



YOUR KEY ENERGY  
EFFICIENCY PARTNER



PRODUCT CATALOGUE

# CAST RESIN DRY-TYPE TRANSFORMERS



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# ABOUT SVEL GROUP

SVEL Group is one of the leading manufacturers of electrotechnical equipment in Russia. SVEL Group's affiliated companies demonstrate extraordinary dynamics in production increase and modernization.

Advanced solutions of our specialists ensure reducing power costs up to 45% due to manufacturing energy efficient equipment.

## Our products:

- Cast Resin Transformers
- Oil Transformers
- Instrument Transformers
- Reactors
- HV Equipment
- Packaged Switchgears
- Packaged Substations
- Modular Substations

RosEnergTrans, affiliated company of SVEL Group, designs and manufactures Cast Resin Transformers and Current Limiting Reactors.

In 2003, SVEL-RosEnergTrans entered the market offering Cast Resin Transformers, 16kVA to 25MVA up to 35kV.

Cast Resin Transformers, Series TS and TSZ, may without additional expenses replace the existing equipment such as:

- Oil-immersed transformers
- Old-fashioned Transformers with PCB cooling
- Dry-Type Transformers made by various manufacturers

SVEL-RosEnergTrans may also manufacture customized transformers with air insulation up to 25,000kVA with Rated Voltage up to 35kV.

Due to close communication with clients, SVEL-RosEnergTrans introduce the most optimal innovative solutions in order to create high quality, safe and reliable product.

All products of SVEL Group comply with the national (GOST), International (IEC) and European (EU) Standards.



# DRY-TYPE TRANSFORMERS IN BRIEF

A transformer is a static electrical unit with two or more inductively coupled coils positioned on a magnet core, in order to convert one or several AC circuits (voltage) into one or several other circuits (voltages) by means of electromagnet induction, without frequency change

Since the induction effect discovery, many studies and experiments have been conducted before the transformers took their current structural design. It continued improving due to developing new insulation material.

These days, the following types of transformer are known:

- Cast Resin Transformers
- Air Insulated Dry-Type Transformer
- Oil-immersed Transformer

## CAST RESIN DRY-TYPE TRANSFORMERS

Dry-Type Transformer with HV winding filled with special compound is called a Cast Resin Transformer. Excellent operating performance boosted their using all around the world showing constant growing in number. Due to vast experience of practical application, the design of Cast Resin Transformers is evolved continuously. In addition to that, the range of rated voltage and power is extended.

## AIR INSULATED DRY-TYPE TRANSFORMERS

Air insulation was in place since the very first models of transformer, long before using oil insulation. Standard winding of such transformer includes conductors with insulating gaps between them as air barriers. The conductors are protected with insulation film or paper. This type of transformers are used less widely, their application covers about 10% of total number of Dry-Type Transformers.

To protect insulation of the conductors, windings of such transformers need to be impregnated under extreme vacuum. With time, air gaps are contaminated with dust that decreases dielectric properties of insulation.

In contradiction to common understanding, no factory-made windings with air insulation is subject to repair on-site with a good level of quality.




## OIL-IMMERSED TRANSFORMERS

Specific feature of oil transformers is transformer/mineral oil as the principal insulation. Apart from that, the design of oil transformer is similar to air insulation transformer. Oil acts as electrical insulation and cooling substance. Due to temperature effect, the oil may expand or contract. To compensate this, as a rule, corrugated tanks are used, or a conservator (expansion tank) is installed above the oil level of transformer.

With time, under external and internal influence, mineral oil may lose their dielectric properties. To maintain rated values, it is necessary to monitor the oil level, check their quality and tightness of tanks. An obvious disadvantage of transformer oil is their fire behavior. Temperature rise or spark may ignite and keep independent burning. Abrupt expansion of gases generated during fire can lead to explosion. In heavy-duty power transformers, these risks are addressed at each level: from introducing additional monitoring systems to periodic inspection and general assessment of equipment condition.

## TRANSFORMER: DESIGN VS. PERFORMANCE

Structural specifics always influence technical performance and operating features of transformers. General set of such characteristics determines universal nature and potential benefits of various transformer modifications.

Characteristics	Cast Resin Transformer	Air Insulation Transformer	Oil-immersed Transformer
			
Fire Safety	Yes	Yes	No
Self-extinguishing Insulation	Yes	Yes	No
Oil Drip Trip and Fire Resistance Walls at transformer's location	No	No	Yes
Hygroscopic Insulation	No	Yes	Yes
Degraded insulation properties with time and influence of ambient environment	No	Yes	Yes
Environment contamination due to oil leakage	No	No	Yes
Periodic Maintenance	No	Yes	Yes
Climate Stability: low sensitivity to humid and salt conditions	Yes	No	Yes
High resistance to dynamic loads due to the use strips as conductor	Yes	No	No
Advanced monitoring of equipment condition (temperature, active parts design)	Yes	Yes	No

To select proper transformer for any power facility, one needs to follow basic parameters of the system, and requirements to their reliable and long service life. Increasing requirements for such parameters as environmental safety, power efficiency and, in addition to that, a possibility of further integration into smart networks should be considered when choosing electrical equipment.

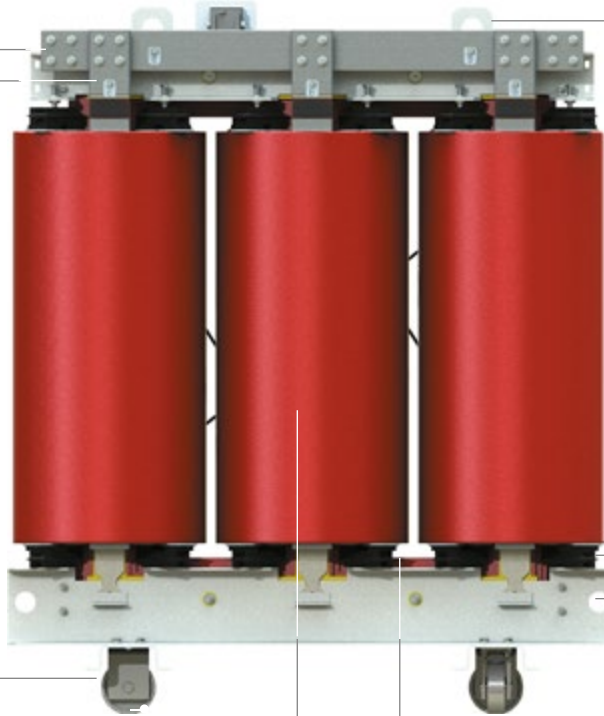
SVEL Group, with their production capacities, high-skilled personnel, is ready to manufacture transformers with due regard to the modern techniques and design solutions. Upon assessing the advantages of Cast Resin Transformers, we develop professional customized solutions depending on certain industry and customer's requirements.

# MAIN COMPONENTS OF CAST RESIN TRANSFORMERS

**LV Bushings**

*LV Neutral (used for star connection)  
Phase*

**Lifting Plate**



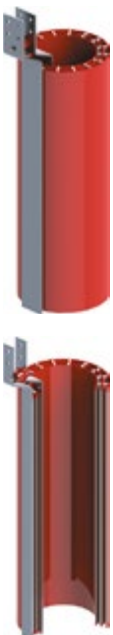
**Rollers**

*Anti-vibration pads, optional*

**Press Spacer**

*Fix Windings and reduce vibration impact*

**Handling Hole, Longitudinal**



**LV Windings**



*Between HV Windings and Magnet Core*

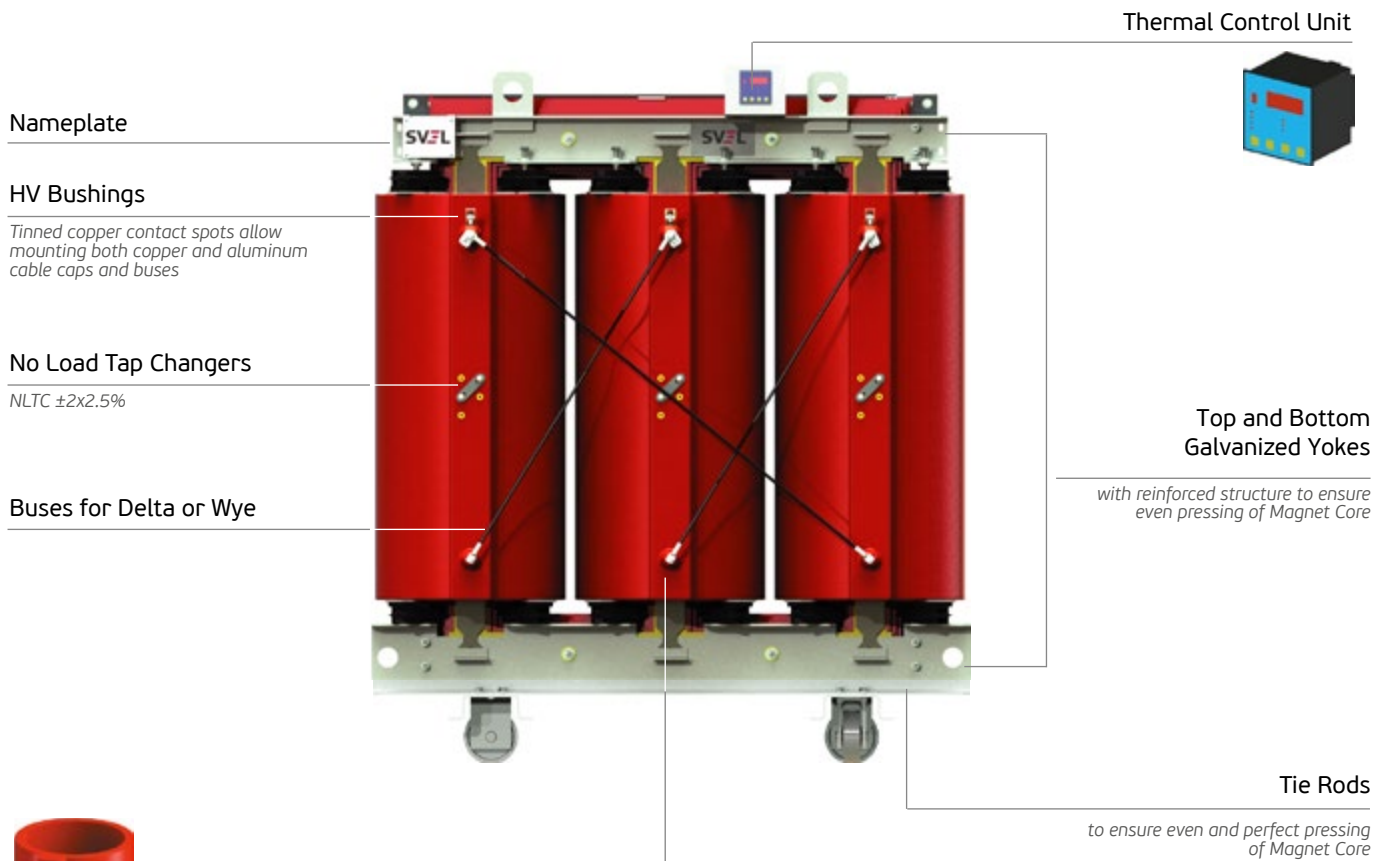
Made of Copper or Aluminum strips with simultaneous winding of interlayer and end insulation. Number of air channels depends on transformer power. All channels are formed by high thermal class fiber profiles. All windings are protected with insulation enamel, and then baked.

Each LV winding is equipped with a Thermal Control Unit (TCU). Film winding ensures even current and heat distribution while possessing high dynamic stability.

**Magnet Core**



Made of sheet cold rolled electric steel, 0.27mm thickness, with heatproof coating. The method of steel cutting and step-lap stacking ensures low No Load Losses and Current. Increased section area ensures stable operation of Cast Resin Transformers in case of overloads. Quality of the material, cutting and assembling technique allow reducing noise.



**HV Windings**



Windings are sections connected in series. The winding itself is made of copper or aluminum stripes, which are further cleaned and rolled as a part of winding process. Interlayer insulation is evenly placed by high-precision equipment to ensure high electrical and mechanical strength. Fully automated process includes filling the windings with an epoxy compound under vacuum to ensure perfect thermal efficiency and high thermal shock resistance. Raw material for windings is purchased only at those manufacturers that meet the strict requirements of SVEL Group.

**Enclosure**

Enclosure ensures the desired protection level of the active part. The enclosure is a steel frame with attached walls, bottom and cover. The walls and bottom have vent holes to cool the transformer. Removable panels on the wide walls of the enclosure provide access to tapping. All walls are removable to facilitate scheduled inspection and maintenance.









**SVEL**

# ACCESSORIES AND OPTIONAL EQUIPMENT

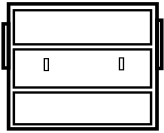
- Transformer is delivered ready to run upon easy installation and commissioning
- Basic configuration of transformer includes all necessary components for their normal operation
- Optional components are provided to expand functions, increase monitoring capabilities and meet specific requirements to the equipment
- Requirements to any transformer are determined at the stage of work order preparation or datasheet filling

## BASIC CONFIGURATION

- Thermal Detectors
- Rollers
- No Load Tap Changer
- Operating Manual
- Spare and Tool Kit
- Packing Material (stretch wrap)

## OPTIONAL COMPONENTS

- Thermal Control Unit
- Protecting Enclosure
- Thermal Protection Cabinet
- Fan Set, Optional
- Set of Current Transformer
- Surge Arrester
- Quick Break Fuse
- Bus Set
- Special Packing (Wooden: Standard, Seaproof, Tropical)

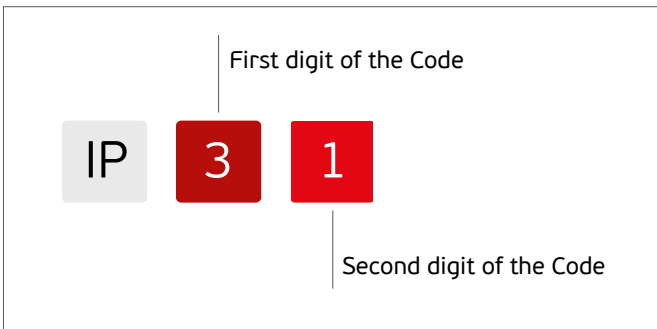


## PROTECTIVE ENCLOSURE

Protection Level of a transformer is designated by IP code as per GOST 14254-2015.

IP Code consists of two digit: first digit means the level of protection from external penetration; second digit means protection from direct liquid flow. Lower digit means lower requirement to transformer's protection.

### PROTECTION LEVEL AS PER GOST 14254-2015



IP 21 Enclosure



IP 31 Enclosure



IP 54 Enclosure

### FIRST DIGIT OF THE CODE

Protection from contact or penetration of foreign matters to active parts.

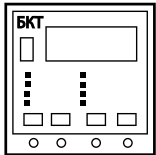
<b>0</b>	No	Unprotected from contact or penetration of foreign matters and items
<b>1</b>	Protection from penetration of large items	Protected from contact with back of hand and penetration of foreign items, Dia > 50mm
<b>2</b>	Protection from penetration of medium items	Protected from finger access to active parts and penetration of foreign items, Dia > 12.5mm
<b>3</b>	Protection from penetration of small items	Protected from tool access to active parts and penetration of foreign items, Dia > 2.5mm
<b>4</b>	Protection from penetration of foreign matters	Protected from wire access to active parts and penetration of foreign items, Dia > 1mm
<b>5</b>	Dust Protection	Full protection from any contact with active parts. Dustproof configuration

### SECOND DIGIT OF THE CODE

Protection from water penetration.

<b>0</b>	No	Unprotected from water penetration
<b>1</b>	Vertical Dropping	Protected from impact of vertical dropping
<b>2</b>	Angled Dropping	Protected from impact of angled dropping if the casing is inclined in any direction at the angle through 15°
<b>3</b>	Precipitation	Protected from water splashes in any direction
<b>4</b>	Blanket spraying	Protected from water splashes in any direction

# ACCESSORIES AND OPTIONAL EQUIPMENT



## THERMAL CONTROL UNIT

Thermal Control Unit (TCU) is intended to control the temperature of transformer. If a transformer equipped with fans, then, in case of overheating, TCU will switch on the cooling fans and safety alarm. If temperature rise continues, and the temperature exceeds the limit, TCU will initiate emergency shutdown. TCU has four channels of thermal sensors. Three sensors monitor temperature of windings, and one controls magnet core.

### TCU Functions:

- If temperature exceeds 130°C at any sensor, the overheat relay would start a fan. If temperature drops to 130°C, the fan would switch off. Cooling mode is displayed on the front panel to monitor fan operation.
- If temperature exceeds 145°C at any sensor, the Overheat Relay would light up Alarm Dot Display on the front panel.
- If temperature exceeds 155°C at any sensor, the Overheat Relay would actuate the corresponding Dot Display on the front panel.
- Failure Relay actuates at any sensor in case of open sensor or short circuit, as well as in case of abnormal temperature rise (20°C/sec, or above) which indicates a malfunction of one of the sensors; and the corresponding indicator lights up.

