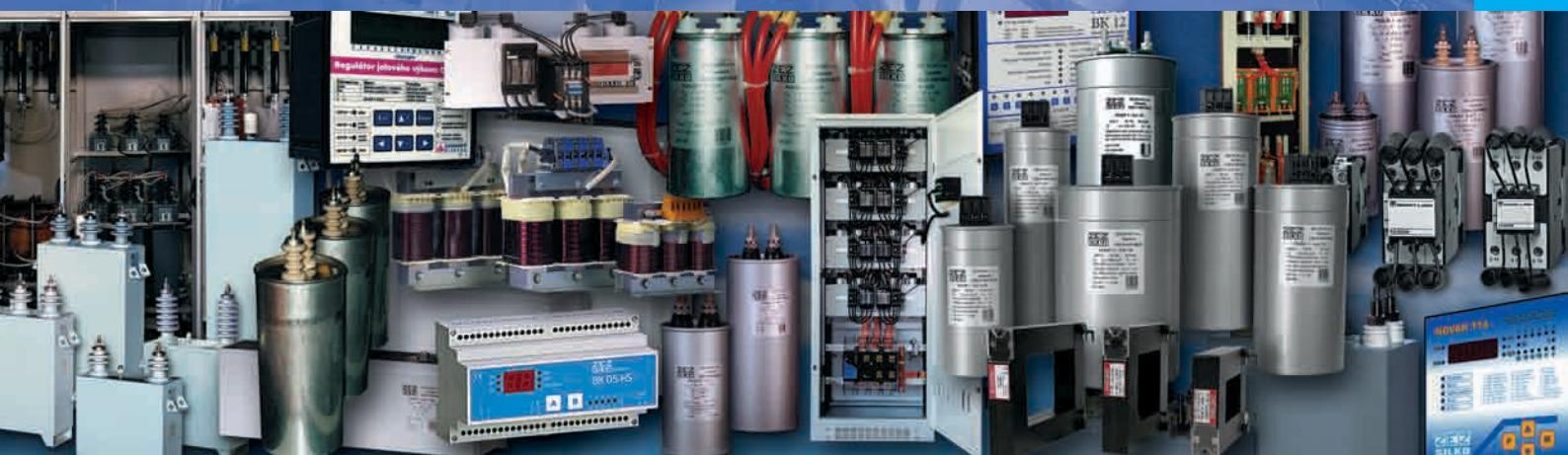
New design of the secondary terminal unit





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