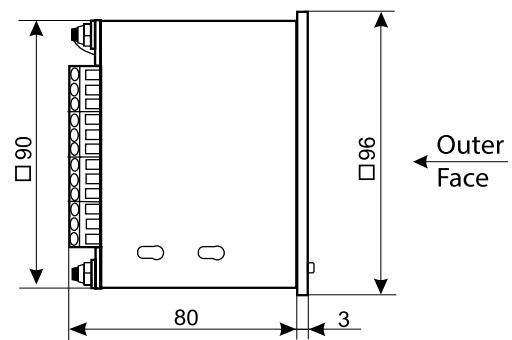
Reset Button can switch off the Overheat Relay. The alarm shall switch on again, as soon as the temperature approaches the level of 5°C to the emergency limit. Operator may switch off the alarm manually. In that case, both Relay and sensors would not switch on again.

The recommended TCU model complies with the unified requirements of SVEL Group in terms of functional integrity and reliability. Both DC and AC are available.

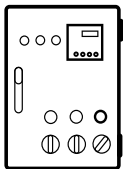


*TCU requires no periodic metrology check as it does not belong to measuring units. Upon request, SVEL may deliver TCU with the certified metrology check.*

TCU Dimensions

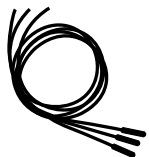


Mount Cut for TCU: 92mm x 92mm



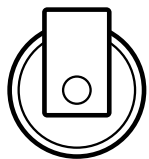
### Thermal Protection Cabinet

Thermal Protection Cabinet includes TCU, additional Vent Relays and Control Board. Thermal Protection Cabinet is assembled and mounted on the transformer, to ensure its convenient maintenance.



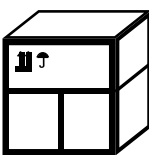
### Thermal Detectors

PT-100 is used to control temperature at certain measuring points. Resistance-temperature linear dependence of PT-100 allows obtaining precise values of the actual temperature rise. Thermal Detector is installed into the area of expected temperature rise, and connected to TCU.



### Rollers

Rollers facilitate movements of transformer within their location. The rollers may be positioned in the longitudinal or transverse direction to ensure relocation to any place. Basic configuration of the majority of our transformers includes rollers.



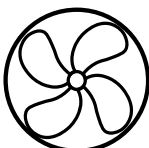
### Packaging

Prior to transportation, the transformer is subject to preservation and packing. We offer several packaging options: stretch wrap, wooden box (Standard, Seaproof or Tropical). The type of packaging depends on the requirements to transformer protection, and possible impact of climate and environment, transportation method and design features of the product.



### Operating Instruction and Manual

Operating Manual includes Passport, Overall Drawing, Datasheet, Operating Instruction and documents on optional instruments and devices.



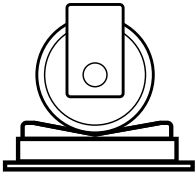
### Fan and Controls Set, Optional

If operating conditions of transformer fall beyond standards, or extra power or overload capacity is required, it is recommended to apply additional cooling system. Fans under each phase winding would force the airflow through the cooling channels. The fans are controlled autonomously by a TCU, or within a Thermal Protection Cabinet.

Parameters of the chosen fans depend on the transformer's rated power.

# ACCESSORIES AND OPTIONAL EQUIPMENT

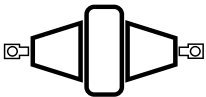
## Set of Vibration Absorbers



SVEL Transformers' design ensures partial vibration damping due to their structural elements. To decrease vibration, additional set of vibration absorbers may be installed. Standard option includes rubber pads decreasing the transient vibrations of equipment. Rubber pads may be installed either under the transformer's rollers or on the surface between the support frame and foundation.

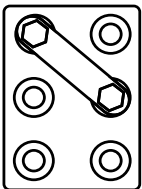
Alternatively, the transformer is installed on the anti-vibration supports of the advanced design providing a higher level of vibration damping.

## Set of Current Transformers



Current Transformers may be installed into certain types of Dry Transformers, upon request. As a rule, it is necessary for rectifier transformers operated within excitation systems of synchronized machines.

## Tap Changer

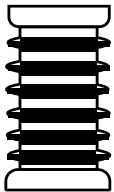


Standard configuration includes No Load Tap Changer (NLTC). NLTC allows adjusting with preliminary de-energizing of the equipment.

On Load Tap Changer (OLTC) ensures tap changing on the energized equipment, if necessary. OLTC is a sophisticated device mounted upon the transformer and connected to the tapping terminals.

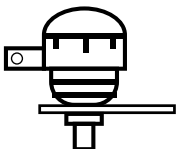
OLTC of a Cast Resin Transformer is oil-free and, therefore, non-flammable. Transformers with OLTC require individual design depending on specific requirements requested by customer, as depth of changing and general structural design may call for non-standard solutions.

## Surge Arrester



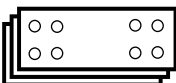
Surge Arrester protects transformer from pulse and climate overloads. Surge Arrester can be installed at HV side of high potential transformers.

## Quick Break Fuse



Quick Break Fuse is installed at LV side of power transformers and rectifier transformers to ensure additional protection and indication.

## Fan Set, Optional



If necessary, SVEL delivers additional set of buses to ensure transition between copper and aluminum sections, as well as to compensate



# QUALITY ASSURANCE

All Cast Resin Transformers are designed and manufactured in accordance with the key industry standards:

- GOST 52719-2007
- GOST 54827-2011
- GOST 16772-77
- IEC 60076-11
- IEC 61378-1

SVEL Group maintains Quality Management System (QMS) in accordance with ISO 9001:2015, as certified by the Certificate of Compliance issued by BSI Group (who pioneered the development of management systems standards). In addition, SVEL is certified in accordance with ISO 14001:2015, Environmental Management System and OHSAS 18001:2017, Occupational Health and Safety Management system.



**IN-HOUSE TEST LABORATORY**



All testing laboratories located at each company affiliate are combined into SVEL Group Testing Center. Testing Center is accredited to conduct a wide range of testing. In addition, special testing may be ordered at various independent test laboratories and centers:

- SVEL manufacture transformers as per Climate (C2), Environmental (E2), and Fire Behavior (F1) classes, stipulated by IEC 60076-11. These parameters are certified by KEMA Laboratories, the Netherlands
- Seismic resistant transformers may withstand earthquakes with magnitude of up to 9 in MSK-64 (as certified by the accredited Makeev Test Center, Miass, Russia)
- SVEL transformers can operate in various climate conditions (climate configuration as per GOST 15150-69)



## SPECIAL TESTING



*Fire Hazard Test*



*Weatherproof Test*



*Contamination Resistance Test*

# SERVICE AND MAINTENANCE

## SERVICE

- Supervised Installation (Technical Supervision and Control)
- Service and Maintenance of Delivered Transformers
- Installation Instruction
- Warranty and Repair
- Delivery Insurance



## STORAGE

Prior to shipping, the transformers are preserved and packed to ensure protection for the whole transport and storage period. Transformers should be stored in the manufacturer’s packaging at a closed, dry, clean and ventilated room. Prior to warehousing, it is required to check the product visually verifying integrity of packaging and equipment.

## WARRANTY

SVEL-RosEnergTrans provides equipment warranty in full:

- Actual parameters comply with the approved requirements
- Manufacturer Warranty – 3 Years or above
- Transformer Service Live – above 30 Years

## PACKAGING

All equipment manufactured by SVEL Group is prepared for packing. Technical specialists provide recommendations regarding their installation and commissioning, and consult client’s maintenance personnel on possible failures and their elimination.

Transformer is shipped to customer inside of a wooden box, or wrapped in stretch film. Packaging type depends on the requirements to protection from environmental or climate impact, mode of transport and specific structural elements of the product.

Nameplate, bushing contacts and earth terminals are protected with preservation grease.



## TRANSPORTATION

Transformers are delivered by rail or automobile roads, while riverine, marine or air transport is also admitted.

Depending on overall dimensions, transformers are shipped completely or partially assembled.

Upon arrival at the point of destination, and prior to unloading, it is required to inspect the delivered equipment jointly with transport company to check for possible mechanical damage.

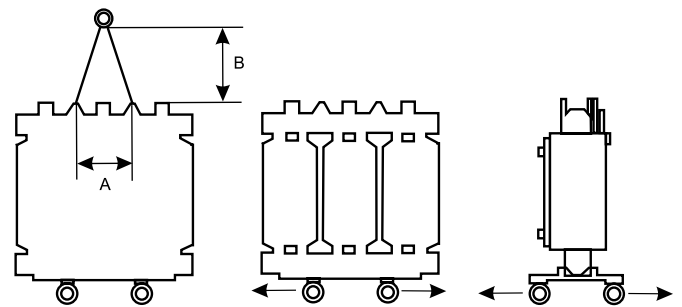


## LOADING&UNLOADING

It is necessary to load/unload transformers by lifting devices and tools with the suitable capacity. Lifting diagram is displayed on the packaging.

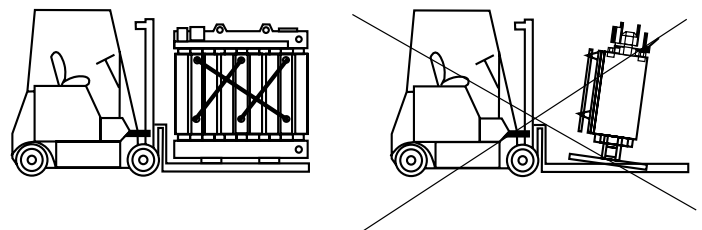
To move unpacked transformer, one should use the corresponding lifting lugs. Lifting diagram is displayed on the Overall Drawing.

Regardless the solid structure, a transformer may fail to withstand rough pushes or jerks during handling. Therefore, it is strongly recommended to use a suitable wire rope (see the picture, level B above level A).



Transformers can be moved in two directions according to orientation of their transport wheels.

Special lugs located near the transport wheels are used for dragging. If no pallet provided, loading by a fork-lifting device is allowed in longitudinal direction, only.



# FURTHER OPERATING FEATURES AND HINTS

## INDOOR INSTALLATION

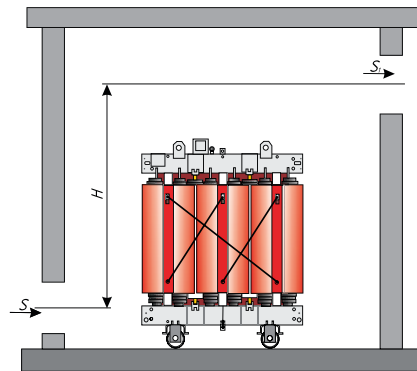
To ensure safe indoor operation of the transformer, it is required to comply with the following recommendations:



- choose distance to live parts as per Operational Code for Electrical Units
- ensure free access for the transformer inspection and maintenance (including the access to No Load Tap Changers)
- ensure heat removal from transformer by vent system
- protect transformer from precipitation, condensed water, foreign particles and objects.

## INDOOR VENTILATION

To calculate indoor ventilation system, one needs to consider air intakes and outlets, and, if necessary, capacity of air forced cooling.



### Input data for calculation:

$P_{SC}$  – Short Circuit Loss at 115°C, kW;

$P_{NL}$  – No Load Loss, kW;

H – Air Intake and Outlet Height Difference, m;

k – coefficient addressing transformer's Protection Degree;

Protection Degree IP00: k=1

Protection Degree IP21, IP31: k=0.5

Air Intake Area S, in m<sup>2</sup>, upon deduction of the area of grates, is determined by the following equation:

$$S = \frac{0,18 \times (P_{SC} + P_{NL})}{k \times \sqrt{H}}$$

Air Outlet Area S<sub>1</sub>, in m<sup>2</sup>, upon deduction of the area of grates, is determined by the following equation:

$$S_1 = 1,1 \cdot S$$

Air Intake and Outlet Areas are calculated by the above equations at average ambient temperature, 20°C and altitude above sea level up to 1,000 m.

If the required Air Intake and Outlet Areas are not available, the air forced ventilation shall be provided at the transformer location.

Required vent system capacity, m<sup>3</sup>/min:

$$V = 4,5 \times (P_{SC} + P_{NL})$$

## OVERLOAD OPERATION

Life cycle of Cast Resin Transformers is Thirty Years or above, however the exact term will always depend on the operation conditions.

To a great extent, the life cycle is affected by overloads experienced by any transformer throughout the whole time of operation.

Overloads, as a rule, lead to temperature rise at windings which negatively impacts insulation and accelerates their thermal wear.

Transformer may run under some overload without any influence on its life cycle subject to their normal load is less than the rated one.

Besides, the permitted overloads should be limited in time. The duration of the transformer's overload depends on the original load prior to overload mode and the average environment index  $\Theta_a$ .

Typically, transformers are manufactured for operation at rated power and rated ambient temperature in accordance with IEC 60726 Series standards:

- max temperature 40°C
- average daily temperature 30°C
- average annual temperature 20°C

Unless otherwise specified, the average annual temperature 20°C shall be referenced as the basis for calculating the basic overload diagrams.

Such climate conditions cover the majority of existing operating modes and regions.

To consider specific operating conditions, we may follow diagrams with the average annual temperature 10°C or 30°C (as selected to be the basic condition for the whole life cycle of transformer).

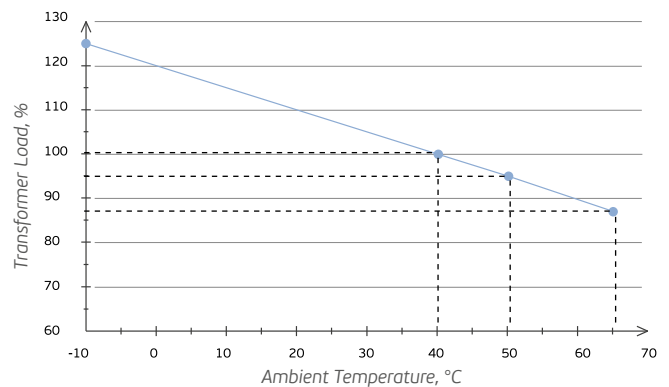
## PERMISSIBLE LOAD VS AMBIENT TEMPERATURE

SVEL transformers are successfully operated under the rated conditions regardless the duration of the previous loads at the ambient temperature up to +40°C.

The chart below clarifies the permissible continuous load at various ambient temperature.

Therefore, even if ambient temperature exceeds the specified value (i.e., +60°C), the transformer keep running at loads not exceeding those in the chart. This is also true for running at low temperatures.

Overload capacity of transformers within the selected temperature mode is determined by the overload charts, below.



The above chart allows designating the permissible continuous load associated to the current ambient temperature.

# FURTHER OPERATING FEATURES AND HINTS

## PERMISSIBLE OVERLOAD CURVES

The chart, below, presents Transformer Overload Vs. Possible Operation Time Curves within the set mode.

Average Annual Temperature condition (with corresponding diagrams) is chosen for the whole life cycle regardless seasons or current temperature conditions. It facilitates overload planning and referencing, while avoids additional adjustments.

Overload level and duration is determined basing on the previous loads, average annual temperature specified in the chart, below.

The highlighted overload levels exceed the rated capacity by the indicated value. I.e., 60% means 160% load: rated load 100% + overload 60%.

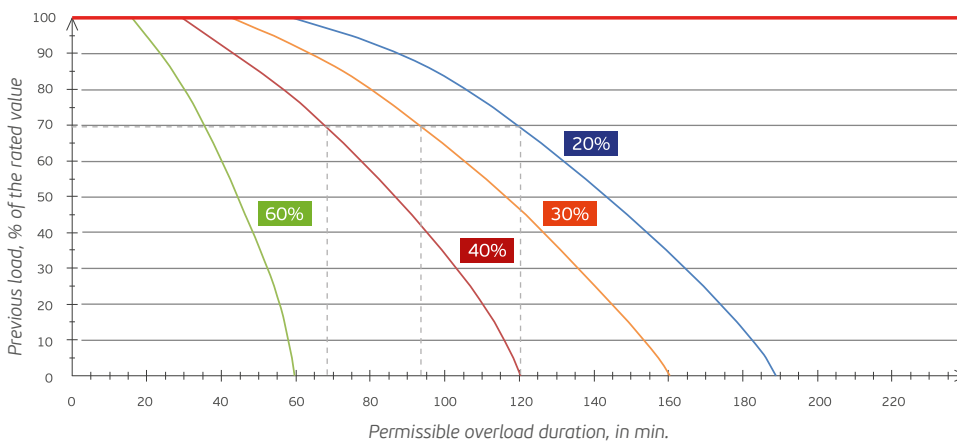
## HOW TO USE THE CHART

1. Choose the curve depending on climate conditions for the whole life cycle of transformer;
2. Find the load level prior to the overload moment, on the vertical axis;
3. Draw a horizontal line to the right until it crosses the curve with the required overload value (overload above the rated value is highlighted in color boxes);
4. Draw a horizontal line downwards to the permissible overload duration.

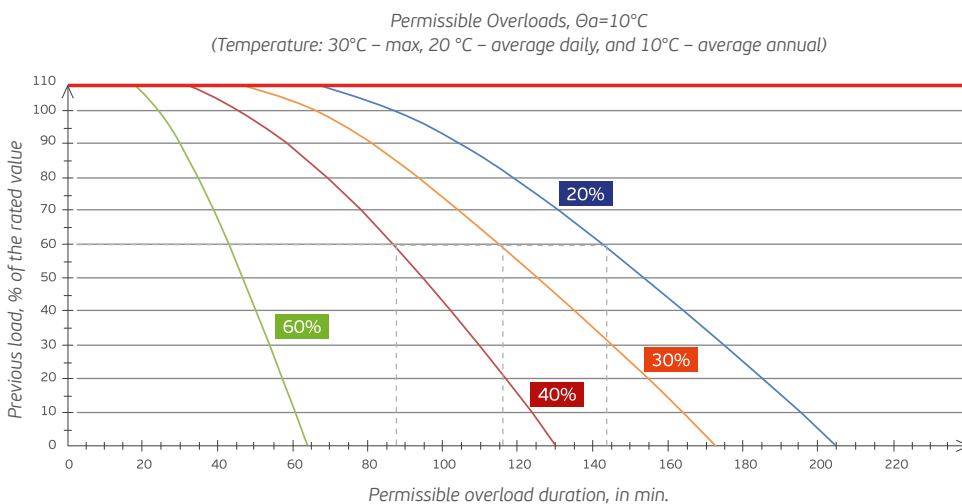
The priority of SVEL is reliability of their transformers with due regard to various operation conditions within the whole life cycle.

It includes the transformer overload capacity setting SVEL transformers apart from the majority of similar products available at the market.

Permissible Overloads of Cast Resin Transformers, Standard Configuration,  $\theta_a=20^\circ\text{C}$   
(Temperature: 40°C – max, 30 °C – average daily, and 20°C – average annual)

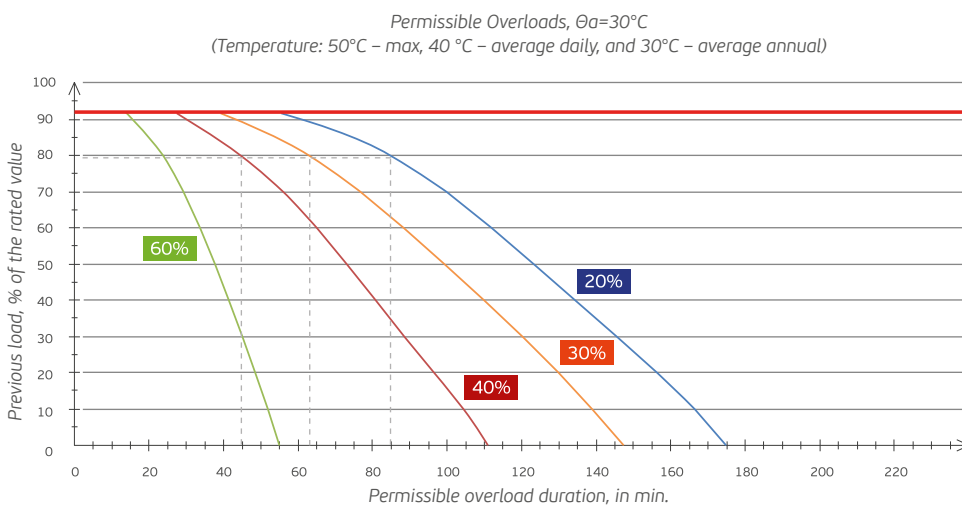


**Example**  
Original Load 70%. Permissible overload above the rated value shall be:  
+40 % within 65 to 70 min;  
+30 % within 90 to 95 min;  
+20 % within 120 to 125 min.



**Example**

Original Load 60%. Permissible overload above the rated value shall be:  
 +40 % within 85 to 90 min;  
 +30 % within 115 to 120 min;  
 +20 % within 140 to 145 min.



**Example**

Original Load 80%. Permissible overload above the rated value shall be:  
 +40 % within 40 to 45 min;  
 +30 % within 60 to 65 min;  
 +20 % within 80 to 85 min.

## ADDITIONAL COOLING SYSTEM

In order to increase overload characteristics of a transformers up to 40%, additional ventilation can be applied.

If a transformer is installed at a confined space with poor ventilation, as well as under ambient temperatures close to max permissible value (+40°C), it is recommended to use additional ventilation to ensure cooling of the transformer.

Certain models of transformers includes air forced cooling system to maintain the rated operating conditions. In most cases, the system is not required.

However, in order to increase overload characteristics and compensate limited space at the transformer location, upon customer's request, SVEL provides additional cooling system.

Additional fans shall be controlled through the standard TCU within the existing settings.

# ENERGY EFFICIENCY

Purchasing a transformer, each customer, first of all, considers their technical characteristics to ensure serviceability of the equipment within the power grid against the specified requirements. These characteristics include: rated power, primary and secondary windings voltage, connection group, short-circuit voltage, product type and compliance in terms of geometry.

The comprehensive specification of the equipment shall include their operating performance, and possible costs that occur during the whole life cycle of the equipment.

Additional costs within life cycle of a transformer are significantly caused by losses, which consist of No Load (PNL) and Short Circuit (PSC) Losses.

No Load Loss originates in the magnet core of a transformer due to electromagnet induction effect. When primary windings are energized, the magnet core saturates power and remagnetizes it with a doubled frequency of the circuit. No Load Loss is unaffected by secondary side (consumer's side), i.e. constant by nature.

No Load Loss Costs  $W_{NL}$  including average annual electricity expenses, Rubles:

$$W_{NL} = P_{NL} * P_A * T_A * n$$

where:

- $P_{NL}$  – No Load Loss of transformer, W
- $P_A$  – average annual electricity expenses (Rubles/kWh)
- $T_A$  – annual operation time of transformer, 365 Days x 24 Hours = 8,760 Hours
- $n$  – number of transformers

In general, Short Circuit Loss includes losses originated in the conductor of windings and busbars due to the flow of current load. The level of losses may vary depending on the actual current load, i.e. Short Circuit Loss is variable.

Short Circuit Loss Costs  $W_{NL}$  including average annual electricity expenses, Rubles:

$$W_{NL} = P_{SC} * K^2 * P_A * T_A * n,$$

where:

- $P_{SC}$  – Short Circuit Loss of transformer, W
- $K$  – transformer load factor
- $P_A$  – average annual electricity expenses (Rubles/kWh)
- $T_A$  – annual operation time of transformer, 365 Days x 24 Hours = 8,760 Hours
- $n$  – number of transformers

The manufacturer sets the rated levels of loss at the design stage considering the correlation between price, efficiency and reliability.

SVEL Group offers several models of distribution transformers depending on their losses: from energy efficient transformers (Class A) to standard loss transformers (Class C). At the same time, apart from the assigned class, all SVEL transformers have consistently high reliability characteristics and overload capacity.



Selecting a transformer, customers need to decide in favor of certain investment model. Either to save on the purchase price, but then spend on losses, or to purchase energy efficient product and run it with the maximum benefit during the whole life cycle.

The standard loss models of transformers (Class C) are made with the common design solutions that meet the needs of the majority of customers, which allows obtaining the effect of additionally reduced cost in comparison with custom-designed Class A transformers.

### Design Solutions for Class C and Class A Transformers

Parameters	Class C	Class A
Losses	Standard	Reduced
Degree of Protection	IP00, IP31	IP00 – IP54
Seismic Magnitude, MSK-64	Up to 6	Up to 9
Thermal Control Unit	Optional	Included
Bushing Configuration	See the Booklet	Both presented in the Booklet or Custom-designed



To identify the most suitable distribution transformer in your particular case, please fill in the Configuration Datasheet basing on those known requirements to the equipment, considering the technical recommendations of this booklet. For Class A Transformers, please indicate the corresponding levels of loss. Upon the review of the filled Datasheet, and clarification of specific details, the decision shall be made on the preferable configuration of the transformer.

Please refer to the detailed specifications of transformers below, Page 32 and onwards.

SVEL Specialists would be happy to assist or consult on any issue regarding energy efficiency, operating performances and configuration of the equipment.

Keeping in mind continuous rise of electricity rates, the total cost of losses can exceed cost of the transformer by several times. If, now, the issue of energy efficiency is not acute for some consumers, in a few years this situation can change, demanding to reduce costs by saving on loss at the national, industrial or internal level of a company.

The relevant calculations may facilitate more accurate development of the company cost reducing policy through energy efficiency of the equipment in use.

**For Your Reference.** Costs estimate of 1 kW Loss at the electricity rate 3 rubles per 1 kWh, and expected annual rise by 7%: first year – 28,120 Rubles, in 3 years – 90,402 Rubles, in 5 years – 161,708 Rubles; in 10 years – 388,513 Rubles, in 30 years – 2,656,200 Rubles. Multiple these values by the total kWh and you will get the real costs.

For instance, full capitalization of losses for 1,600kVA transformer with the similar input data can estimate 42 Million Rubles by the end of their service life that considerably exceeds the purchase price.

While savings on loss when choosing an energy-efficient transformer of Class A can reach 3.9 million rubles (see table below)

Please contact the manufacturer to find more information regarding energy efficient transformers, or visit our website: [svel.com](http://svel.com)

*Summary Cost Estimates on No Load and Short Circuit Losses for the whole life cycle of a typical 1,600kVA Transformer*

Lifetime, Years	Loss Cost, Class A Transformer	Loss Cost, Class C Transformer	Saving on Loss Cost, Ruble
1	444,852	486,469	41,617
2	920,844	1,006,991	86,147
3	1,430,155	1,563,949	133,795
4	1,976,118	2,159,895	184,777
5	2,558,228	2,797,557	239,329
10	6,146,276	6,721,275	574,999
15	11,178,698	12,224,492	1,045,795
20	18,236,930	19,943,039	1,706,110
25	28,136,465	30,768,701	2,632,236
30	42,021,077	45,952,252	3,931,175

# CAST RESIN POWER TRANSFORMERS

SVEL-RosEnergTrans offers a wide range of Cast Resin Transformers with various technical characteristics to address any customer needs.

## Technical Specification of Cast Resin Transformer

Parameters	Values
Category	Step-down, Step-up, Matching
Power, kVA	16 - 25,000
Rated High Voltage (HV Winding), kV	3.15; 6; 6.3; 10; 10.5; 13.8; 15.75; 20; 35
Tap Change (Type, Range and Number of Stages)	NLTC $\pm 2 \times 2.5\%$ ; OLTC $\pm 4 \times 2.5\%$
Rated Low Voltage (LV Winding), kV	0.23; 0.4; 0.69; 6; 6.3; 10; 10.5
Frequency, Hz	50; 60
Windings Connection Group	Dyn11; Yyn0
Thermal Class (GOST P 52719-2007)	F
Climate Configuration (GOST 15150-69)	Any
Degree of Protection (GOST14254-96)	IP00 - IP54
Seismic Magnitude at the Transformer Location, MSK-64	Up to 9
Warranty Service Life	3 Years or Above
Life Time	30 Years or Above

### **Cast Resin Distribution Transformer, 16kVA to 3,200kVA**

The most demanded type Cast Resin transformers, typically used at distribution grids and step-down substations. Free from any combustible material, this transformer is recommended for facilities with close proximity to public places, at distant sites located far from emergency services or fire stations.

Transformers intended for distribution grids are distinguished for their flexible configuration in terms of variety of bushing locations.

Extensive production experience, a wide spectrum of end-to-end solutions, flexible approach to the equipment configuration makes it possible to operate SVEL transformers at any sector of economic activity.

Cast Resin Distribution Transformers vary in loss level, depending on the requirements for energy efficiency.





### **Heavy-Duty Transformer: 4,000kVA to 25,000kVA**

Power transformers with the rated power over 4,000kVA should be made with due consideration of specific features of heavy-duty equipment: increased current, voltage, thermal loss, and requirements to mechanical strength of the product. SVEL Group designs and manufactures heavy-duty transformers considering each of the above factors.

Our production capacities allow manufacturing Cast Resin Transformers with the rated power up to 25,000kVA with voltage class up to 35kV. These transformers are capable to replace Oil Filled Transformers existing at various power engineering facilities.

The most demanded are the enclosed transformers for outdoor application. Each power transformer of high capacity is designed upon customers' specific requirements.



### **Auxiliary Transformers for Electric Power Plants and Other Facilities**

Auxiliary Transformers can be manufactured with the primary voltage of 6kV to 35kV.

An additional feature that is taken into account at the design stage is a higher level of short-circuit withstand capability.



# CAST RESIN POWER TRANSFORMERS



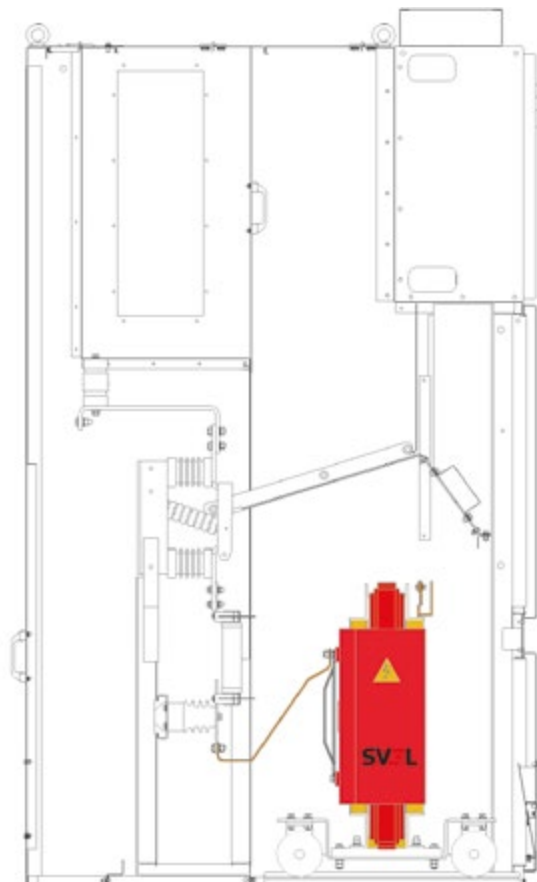
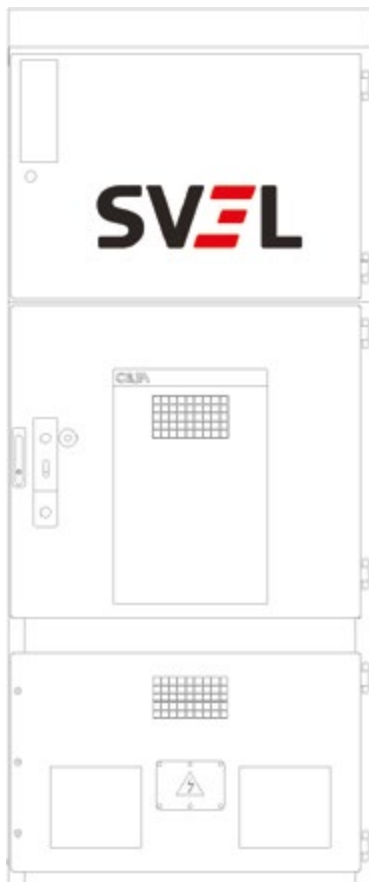
## Power Transformer for Switchgears, 25kVA to 63kVA

This type of transformer is used for energizing Switchgears, voltage class 6kV to 10kV. Cast Resin design of the equipment ensure normal operation at peak load up to 145kVA, in case of in-rush current. Compact size of the transformer allow integrating this transformer into any power cell, however, this transformer is used inside of SVEL Switchgears.

Please refer to specification of this type of transformer on [Page 39](#).



*Method of SVEL Transformer Installation into Power Cell*





### Seismic, Vibration & Mechanically Resistant Power Transformer

SVEL Group offers special transformers with additional vibration proof characteristics intended to run in the areas with high seismic activity, increased vibration and mechanical loads.

These transformers include special protective configuration to withstand seismic shocks with the magnitude up to 9, MSK-64 classification. Their compliance with the applicable requirements is confirmed by specific tests conducted at the accredited Makeev Test Center, Miass, Russia.



### Transformers for Wind Power Plants

SVEL designs transformers to address the needs of alternate energy industry with their specific requirements to equipment installation, as well as loads and operation conditions.

SVEL Group offers both power and rectifier transformers to wind and solar power plants.



# CAST RESIN POWER TRANSFORMERS



## **Power Transformer with OLTC (On Load Tap Changer)**

Sometimes, if it is required to ensure deep and frequent voltage control, the transformer should be controlled under the existing load. On Load Tap Changer allows adjustments on the spot without disconnection of the equipment, consumers or using backup capacities.

SVEL Group designs and manufactures transformers with On Load Tap Changer upon customer's request.



## **Power Transformer with OLTC (On Load Tap Changer)**

Transformers with amorphous steel magnet core are a standing apart category of equipment. This structural design allows reducing No Load Loss by 4 to 5 times as compared with the similar models made of cold rolled regular grain-oriented steel. This feature is critical for the equipment with no load running most of time, while the requirements regarding heat emission are strict.

Upon the completed R&D, and basing on the vast production experience, SVEL Group offers Cast Resin Transformers with amorphous steel magnet core up to 1,000kVA.

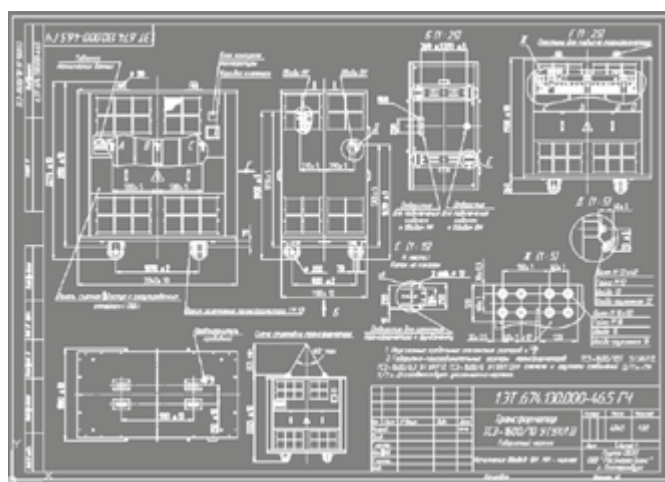
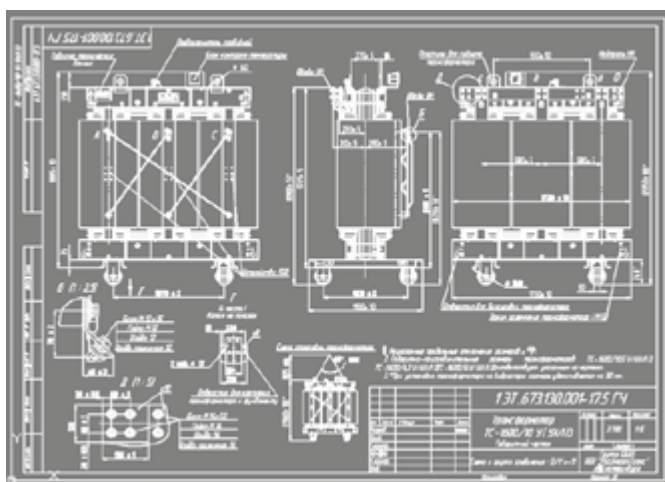


# DESIGN AND ENGINEERING

SVEL engages design and engineering companies and customers at each stage of project development: starting from document review, design and survey activity and to commissioning on site.

Our Specialists would be happy to assist or consult on any issue regarding selecting and installation of the equipment manufactured by SVEL.

We offer many additional Design&Engineering tools for the most demanded equipment using 2D and 3D Modelling.



The following pages contain technical specification of various transformers for design and engineering specialists.

To request for technical specification or clarify any details, please fill in the Configuration Datasheets in this booklet or use the convenient e-Datasheet available at our website, or contact our Specialists directly.

\* All technical data provided for reference only.

## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 6kV AND 10kV

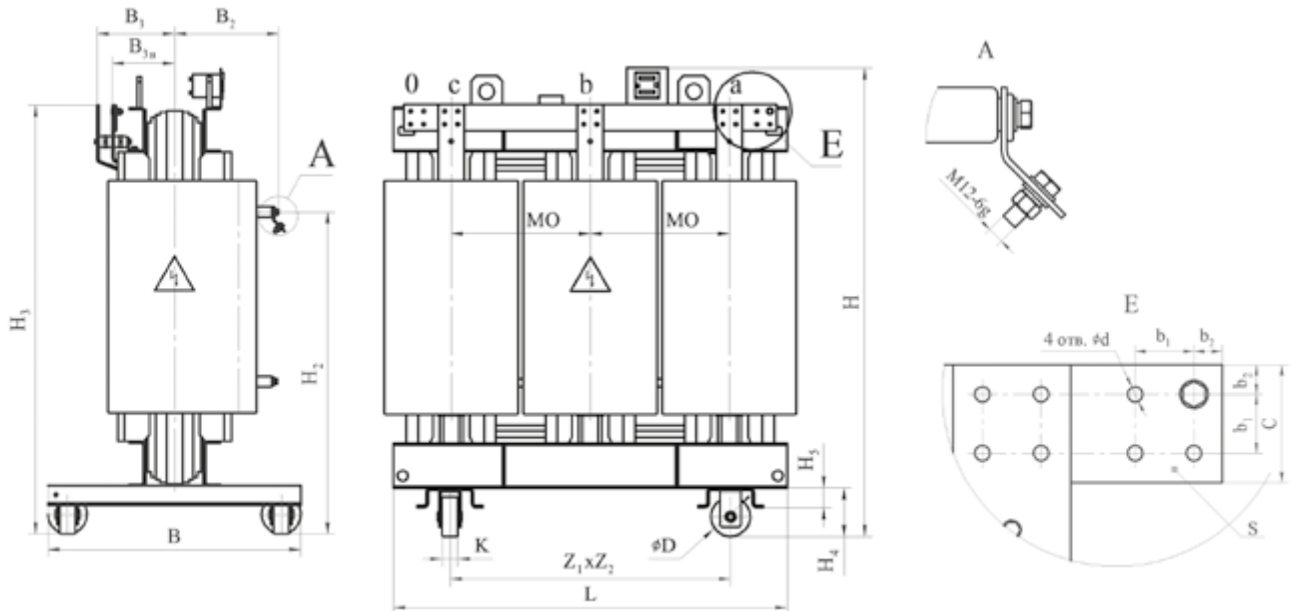
Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	16	25	40	63	100	160	250	400
Parameter			Values							
$P_{NL}$	No Load Loss	W	140	190	230	280	400	550	700	1000
$P_{SC75}$	Short Circuit Loss at 75°C	W	400	470	660	1050	1350	2150	2700	3900
$P_{SC115}$	Short Circuit Loss at 115°C	W	450	530	730	1150	1500	2400	3000	4350
$I_{NL}$	No Load Current	%	4,5	3	3	3,5	2,5	0,9	0,9	0,6
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	4	4	4	4
$L_{pA}$	Sound Pressure Level	dB	44	44	46	48	50	52	52	52
Me	Winding Material		Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al	Al	Al
Overall Dimensions and Weight										
L	Length	mm	780	880	940	950	1050	1060	1140	1280
B	Width	mm	520	520	520	520	620	620	620	770
H	Height	mm	920	955	985	1075	1200	1300	1370	1500
M	Weight	kg	260	340	420	500	690	790	930	1500



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	16	25	40	63	100	160	250	400
Parameter			Mounting Dimensions of HV and LV Bushings							
$H_2$	Height up to HV Bushing	mm	580	605	620	710	790	840	900	1010
$B_2$	Distance from axle to HV Bushing	mm	210	220	225	225	235	285	270	295
MO	Distance between Phase Bushings	mm	270	290	305	310	325	365	285	435
$H_3$	Height up to LV Bushing	mm	800	825	855	930	1105	1155	1205	1330
$B_3$	Distance from axle to LV Bushing	mm	200	205	210	205	215	225	240	255
$B_{3H}$	Distance from axle to LV Neutral	mm	155	155	155	155	160	170	185	200
Parameters of LV Connecting Buses										
s	Bus Thickness	mm	5	5	5	5	5	5	5	6
$b_1$	Distance between bus holes	mm	-	-	-	-	-	-	-	-
$b_2$	Distance between bus edge and bus hole	mm	20	20	20	20	20	20	20	30
C	Bus Width	mm	40	40	40	40	40	40	40	60
d	Hole Diameter	mm	13	13	13	13	13	13	13	13
$N_{hot}$	Number of Holes	pcp	1	1	1	1	1	1	1	1
Mounting and Transport Elements										
K	Roller Width	mm	40	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	420	420	420	420	520	720	720	840
$Z_2$	Transverse Track	mm	420	420	420	420	520	520	520	670



## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 6kV AND 10kV

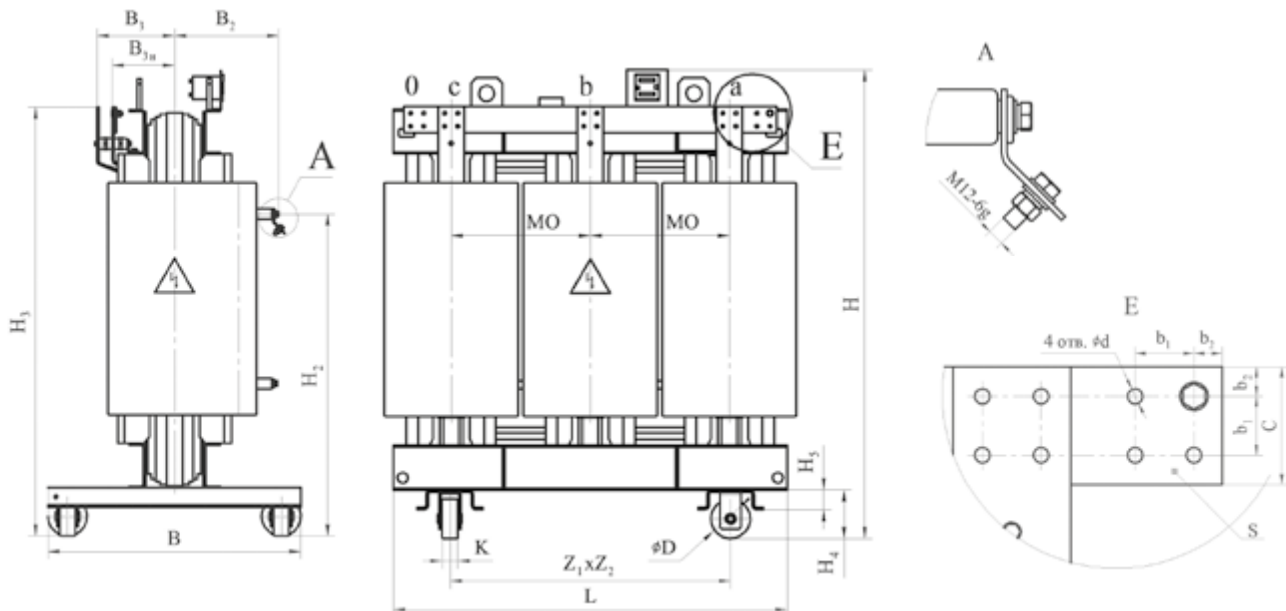
Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	630	1000	1250	1600	2000	2500	3200
Parameter			Values						
$P_{NL}$	No Load Loss	W	1150	1650	1950	2370	2800	3300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	6650	8650	10200	11900	14200	16750	22100
$P_{SC115}$	Short Circuit Loss at 115°C	W	7400	9600	11500	13450	16050	19000	25000
$I_{NL}$	No Load Current	%	0,4	0,35	0,35	0,35	0,3	0,3	0,3
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	53	53	54	54	56	60	64
Me	Winding Material		Al	Al	Al	Al	Al	Al	Al
<b>Overall Dimensions and Weight</b>									
L	Length	mm	1450	1570	1660	1730	1835	2000	2340
B	Width	mm	770	970	970	1100	1270	1270	1500
H	Height	mm	1580	1805	1955	2050	2175	2340	2595
M	Weight	kg	260	340	420	500	690	790	930



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	630	1000	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings						
$H_2$	Height up to HV Bushing	mm	1055	1255	1405	1470	1605	1750	1975
$B_2$	Distance from axle to HV Bushing	mm	345	375	380	390	410	400	490
MO	Distance between Phase Bushings	mm	490	530	565	580	620	650	790
$H_3$	Height up to LV Bushing	mm	1430	1660	1805	1900	2045	2160	2455
$B_3$	Distance from axle to LV Bushing	mm	275	300	295	310	340	370	425
$B_{3n}$	Distance from axle to LV Neutral	mm	215	240	235	250	260	285	335
<b>Parameters of LV Connecting Buses</b>									
s	Bus Thickness	mm	6	10	10	10	12	15	20
$b_1$	Distance between bus holes	mm	40	50	50	60	60	60	70
$b_2$	Distance between bus edge and bus hole	mm	20	25	25	30	30	30	40
C	Bus Width	mm	80	100	100	120	120	120	150
d	Hole Diameter	mm	13	13	17	17	17	17	17
$N_{hot}$	Number of Holes	pcp	4	4	4	4	4	4	4
<b>Mounting and Transport Elements</b>									
K	Roller Width	mm	40	50	50	50	50	50	50
D	Roller Diameter	mm	125	160	160	160	160	160	160
$H_4$	Carriage Height	mm	160	205	240	240	240	240	240
$H_5$	Beam Height	mm	75	75	75	75	90	90	90
$Z_1$	Longitudinal Track	mm	840	1070	1070	1070	1070	1070	1300
$Z_2$	Transverse Track	mm	670	820	820	820	1070	1070	1300

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP21-31 (Protective Enclosure)

LV Side: 0.4kV

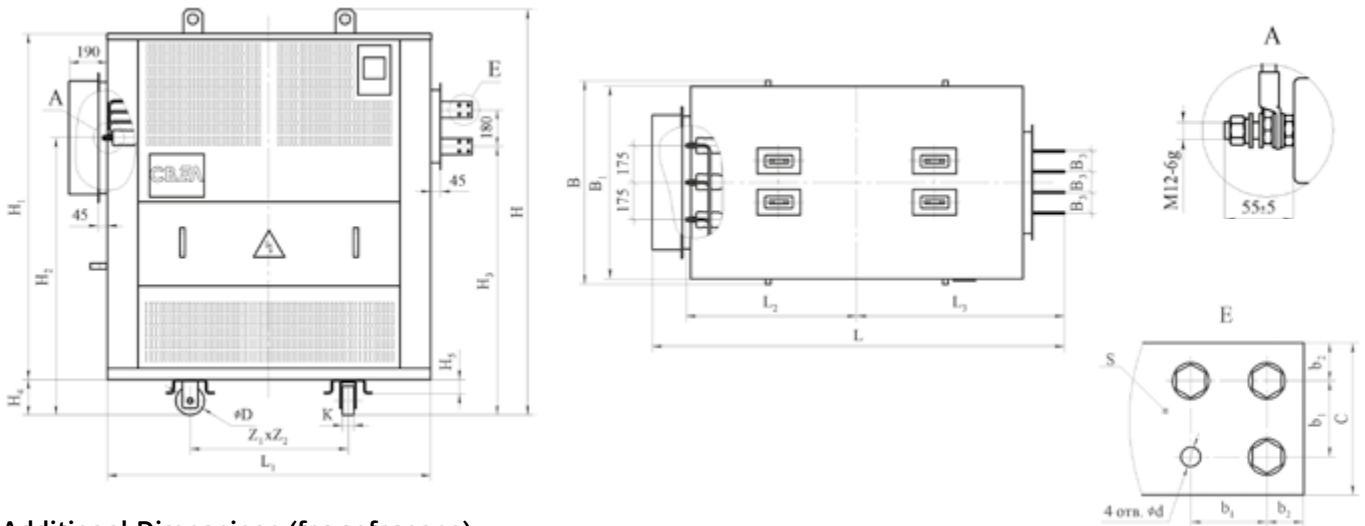
Bushings Layout: Left, Right (Side Bushings)

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1250	1600	2000
Parameter			Values								
$P_{NL}$	No Load Loss	W	400	550	700	1000	1150	1650	1950	2370	2800
$P_{SC75}$	Short Circuit Loss at 75°C	W	1400	2200	2750	4050	6850	9200	10200	11900	14200
$P_{SC115}$	Short Circuit Loss at 115°C	W	1550	2450	3050	4500	7600	10200	12000	13750	17000
$I_{NL}$	No Load Current	%	2,5	0,9	0,9	0,6	0,4	0,35	0,35	0,35	0,3
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	50	52	52	52	53	53	54	54	56

Me	Winding Material		Al, Cu	Al	Al	Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight								
L	Length	mm	1560	1720	1720	1905	1995	2145	2390	2465	2665
B	Width	mm	820	880	880	980	980	1055	1080	1180	1270
H	Height	mm	1425	1470	1495	1735	1980	2120	2265	2280	2500

M	Weight	kg	790	930	1250	1730	2200	2950	3550	3900	4660
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### Additional Dimensions (for reference)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1250	1600	2000
Parameter			Mounting Dimensions of HV and LV Bushings								
$H_2$	Height up to HV Bushing	mm	940	770	995	1240	1355	1435	1505	1650	1755
$B_2$	Distance from axle to HV Bushing	mm	720	770	770	785	825	930	1040	1110	1160
$M_0$	Distance between Phase Bushings	mm	1125	890	1120	1305	1450	1475	1655	1855	1855
$H_3$	Height up to LV Bushing	mm	740	820	820	955	1005	1080	1200	1255	1350
$B_3$	Distance from axle to LV Bushing	mm	100	100	100	100	100	100	130	130	130
			Parameters of LV Connecting Buses								
s	Bus Thickness	mm	5	5	5	6	6	10	10	10	10
$b_1$	Distance between bus holes	mm	-	-	-	45	45	45	60	60	60
$b_2$	Distance between bus edge and bus hole	mm	20	20	20	17,5	17,5	17,5	20	20	30
C	Bus Width	mm	40	40	40	80	80	80	100	100	120
d	Hole Diameter	mm	13	13	13	13	13	13	13	17	17
$N_{hol}$	Number of Holes	pcp	1	1	1	4	4	4	4	4	4
			Mounting and Transport Elements								
K	Roller Width	mm	40	40	40	40	40	50	50	50	50
D	Roller Diameter	mm	125	125	125	125	125	160	160	160	160
$H_4$	Carriage Height	mm	160	160	160	160	160	205	240	240	240
$H_5$	Beam Height	mm	75	75	75	75	75	75	75	75	90
$Z_1$	Longitudinal Track	mm	520	720	720	840	840	1070	1070	1070	1070
$Z_2$	Transverse Track	mm	520	520	520	670	670	820	820	820	1070
			Enclosure Dimensions								
$L_1$	Length	mm	1260	1420	1420	1520	1600	1750	2000	2040	2250
$B_1$	Width	mm	740	800	800	900	900	975	1000	1100	1190
$H_1$	Height	mm	1205	1250	1250	1480	1710	1805	1930	1935	2140

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP21-31 (Protective Enclosure)

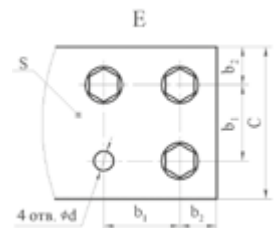
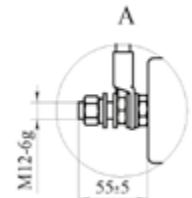
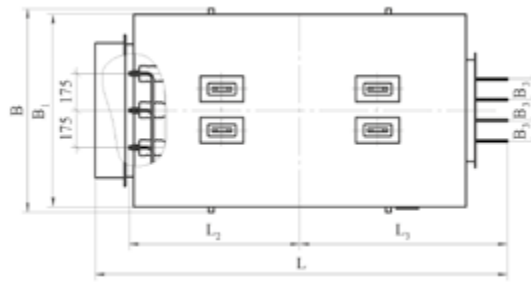
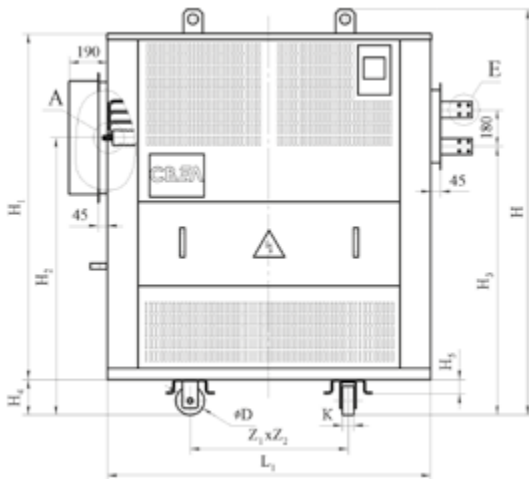
LV Side: 0.4kV

Bushings Layout: Left, Right (Side Bushings)

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	2500	3200
Parameter			Values	
$P_{NL}$	No Load Loss	W	3300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	16750	22100
$P_{SC115}$	Short Circuit Loss at 115°C	W	20700	27000
$I_{NL}$	No Load Current	%	0,3	0,3
$U_{SC}$	Short Circuit Voltage	%	6	6
$L_{pA}$	Sound Pressure Level	dB	60	64

Me	Winding Material		Al	Al
<b>Overall Dimensions and Weight</b>				
L	Length	mm	2825	3215
B	Width	mm	1270	1500
H	Height	mm	2805	2855
M	Weight	kg	5780	8460



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings	
$H_2$	Height up to HV Bushing	mm	1790	2350
$B_2$	Distance from axle to HV Bushing	mm	1190	1330
MO	Distance between Phase Bushings	mm	1675	2220
$H_3$	Height up to LV Bushing	mm	1435	1675
$L_3$	Distance from axle to LV Bushing	mm	130	130
<b>Parameters of LV Connecting Buses</b>				
s	Bus Thickness	mm	10	10
$b_1$	Distance between bus holes	mm	60	60
$b_2$	Distance between bus edge and bus hole	mm	20	20
C	Bus Width	mm	100	100
d	Hole Diameter	mm	17	17
$N_{hot}$	Number of Holes	pcp	4	4
<b>Mounting and Transport Elements</b>				
K	Roller Width	mm	50	50
D	Roller Diameter	mm	160	160
$H_4$	Carriage Height	mm	240	240
$H_5$	Beam Height	mm	90	90
$Z_1$	Longitudinal Track	mm	1070	1300
$Z_2$	Transverse Track	mm	1070	1300
<b>Enclosure Dimensions</b>				
$L_1$	Length	mm	2400	2790
$B_1$	Width	mm	1190	1470
$H_1$	Height	mm	2440	2535

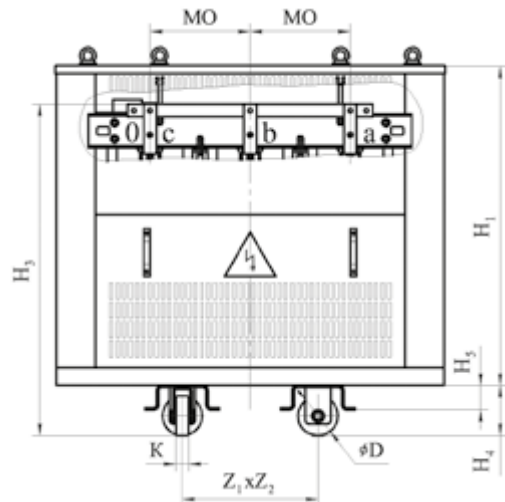
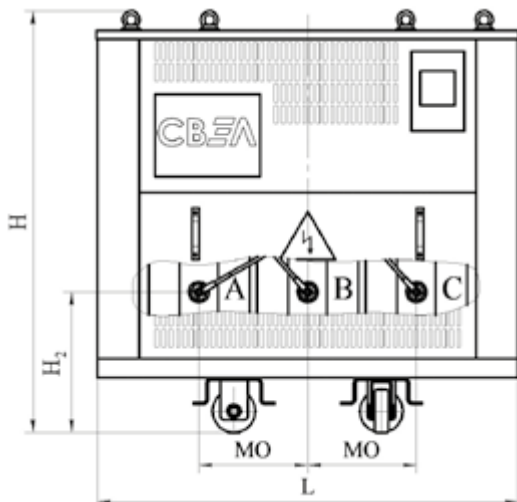
## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP21-31 (Protective Enclosure)  
 Bushings Layout: Bottom (cable connected through the bottom plate of Enclosure)

LV Side: 0.4kV

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	16	25	40	63	100	160	250
Parameter			Values						
$P_{NL}$	No Load Loss	W	140	190	230	280	400	550	700
$P_{SC75}$	Short Circuit Loss at 75°C	W	400	500	700	1100	1400	2200	2750
$P_{SC115}$	Short Circuit Loss at 115°C	W	450	550	750	1200	1550	2450	3050
$I_{NL}$	No Load Current	%	4,5	3	3,5	3,5	2,5	0,9	0,9
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	4	4	4
$L_{pA}$	Sound Pressure Level	dB	44	44	46	48	50	52	52
Me	Winding Material		Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al	Al
<b>Overall Dimensions and Weight</b>									
L	Length	mm	1120	1120	1120	1120	1260	1420	1420
B	Width	mm	830	830	830	830	820	980	980
H	Height	mm	1105	1105	1105	1105	1430	1465	1495
M	Weight	kg	350	410	490	580	780	930	1200



### Additional Dimensions (for reference)

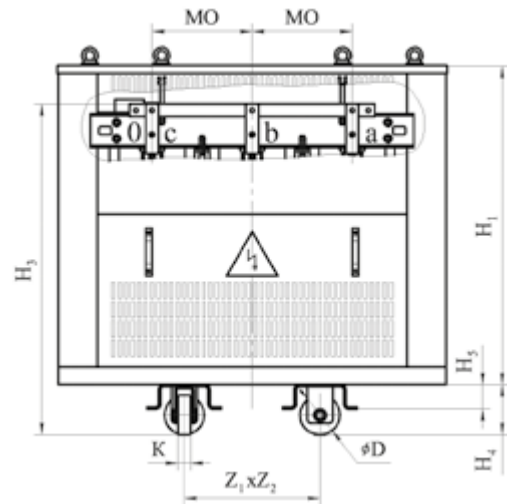
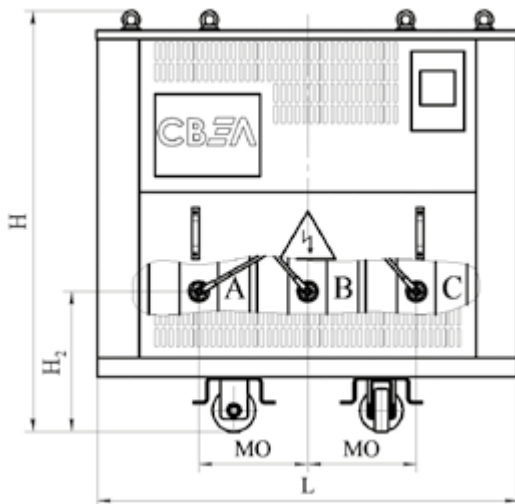
Rated Power, kVA		kVA	16	25	40	63	100	160	250
Parameter			Mounting Dimensions of HV and LV Bushings						
$H_2$	Height up to HV Bushing	mm	355	360	375	375	420	470	480
$B_2$	Distance from axle to HV Bushing	mm	210	220	225	225	235	285	270
MO	Distance between Phase Bushings	mm	270	290	305	310	325	365	385
$H_3$	Height up to LV Bushing	mm	645	660	690	775	935	985	1040
$B_3$	Distance from axle to LV Bushing	mm	245	250	255	250	255	270	285
$B_{3H}$	Distance from axle to LV Neutral	mm	200	205	210	205	210	225	240
<b>Parameters of LV Connecting Buses</b>									
s	Bus Thickness	mm	5	5	5	5	5	5	5
$b_1$	Distance between bus holes	mm	-	-	-	-	-	-	-
$b_2$	Distance between bus edge and bus hole	mm	20	20	20	20	20	20	20
C	Bus Width	mm	40	40	40	40	40	40	40
d	Hole Diameter	mm	13	13	13	13	13	13	13
$N_{hot}$	Number of Holes	pcp	1	1	1	1	1	1	1
<b>Mounting and Transport Elements</b>									
K	Roller Width	mm	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	420	420	420	420	520	720	720
$Z_2$	Transverse Track	mm	420	420	420	420	520	520	520
<b>Enclosure Dimensions</b>									
L	Length	mm	1120	1120	1120	1120	1260	1420	1420
$B_1$	Width	mm	750	750	750	750	740	900	800
$H_1$	Height	mm	890	890	890	890	1205	1250	1250

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP21-31 (Protective Enclosure)  
 Bushings Layout: Bottom (cable connected through the bottom plate of Enclosure)

LV Side: 0.4kV  
 Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	400	600	1000	1250	1600	2000	2500
Parameter			Values						
$P_{NL}$	No Load Loss	W	1000	1150	1650	1950	2370	2800	3300
$P_{SC75}$	Short Circuit Loss at 75°C	W	4050	6850	9200	10200	11900	14200	16750
$P_{SC115}$	Short Circuit Loss at 115°C	W	4500	7600	10200	11500	13450	16050	19000
$I_{NL}$	No Load Current	%	0,6	0,4	0,35	0,35	0,35	0,3	0,3
$U_{SC}$	Short Circuit Voltage	%	4	6	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	52	53	53	54	54	56	60
Me	Winding Material		Al	Al	Al	Al	Al	Al	Al
<b>Overall Dimensions and Weight</b>									
L	Length	mm	1520	1600	1780	2040	2040	2250	2400
B	Width	mm	980	1080	1130	1180	1180	1270	1270
H	Height	mm	1735	1970	2120	2265	2280	2500	2800
M	Weight	kg	1700	2200	2885	3550	3900	4660	5670



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	400	600	1000	1250	1600	2000	2500
Parameter			Mounting Dimensions of HV and LV Bushings						
$H_2$	Height up to HV Bushing	mm	500	535	605	645	670	705	685
$B_2$	Distance from axle to HV Bushing	mm	295	345	380	380	390	410	400
MO	Distance between Phase Bushings	mm	435	490	530	565	580	620	650
$H_3$	Height up to LV Bushing	mm	1155	1180	1370	1805	1900	2045	2155
$B_3$	Distance from axle to LV Bushing	mm	300	330	295	295	310	340	370
$B_{3H}$	Distance from axle to LV Neutral	mm	255	280	300	235	240	260	285
<b>Parameters of LV Connecting Buses</b>									
s	Bus Thickness	mm	5	6	8	10	10	12	15
$b_1$	Distance between bus holes	mm	-	40	50	50	60	60	60
$b_2$	Distance between bus edge and bus hole	mm	30	20	25	25	30	30	30
C	Bus Width	mm	60	80	100	100	120	120	120
d	Hole Diameter	mm	13	13	13	17	17	17	17
$N_{hot}$	Number of Holes	pcp	1	4	4	4	4	4	4
<b>Mounting and Transport Elements</b>									
K	Roller Width	mm	40	40	50	50	50	50	50
D	Roller Diameter	mm	125	125	160	160	160	160	160
$H_4$	Carriage Height	mm	160	160	205	240	240	240	240
$H_5$	Beam Height	mm	75	75	75	75	75	90	90
$Z_1$	Longitudinal Track	mm	840	840	1070	1070	1070	1070	1070
$Z_2$	Transverse Track	mm	670	670	820	820	820	1070	1070
<b>Enclosure Dimensions</b>									
L	Length	mm	1520	1600	1780	2040	2040	2250	2400
$B_1$	Width	mm	900	1000	1050	1100	1100	1190	1190
$H_1$	Height	mm	1480	1700	1800	1930	1930	2140	2440

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP21-31 (Protective Enclosure)

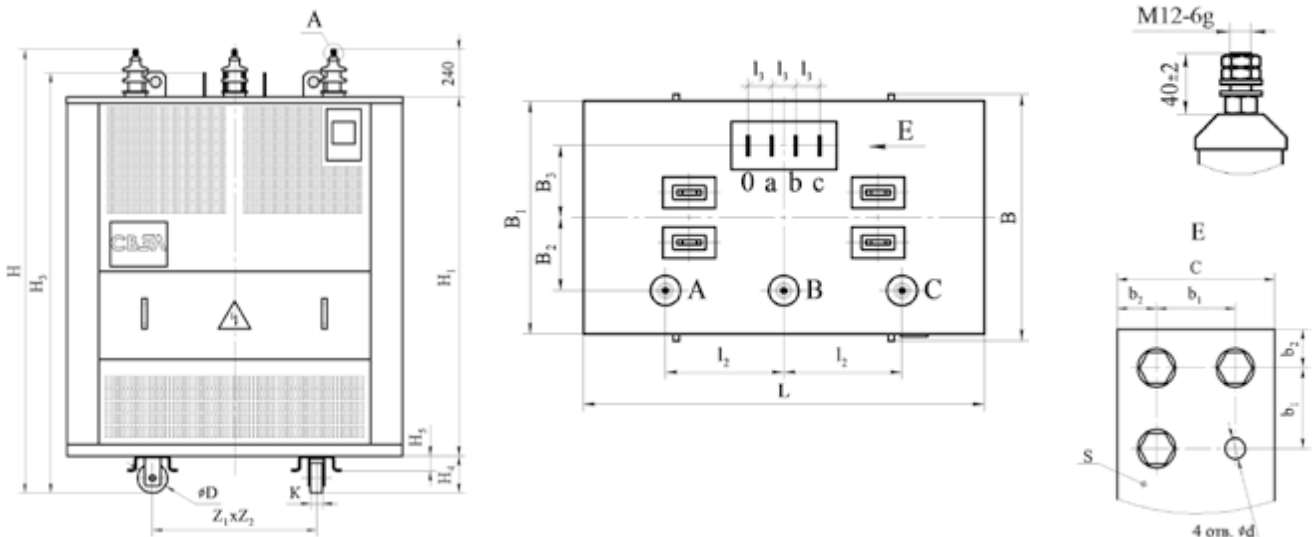
LV Side: 0.4kV

Bushings Layout: Top (HV and LV Bushings on the top plate of Enclosure)

Loss Level: Energy Efficiency (Class A)

Rated Power, kVA		kVA	160	250	400	630	1000	1250	1600	2000	2500
Parameter			Values								
$P_{NL}$	No Load Loss	W	550	700	1000	1150	1650	1950	2370	2800	3300
$P_{SC75}$	Short Circuit Loss at 75°C	W	2200	2750	4050	6850	9200	10700	12200	15100	18400
$P_{SC115}$	Short Circuit Loss at 115°C	W	2450	3050	4500	7600	10200	12000	13750	17000	20700
$I_{NL}$	No Load Current	%	0,9	0,9	0,6	0,4	0,35	0,35	0,35	0,3	0,3
$U_{SC}$	Short Circuit Voltage	%	4	4	4	6	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	52	52	52	53	53	54	54	56	60

Me	Winding Material		Al	Al	Al	Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight								
L	Length	mm	1420	1420	1520	1600	1780	2040	2040	2250	2400
B	Width	mm	880	880	980	980	1050	1180	1180	1270	1270
H	Height	mm	1650	1650	1880	2100	2245	2410	2410	2620	2920
M	Weight	kg	930	1100	1700	2200	2880	3550	3900	4660	5780



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	160	250	400	630	1000	1250	1600	2000	2500
Parameter			Mounting Dimensions of HV and LV Bushings								
H	Height up to HV Bushing	mm	1650	1650	1880	2100	2245	2410	2410	2620	2920
$B_2$	Distance from axle to HV Bushing	mm	225	225	275	290	305	350	350	400	400
$l_2$	Distance between HV Bushings	mm	200	200	200	200	350	540	540	540	540
$H_3$	Height up to LV Bushing	mm	1500	1500	1740	1950	2105	2305	2280	2515	2855
$B_3$	Distance from axle to LV Bushing	mm	250	250	280	290	300	410	410	410	450
$l_3$	Distance between LV Bushings	mm	100	100	100	100	100	130	130	130	130
			Parameters of LV Connecting Buses								
s	Bus Thickness	mm	5	5	6	6	10	10	10	10	15
$b_1$	Distance between bus holes	mm	-	-	45	45	45	60	60	60	60
$b_2$	Distance between bus edge and bus hole	mm	20	20	17,5	17,5	17,5	20	20	30	30
C	Bus Width	mm	40	40	80	80	80	100	100	120	120
d	Hole Diameter	mm	13	13	13	13	13	17	17	17	17
$N_{hot}$	Number of Holes	pcp	1	1	4	4	4	4	4	4	4
			Mounting and Transport Elements								
K	Roller Width	mm	40	40	40	40	50	50	50	50	50
D	Roller Diameter	mm	125	125	125	125	160	160	160	160	160
$H_4$	Carriage Height	mm	160	160	160	160	205	240	240	240	240
$H_5$	Beam Height	mm	75	75	75	75	75	75	75	90	90
$Z_1$	Longitudinal Track	mm	720	720	840	840	1070	1070	1070	1070	1070
$Z_2$	Transverse Track	mm	520	520	670	670	820	820	820	1070	1070
			Enclosure Dimensions								
L	Length	mm	1420	1420	1520	1600	1780	2040	2040	2250	2400
$B_1$	Width	mm	800	800	900	900	970	1100	1100	1190	1190
$H_1$	Height	mm	1250	1250	1480	1700	1800	1930	1930	2140	2440

## TECHNICAL DATA: CAST RESIN TRANSFORMERS FOR SWITCHGEARS, 6kV AND 10kV

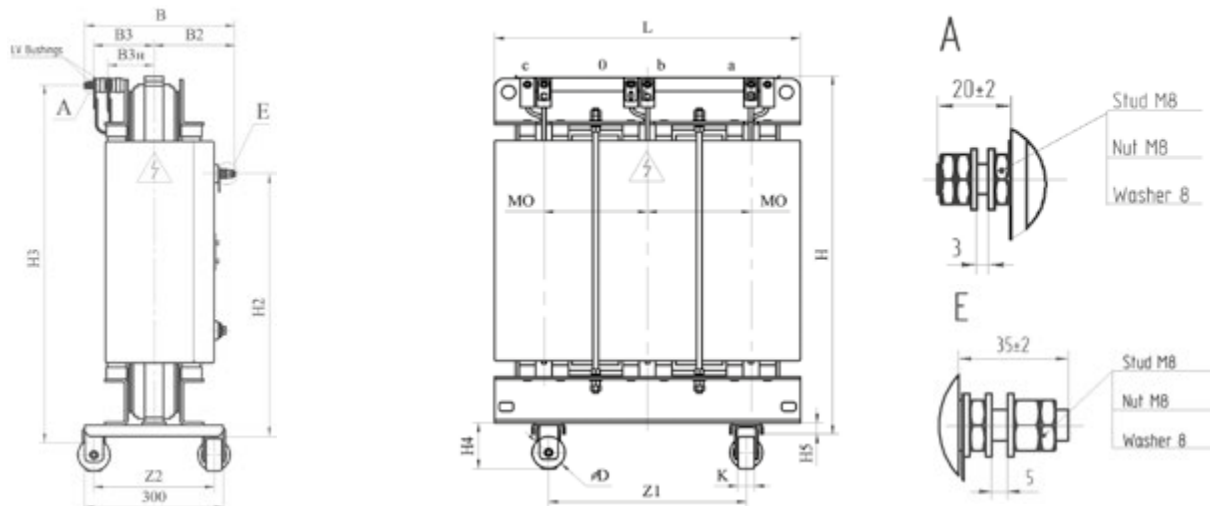
Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Rated Power, kVA			25	40	63
Parameter		kVA	Values		
$P_{NL}$	No Load Loss	W	165	245	365
$P_{SC75}$	Short Circuit Loss at 75°C	W	450	630	720
$P_{SC115}$	Short Circuit Loss at 115°C	W	500	700	800
$I_{NL}$	No Load Current	%	3	3,5	3,5
$U_{SC}$	Short Circuit Voltage	%	2,1	1,9	1,5
$L_{pA}$	Sound Pressure Level	dB	44	46	48
Me	Winding Material		Al, Cu	Al, Cu	Al, Cu
<b>Overall Dimensions and Weight</b>					
L	Length	mm	650	650	740
B	Width	mm	325	325	350
H	Height*	mm	750	785	825
M	Weight	kg	280	340	475

\* Height dimensions are referenced for the transformer without rollers and TCU



### Additional Dimensions (for reference)

Rated Power, kVA			25	40	63
Parameter		kVA	Mounting Dimensions of HV and LV Bushings		
$H_2$	Height up to HV Bushing	mm	555	570	600
$B_2$	Distance from axle to HV Bushing	mm	175	175	190
MO	Distance between Phase Bushings	mm	220	220	250
$H_{3H}$	Height up to LV Bushing	mm	755	780	820
$B_3$	Distance from axle to LV Bushing	mm	125	130	140
$B_{3H}$	Distance from axle to LV Neutral	mm	95	100	110
<b>Parameters of LV Connecting Buses</b>					
s	Bus Thickness	mm	4	4	4
$b_1$	Distance between bus holes	mm	-	-	-
$b_2$	Distance between bus edge and bus hole	mm	15	15	15
C	Bus Width	mm	30	30	30
d	Hole Diameter	mm	9	9	9
$N_{hot}$	Number of Holes	pcp	1	1	1
<b>Mounting and Transport Elements</b>					
K	Roller Width	mm	35	35	35
D	Roller Diameter	mm	70	70	70
$H_4$	Carriage Height	mm	100	100	100
$H_5$	Beam Height	mm	25	25	25
$d_{osn}$	Mounting Hole to fix on foundation	mm	17	17	17
$Z_1$	Longitudinal Track	mm	420	420	420
$Z_2$	Transverse Track	mm	260	260	260

Notes:

- 1) If the desired rated power is not included, the characteristics are considered upon customer's request.
- 2) Max deviations of measured parameters as per GOST 52719.

## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP00 (no enclosure)

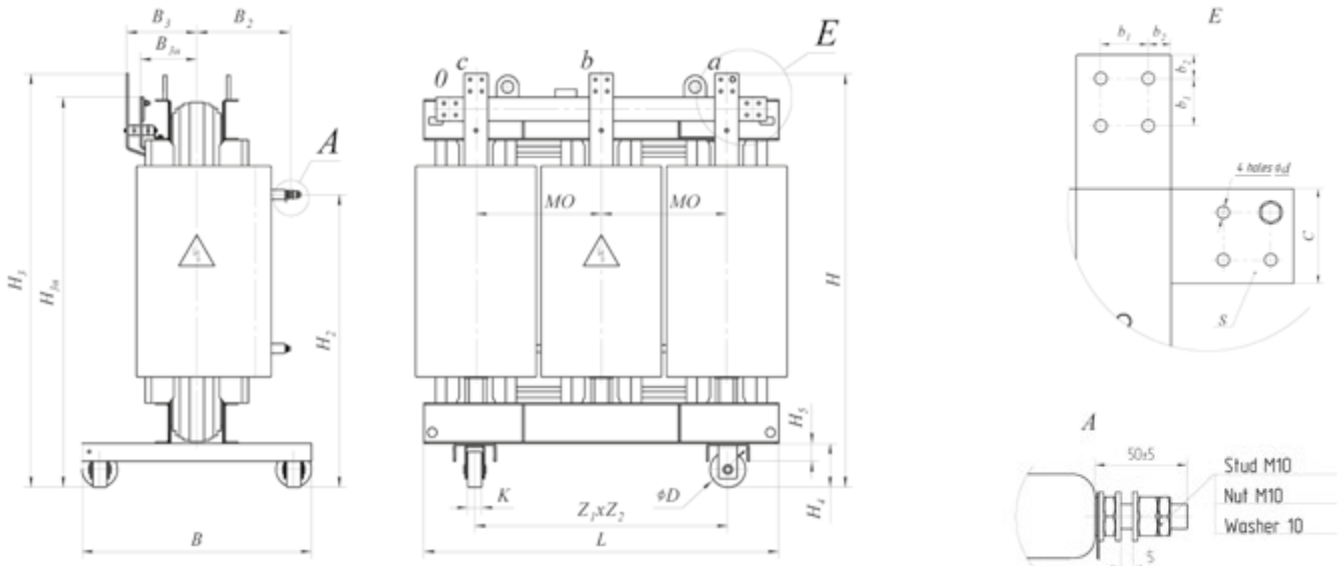
LV Side: 0.4kV

Bushings Layout: standard busbars

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	100	160	250	400	630	800	1000	1000
Parameter			Values							
$P_{NL}$	No Load Loss	W	440	610	820	1150	1500	1800	2100	2100
$P_{SC75}$	Short Circuit Loss at 75°C	W	1800	2450	3150	4400	6600	8100	9000	9000
$P_{SC120}$	Short Circuit Loss at 120°C	W	2000	2700	3500	4900	7300	9000	10000	10000
$I_{NL}$	No Load Current	%	1	1,1	0,85	0,7	0,75	0,7	0,6	0,6
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	6	6	6	8
$L_{pA}$	Sound Pressure Level	dB	53	55	55	56	57	57	57	57

Me	Winding Material		Al	Al	Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight							
L	Length	mm	1085	1080	1140	1235	1445	1500	1535	1590
B	Width	mm	700	700	700	910	910	910	910	910
H	Height	mm	1120	1135	1295	1485	1530	1650	1730	1730
M	Weight	kg	620	725	970	1300	1700	2000	2300	2250



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	100	160	250	400	630	800	1000	1000
Parameter			Mounting Dimensions of HV and LV Bushings							
$H_2$	Height up to HV Bushing	mm	680	760	875	990	1050	1150	1220	1200
$B_2$	Distance from axle to HV Bushing	mm	270	270	270	300	335	350	350	365
MO	Distance between Phase Bushings	mm	365	365	385	415	485	500	515	530
$H_3$	Height up to LV Bushing	mm	1115	1135	1295	1485	1530	1650	1730	1730
$H_{3H}$	Distance from axle to LV Neutral	mm	1055	1075	1200	1365	1410	1530	1610	1590
$B_3$	Distance from axle to LV Bushing	mm	245	240	240	265	275	290	290	290
$B_{3H}$	Distance from axle to LV Neutral	mm	190	185	185	205	215	230	230	230
			Parameters of LV Connecting Buses							
s	Bus Thickness	mm	5	5	5	6	8	8	10	10
$b_1$	Distance between bus holes	mm	-	-	-	40	40	50	50	50
$b_2$	Distance between bus edge and bus hole	mm	20	20	30	20	20	25	25	25
C	Bus Width	mm	40	40	60	80	80	100	100	100
d	Hole Diameter	mm	13	13	13	13	13	13	13	13
$N_{hol}$	Number of Holes	pcp	1	1	1	4	4	4	4	4
			Mounting and Transport Elements							
K	Roller Width	mm	40	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	520	520	520	670	670	670	820	820
$Z_2$	Transverse Track	mm	520	520	520	670	670	670	820	820



## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP00 (no enclosure)

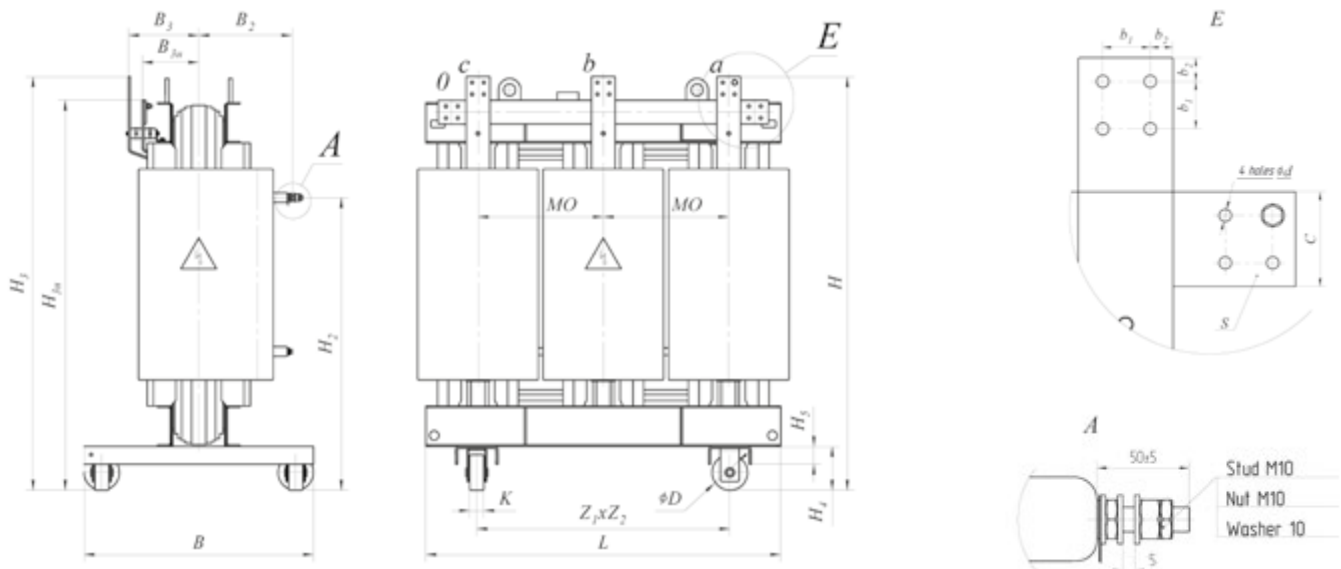
LV Side: 0.4kV

Bushings Layout: standard busbars

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Values				
$P_{NL}$	No Load Loss	W	2500	2800	3600	4300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	10500	12650	15800	18600	22700
$P_{SC120}$	Short Circuit Loss at 120°C	W	12000	14500	18000	21000	26000
$I_{NL}$	No Load Current	%	0,5	0,5	0,5	0,5	0,5
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	57	57	59	63	67

Me	Winding Material		Al	Al	Al	Al	Al
			Overall Dimensions and Weight				
L	Length	mm	1730	1775	1910	1940	1980
B	Width	mm	1110	1110	1210	1210	1210
H	Height	mm	1775	2005	2055	2345	2535
M	Weight	kg	2950	3450	4350	4950	5850



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings				
$H_2$	Height up to HV Bushing	mm	1222	1425	1452	1712	1900
$B_2$	Distance from axle to HV Bushing	mm	390	390	410	420	425
MO	Distance between Phase Bushings	mm	580	595	640	650	665
$H_3$	Height up to LV Bushing	mm	1765	1995	2045	2335	2525
$H_{3H}$	Distance from axle to LV Neutral	mm	1645	1995	1905	2165	2355
$B_3$	Distance from axle to LV Bushing	mm	290	300	330	330	390
$B_{3H}$	Distance from axle to LV Neutral	mm	220	240	265	265	290
			Parameters of LV Connecting Buses				
s	Bus Thickness	mm	10	12	15	15	20
$b_1$	Distance between bus holes	mm	50	60	60	70	70
$b_2$	Distance between bus edge and bus hole	mm	25	30	30	40	40
C	Bus Width	mm	100	120	120	150	150
d	Hole Diameter	mm	13	17	17	17	17
$N_{hol}$	Number of Holes	pcp	4	4	4	4	4
			Mounting and Transport Elements				
K	Roller Width	mm	40	40	40	40	50
D	Roller Diameter	mm	125	125	125	125	160
$H_4$	Carriage Height	mm	160	160	160	160	205
$H_5$	Beam Height	mm	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	820	820	1070	1070	1070
$Z_2$	Transverse Track	mm	820	820	1070	1070	1070

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP31 (Protective Enclosure)

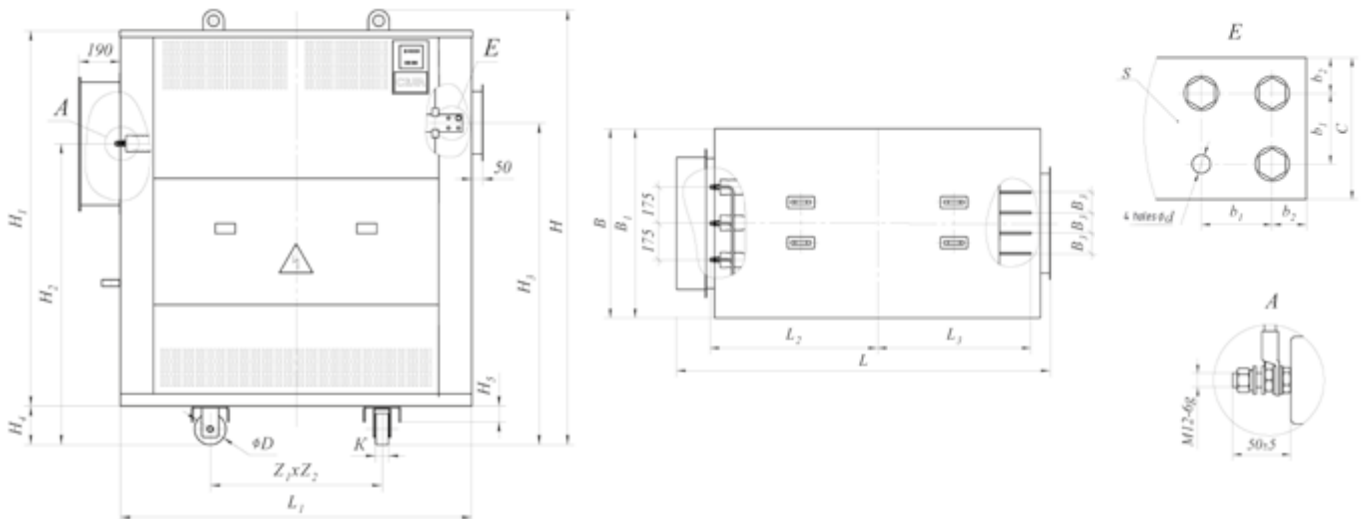
LV Side: 0.4kV

Bushings Layout: Left, Right (Side Bushings)

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Values						
$P_{NL}$	No Load Loss	W	440	610	820	1150	1500	2100	2100
$P_{SC75}$	Short Circuit Loss at 75°C	W	1850	2500	3250	4600	6850	9400	9400
$P_{SC120}$	Short Circuit Loss at 120°C	W	2050	2800	3600	5100	7600	10400	10400
$I_{NL}$	No Load Current	%	1	1,1	0,85	0,7	0,75	0,6	0,6
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	6	6	8
$L_{pA}$	Sound Pressure Level	dB	53	55	55	56	57	57	57

Me	Winding Material		Al	Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight						
L	Length	mm	1580	1580	1640	1840	1950	2040	2040
B	Width	mm	920	920	940	1090	1090	1090	1090
H	Height	mm	1425	1425	1605	1810	1810	2010	2010
M	Weight	kg	860	970	1220	1550	1950	2600	2550



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Mounting Dimensions of HV and LV Bushings						
$H_2$	Height up to HV Bushing	mm	830	850	1030	1200	1260	1435	1435
$L_2$	Distance from axle to HV Bushing	mm	705	705	735	800	895	935	935
$H_3$	Height up to LV Bushing	mm	1045	1065	1255	1445	1490	1685	1685
$L_3$	Distance from axle to LV Bushing	mm	820	620	650	705	800	860	860
$B_3$	Distance between Phase Bushings	mm	100	100	100	100	100	100	100
			Parameters of LV Connecting Buses						
s	Bus Thickness	mm	5	5	5	6	8	10	10
$b_1$	Distance between bus holes	mm	-	-	-	40	40	50	50
$b_2$	Distance between bus edge and bus hole	mm	20	20	30	20	20	25	25
C	Bus Width	mm	40	40	60	80	80	100	100
d	Hole Diameter	mm	13	13	13	13	13	13	13
$N_{hot}$	Number of Holes	pcp	1	1	1	4	4	4	4
			Mounting and Transport Elements						
K	Roller Width	mm	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	520	520	520	670	670	820	820
$Z_2$	Transverse Track	mm	520	520	520	670	670	820	820
			Enclosure Dimensions						
$L_1$	Length	mm	1340	1340	1400	1510	1710	1800	1800
$B_1$	Width	mm	880	880	900	1050	1050	1050	1050
$H_1$	Height	mm	1165	1165	1345	1550	1550	1750	1750

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

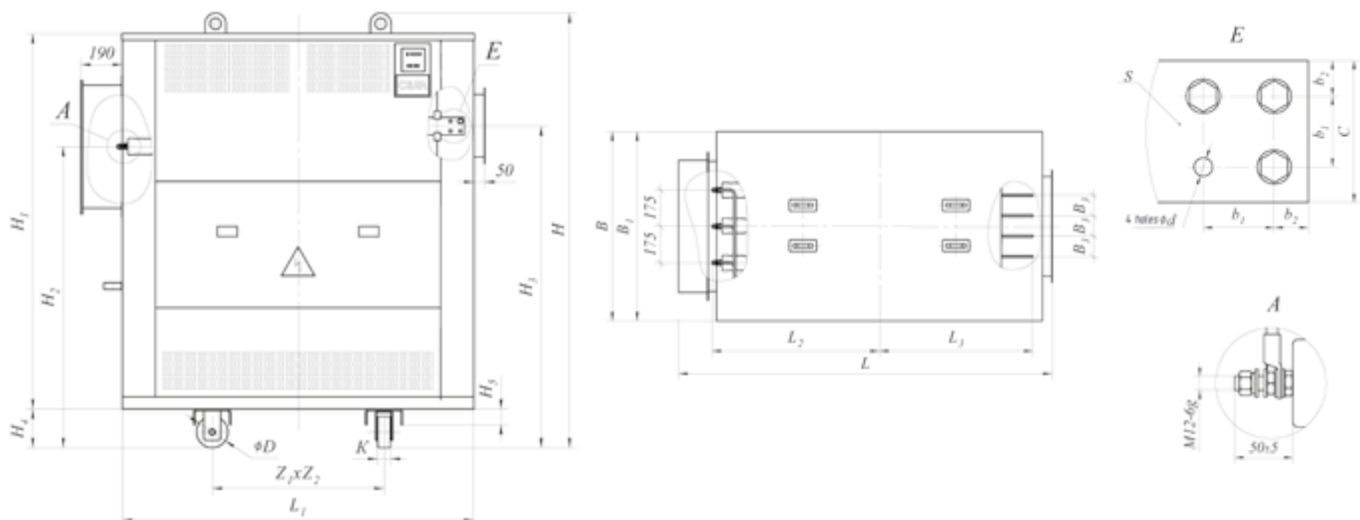
Degree of Protection: IP31 (Protective Enclosure)

LV Side: 0.4kV

Bushings Layout: Left, Right (Side Bushings)

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Values				
$P_{NL}$	No Load Loss	W	2500	2800	3600	4300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	12000	13950	17000	20150	24800
$P_{SC120}$	Short Circuit Loss at 120°C	W	13500	15950	19500	23100	28000
$I_{NL}$	No Load Current	%	0,5	0,5	0,5	0,5	0,5
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	57	57	59	63	67
Me	Winding Material		Al	Al	Al	Al	Al
<b>Overall Dimensions and Weight</b>							
L	Length	mm	2250	2250	2450	2455	2450
B	Width	mm	1150	1150	1250	1250	1240
H	Height	mm	2140	2325	2330	2595	2795
M	Weight	kg	3300	3800	4800	5300	6300



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings				
$H_2$	Height up to HV Bushing	mm	1445	1655	1705	1955	2145
$L_2$	Distance from axle to HV Bushing	mm	1045	1045	1110	1110	1115
$H_3$	Height up to LV Bushing	mm	1715	1935	1985	2260	2450
$L_3$	Distance from axle to LV Bushing	mm	930	965	1025	1030	1045
$B_3$	Distance between Phase Bushings	mm	130	130	130	130	150
<b>Parameters of LV Connecting Buses</b>							
s	Bus Thickness	mm	10	12	15	15	20
$b_1$	Distance between bus holes	mm	60	60	60	60	60
$b_2$	Distance between bus edge and bus hole	mm	20	30	30	45	45
C	Bus Width	mm	100	120	120	150	150
d	Hole Diameter	mm	17	17	17	17	17
$N_{hot}$	Number of Holes	pcp	4	4	4	4	4
<b>Mounting and Transport Elements</b>							
K	Roller Width	mm	40	40	40	40	50
D	Roller Diameter	mm	125	125	125	125	160
$H_4$	Carriage Height	mm	160	160	160	160	205
$H_5$	Beam Height	mm	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	820	820	1070	1070	1070
$Z_2$	Transverse Track	mm	820	820	1070	1070	1070
<b>Enclosure Dimensions</b>							
$L_1$	Length	mm	2000	2000	2200	2200	2200
$B_1$	Width	mm	1100	1100	1200	1205	1200
$H_1$	Height	mm	1802	2050	2052	2320	2482

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

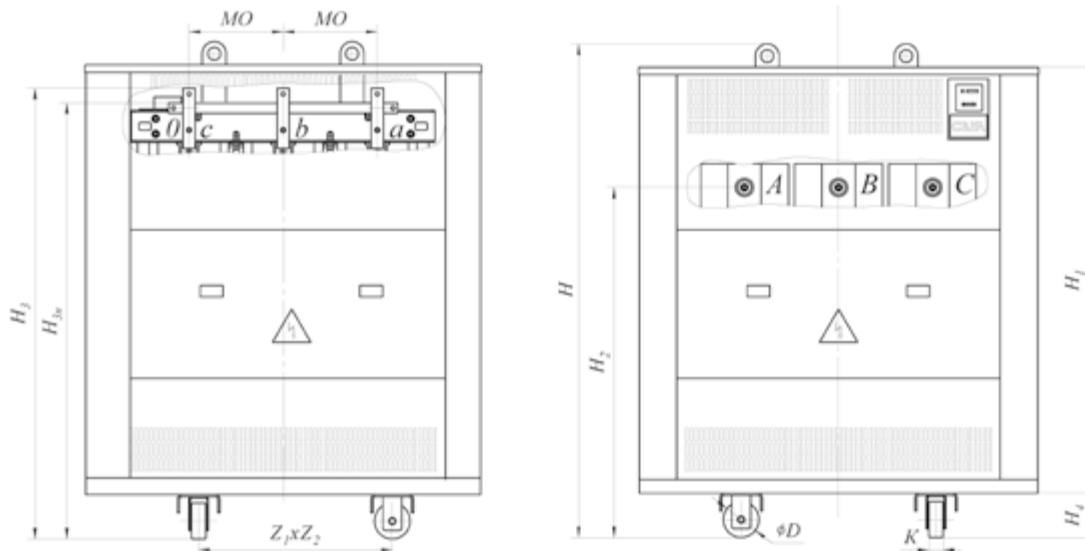
Degree of Protection: IP31 (Protective Enclosure)

Bushings Layout: Bottom (cable connected through the bottom plate of Enclosure)

LV Side: 0.4kV

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Values						
$P_{NL}$	No Load Loss	W	440	610	820	1150	1500	2100	2100
$P_{SC75}$	Short Circuit Loss at 75°C	W	1850	2500	3250	4600	6850	9400	9400
$P_{SC120}$	Short Circuit Loss at 120°C	W	2050	2800	3600	5100	7600	10400	10400
$I_{NL}$	No Load Current	%	1	1,1	0,85	0,7	0,75	0,6	0,6
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	6	6	6
$L_{pA}$	Sound Pressure Level	dB	53	55	55	56	57	57	57
Me	Winding Material		Al	Al	Al	Al	Al	Al	Al
<b>Overall Dimensions and Weight</b>									
L	Length	mm	1340	1340	1400	1510	1710	1800	1800
B	Width	mm	920	920	940	1090	1090	1090	1090
H	Height	mm	1425	1425	1605	1810	1810	2010	2010
M	Weight	kg	860	970	1220	1550	1950	2550	2500



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Mounting Dimensions of HV and LV Bushings						
$H_2$	Height up to HV Bushing	mm	680	760	875	990	1050	1220	1200
$B_2$	Distance from axle to HV Bushing	mm	270	270	270	300	335	350	365
MO	Distance between phase bushings	mm	365	365	385	415	485	515	530
$H_3$	Height up to LV Bushing	mm	1115	1135	1295	1485	1530	1730	1730
$B_3$	Distance from axle to LV Bushing	mm	245	240	240	265	275	290	290
$B_{3H}$	Distance from axle to LV Neutral	mm	190	185	185	210	215	230	230
<b>Parameters of LV Connecting Buses</b>									
s	Bus Thickness	mm	5	5	5	6	8	10	10
$b_1$	Distance between bus holes	mm	-	-	-	40	40	50	50
$b_2$	Distance between bus edge and bus hole	mm	20	20	30	20	20	25	25
C	Bus Width	mm	40	40	60	80	80	100	100
d	Hole Diameter	mm	13	13	13	13	13	13	13
$N_{hot}$	Number of Holes	pcp	1	1	1	4	4	4	4
<b>Mounting and Transport Elements</b>									
K	Roller Width	mm	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	520	520	520	670	670	820	820
$Z_2$	Transverse Track	mm	520	520	520	670	670	820	820
<b>Enclosure Dimensions</b>									
L	Length	mm	1340	1340	1400	1510	1710	1800	1800
$B_1$	Width	mm	880	880	900	1050	1050	1050	1050
$H_1$	Height	mm	1165	1165	1345	1550	1550	1750	1750

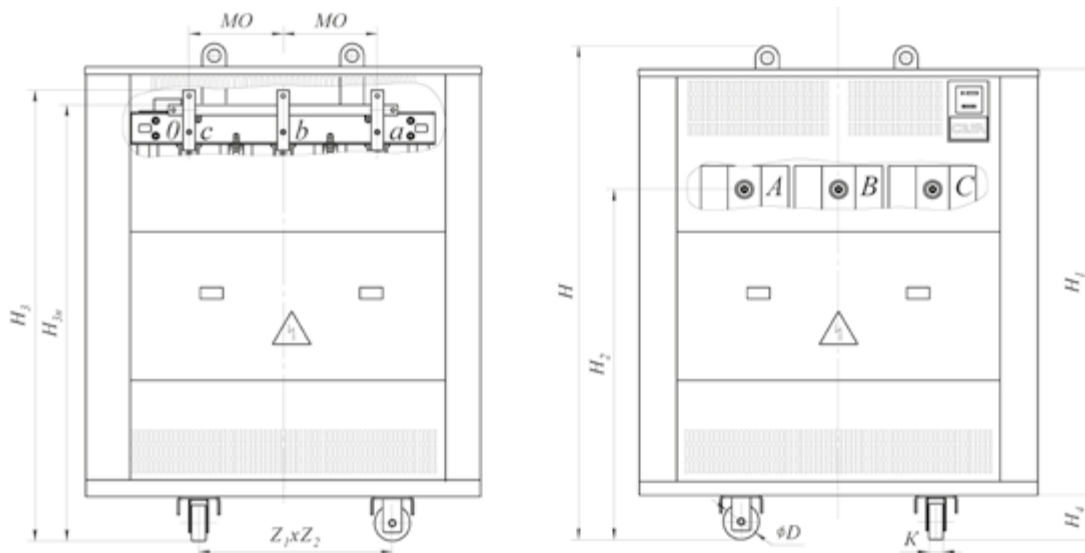
## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: IP31 (Protective Enclosure)  
 Bushings Layout: Bottom (cable connected through the bottom plate of Enclosure)

LV Side: 0.4kV

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Values				
$P_{NL}$	No Load Loss	W	2500	2800	3600	4300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	12000	13950	17000	20150	24800
$P_{SC120}$	Short Circuit Loss at 120°C	W	13500	15950	19500	23100	28000
$I_{NL}$	No Load Current	%	0,5	0,5	0,5	0,5	0,5
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	57	57	59	63	67
Me	Winding Material		Al	Al	Al	Al	Al
Overall Dimensions and Weight							
L	Length	mm	2025	2025	2225	2225	2225
B	Width	mm	1150	1150	1250	1250	1240
H	Height	mm	2140	2325	2330	2595	2795
M	Weight	kg	3300	3800	4800	5300	6300



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings				
$H_2$	Height up to HV Bushing	mm	1222	1425	1452	1712	1900
$B_2$	Distance from axle to HV Bushing	mm	390	390	410	420	425
MO	Distance between phase bushings	mm	580	595	640	650	665
$H_3$	Height up to LV Bushing	mm	1765	1995	2045	2335	2525
$B_3$	Distance from axle to LV Bushing	mm	290	300	330	330	390
$B_{3H}$	Distance from axle to LV Neutral	mm	220	240	265	265	290
Parameters of LV Connecting Buses							
s	Bus Thickness	mm	10	12	15	15	20
$b_1$	Distance between bus holes	mm	50	60	60	70	70
$b_2$	Distance between bus edge and bus hole	mm	25	30	30	40	40
C	Bus Width	mm	100	120	120	150	150
d	Hole Diameter	mm	13	17	17	17	17
$N_{hot}$	Number of Holes	pcp	4	4	4	4	4
Mounting and Transport Elements							
K	Roller Width	mm	40	40	40	40	50
D	Roller Diameter	mm	125	125	125	125	160
$H_4$	Carriage Height	mm	160	160	160	160	205
$H_5$	Beam Height	mm	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	820	820	1070	1070	1070
$Z_2$	Transverse Track	mm	820	820	1070	1070	1070
Enclosure Dimensions							
$L_1$	Length	mm	2000	2000	2200	2200	2200
$B_1$	Width	mm	1100	1100	1200	1205	1200
$H_1$	Height	mm	1802	2050	2052	2320	2482

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

Degree of Protection: : IP31 (Protective Enclosure)

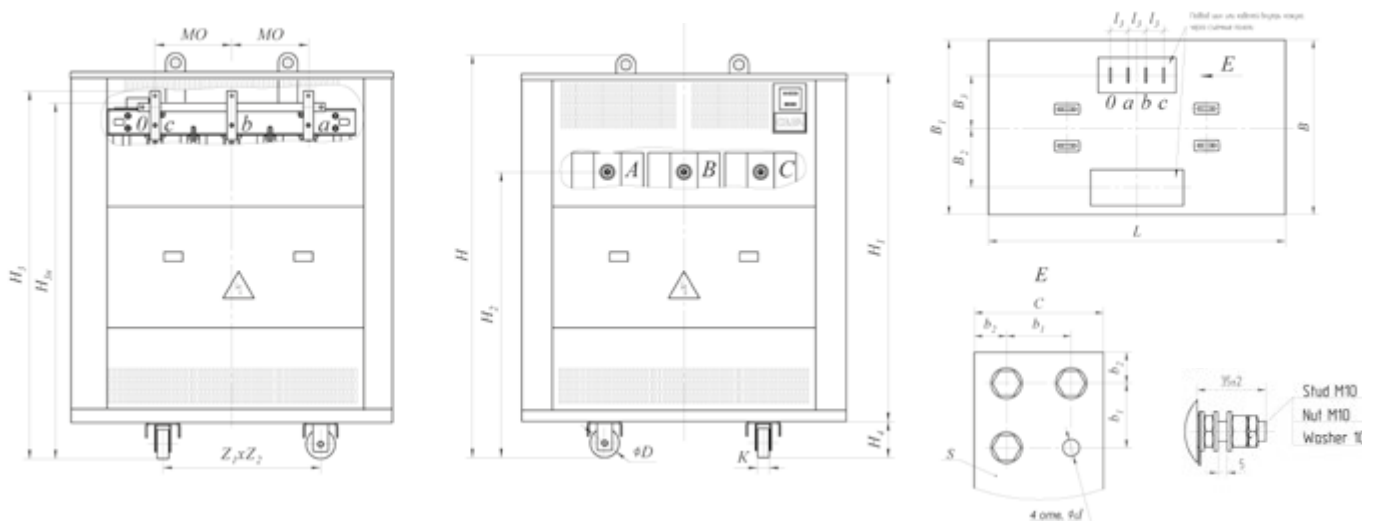
LV Side: 0.4kV

Bushings Layout: Top (HV and LV Bushings on the top plate of Enclosure)

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Values						
$P_{NL}$	No Load Loss	W	440	610	820	1150	1500	2100	2100
$P_{SC75}$	Short Circuit Loss at 75°C	W	1850	2500	3250	4600	6850	9400	9400
$P_{SC120}$	Short Circuit Loss at 120°C	W	2050	2800	3600	5100	7600	10400	10400
$I_{NL}$	No Load Current	%	1	1,1	0,85	0,7	0,75	0,6	0,6
$U_{SC}$	Short Circuit Voltage	%	4	4	4	4	6	6	6
$L_{pA}$	Sound Pressure Level	dB	53	55	55	56	57	57	57

Me	Winding Material		Al	Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight						
L	Length	mm	1340	1340	1400	1510	1710	1800	1800
B	Width	mm	920	920	940	1090	1090	1090	1090
H	Height	mm	1465	1425	1605	1810	1810	2070	2070
M	Weight	kg	860	970	1220	1550	1950	2550	2500



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	100	160	250	400	630	1000	1000
Parameter			Mounting Dimensions of HV and LV Bushings						
H	Height up to HV Bushing	mm	680	760	875	990	1050	1220	1200
$B_2$	Distance from axle to HV Bushing	mm	270	270	270	300	335	350	365
$I_2$	Distance between HV Bushings	mm	365	365	385	415	485	515	515
$H_3$	Height up to LV Bushing	mm	1465	1135	1295	1485	1530	1685	1685
$B_3$	Distance from axle to LV Bushing	mm	305	305	315	390	390	390	390
$I_{3H}$	Distance between LV Bushings	mm	100	100	100	100	100	100	100
			Parameters of LV Connecting Buses						
s	Bus Thickness	mm	5	5	5	6	8	10	10
$b_1$	Distance between bus holes	mm	-	-	-	40	40	50	50
$b_2$	Distance between bus edge and bus hole	mm	20	20	30	20	20	25	25
C	Bus Width	mm	40	40	60	80	80	100	100
d	Hole Diameter	mm	13	13	13	14	13	13	13
$N_{hot}$	Number of Holes	pcp	1	1	1	4	4	4	4
			Mounting and Transport Elements						
K	Roller Width	mm	40	40	40	40	40	40	40
D	Roller Diameter	mm	125	125	125	125	125	125	125
$H_4$	Carriage Height	mm	160	160	160	160	160	160	160
$H_5$	Beam Height	mm	75	75	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	520	520	520	670	670	820	820
$Z_2$	Transverse Track	mm	520	520	520	670	670	820	820
			Enclosure Dimensions						
$L_1$	Length	mm	1340	1340	1400	1510	1710	1800	1800
$B_1$	Width	mm	880	880	900	1050	1050	1050	1050
$H_1$	Height	mm	1165	1165	1345	1550	1550	1750	1750

## TECHNICAL DATA: CAST RESIN PROTECTED TRANSFORMERS, 6kV AND 10kV

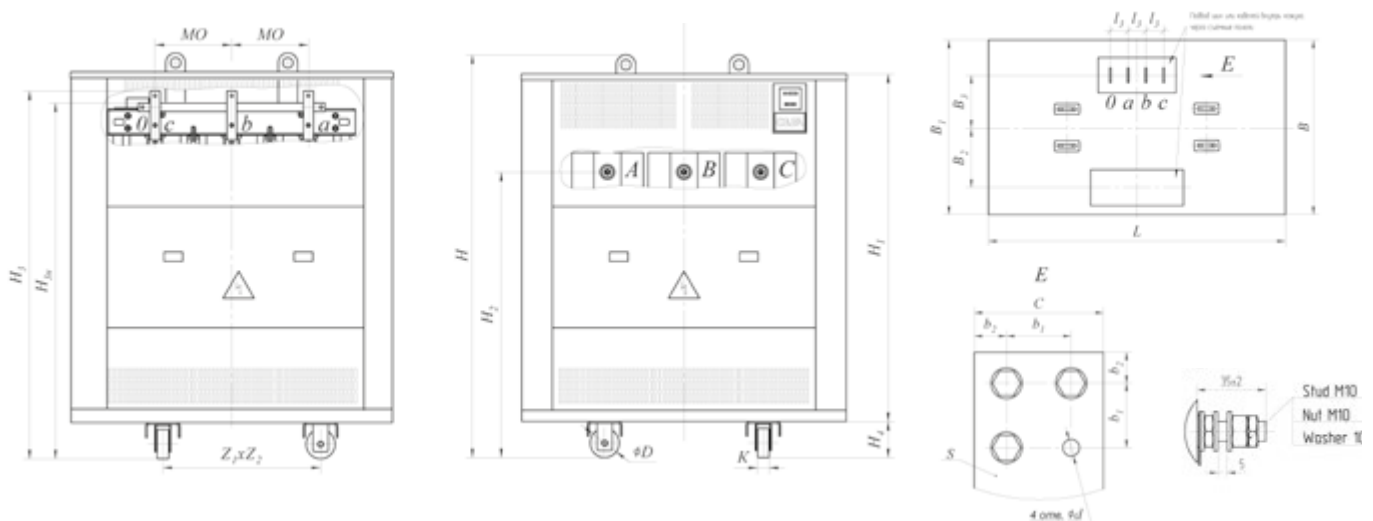
Degree of Protection: : IP31 (Protective Enclosure)

LV Side: 0.4kV

Bushings Layout: Top (HV and LV Bushings on the top plate of Enclosure)

Loss Level: Standard (Class C)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Values				
$P_{NL}$	No Load Loss	W	2500	2800	3600	4300	5300
$P_{SC75}$	Short Circuit Loss at 75°C	W	12000	13950	17000	20150	24800
$P_{SC120}$	Short Circuit Loss at 120°C	W	13500	15950	19500	23100	28000
$I_{NL}$	No Load Current	%	0,5	0,5	0,5	0,5	0,5
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	57	57	59	63	67
Me	Winding Material		Al	Al	Al	Al	Al
<b>Overall Dimensions and Weight</b>							
L	Length	mm	2025	2025	2225	2225	2225
B	Width	mm	1150	1150	1250	1250	1240
H	Height	mm	2140	2325	2330	2595	2795
M	Weight	kg	3300	3800	4800	5300	6300



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings				
H	Height up to HV Bushing	mm	1222	1425	1452	1712	1900
$B_2$	Distance from axle to HV Bushing	mm	390	390	410	420	425
MO	Distance between Phase Bushings	mm	580	595	640	650	665
$H_3$	Height up to LV Bushing	mm	1765	1995	2045	2335	2525
$B_3$	Distance from axle to LV Bushing	mm	290	300	330	330	390
$B_{3H}$	От оси до нейтрали НН	mm	220	240	265	265	290
<b>Parameters of LV Connecting Buses</b>							
s	Bus Thickness	mm	10	12	15	15	20
$b_1$	Distance between bus holes	mm	50	60	60	70	70
$b_2$	Distance between bus edge and bus hole	mm	25	30	30	40	40
C	Bus Width	mm	100	120	120	150	150
d	Hole Diameter	mm	13	17	17	17	17
$N_{hot}$	Number of Holes	pcp	4	4	4	4	4
<b>Mounting and Transport Elements</b>							
K	Roller Width	mm	40	40	40	40	50
D	Roller Diameter	mm	125	125	125	125	160
$H_4$	Carriage Height	mm	160	160	160	160	205
$H_5$	Beam Height	mm	75	75	75	75	75
$Z_1$	Longitudinal Track	mm	820	820	1070	1070	1070
$Z_2$	Transverse Track	mm	820	820	1070	1070	1070
<b>Enclosure Dimensions</b>							
$L_1$	Length	mm	2000	2000	2200	2200	2200
$B_1$	Width	mm	1100	1100	1200	1205	1200
$H_1$	Height	mm	1802	2050	2052	2320	2482

## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 20kV

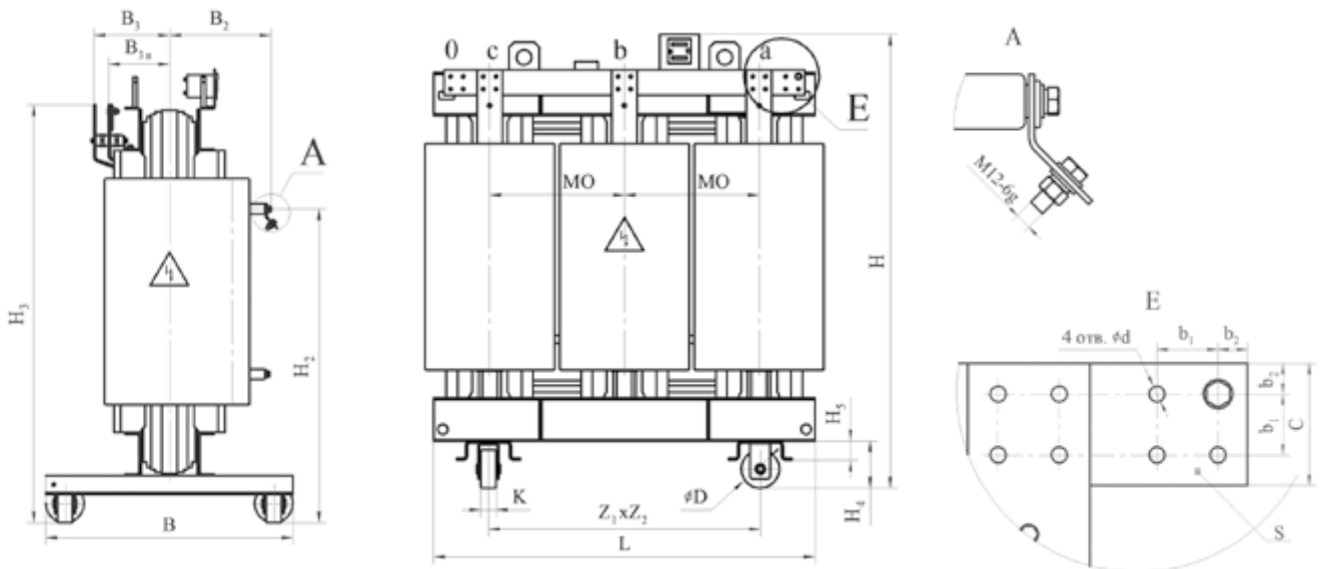
Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Rated Power, kVA		kVA	1000	1250	1600	2000	2500	3200
Parameter			Values					
$P_{NL}$	No Load Loss	W	2100	2600	3100	4350	5500	5800
$P_{SC75}$	Short Circuit Loss at 75°C	W	8650	11600	12500	15900	16750	23100
$P_{SC115}$	Short Circuit Loss at 115°C	W	9600	13100	14100	17900	18900	26000
$I_{NL}$	No Load Current	%	0,55	0,5	0,5	0,5	0,5	0,5
$U_{SC}$	Short Circuit Voltage	%	6	6	6	6	6	6
$L_{pA}$	Sound Pressure Level	dB	58	58	59	62	64	65

Me	Winding Material		Al	Al	Al	Al	Al	Al
			Overall Dimensions and Weight					
L	Length	mm	1725	1980	2045	2300	2500	2600
B	Width	mm	970	1190	1190	1500	1830	1830
H	Height	mm	1920	2010	2195	2430	2670	2800
M	Weight	kg	3000	3700	4400	5800	7800	8200



### Additional Dimensions (for reference)

Rated Power, kVA		kVA	1000	1250	1600	2000	2500	3200
Parameter			Mounting Dimensions of HV and LV Bushings					
$H_2$	Height up to HV Bushing	mm	1360	1440	1570	1550	1825	2040
$B_2$	Distance from axle to HV Bushing	mm	380	410	410	465	480	490
MO	Distance between Phase Bushings	mm	585	650	665	750	820	860
$H_3$	Height up to LV Bushing	mm	1820	1925	2140	2100	2610	2650
$B_3$	Distance from axle to LV Bushing	mm	300	345	350	420	460	470
$B_{3n}$	От оси до нейтрали НН	mm	240	265	270	335	370	380
			Parameters of LV Connecting Buses					
s	Bus Thickness	mm	10	10	12	15	20	20
$b_1$	Distance between bus holes	mm	50	50	60	60	70	70
$b_2$	Distance between bus edge and bus hole	mm	25	25	30	30	40	40
C	Bus Width	mm	100	100	120	120	150	150
d	Hole Diameter	mm	13	13	17	17	17	17
$N_{hot}$	Number of Holes	pcp	4	4	4	4	4	4
			Mounting and Transport Elements					
K	Roller Width	mm	50	50	50	70	70	70
D	Roller Diameter	mm	160	160	160	200	200	200
$H_4$	Carriage Height	mm	205	205	205	240	240	240
$H_5$	Beam Height	mm	75	75	75	90	90	90
$Z_1$	Longitudinal Track	mm	1070	1070	1070	1070	1300	1300
$Z_2$	Transverse Track	mm	820	1070	1070	1070	1300	1300



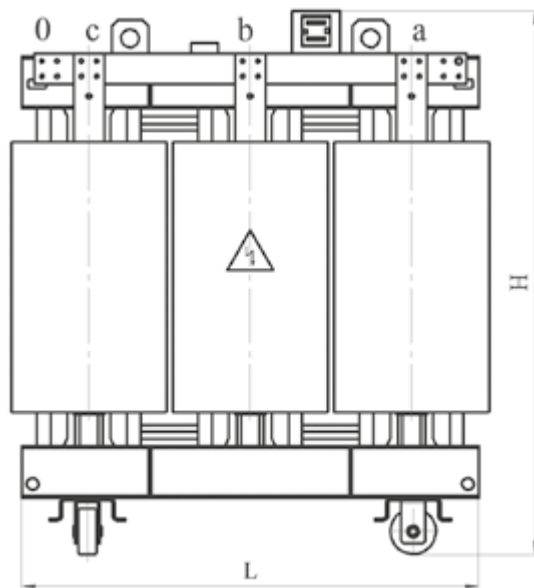
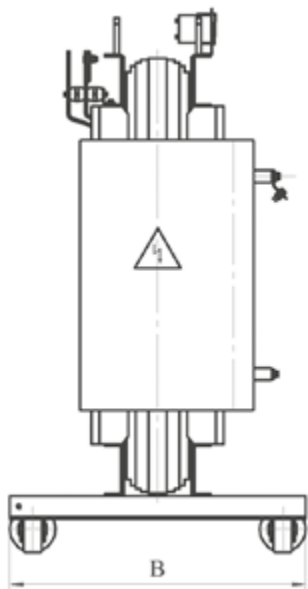
## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 35kV

Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Rated Power, kVA		kVA	16	40	63	100	250	400	630
Parameter			Values						
P <sub>NL</sub>	No Load Loss	W	400	435	650	750	1300	2000	2150
P <sub>SC75</sub>	Short Circuit Loss at 75°C	W	720	790	1050	1450	2600	3400	6400
P <sub>SC115</sub>	Short Circuit Loss at 115°C	W	800	800	1150	1600	2850	3800	7100
I <sub>NL</sub>	No Load Current	%	4,1	3,2	2,1	2	1,7	1,1	0,9
U <sub>SC</sub>	Short Circuit Voltage	%	4	4	4	4	4	4	6
L <sub>pA</sub>	Sound Pressure Level	dB	50	51	51	52	52	53	53
Me	Winding Material		Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al, Cu	Al	Al
Overall Dimensions and Weight									
L	Length	mm	1400	1400	1400	1480	1630	2090	1900
B	Width	mm	620	620	620	620	770	1100	1500
H	Height	mm	1365	1365	1515	1520	1635	2045	2045
M	Weight	kg	850	850	1050	1200	1850	3050	3150



## TECHNICAL DATA: CAST RESIN TRANSFORMERS, 35kV

Degree of Protection: IP00 (no enclosure)

LV Side: 0.4kV

Bushings Layout: standard busbars

Rated Power, kVA		kVA	1000	1250	1600	2000	2500	3200	
Parameter			Values						
P <sub>NL</sub>	No Load Loss	W	2850	3650	4100	4950	5500	6900	
P <sub>SC75</sub>	Short Circuit Loss at 75°C	W	7200	10000	11600	15000	16800	22100	
P <sub>SC115</sub>	Short Circuit Loss at 115°C	W	8000	11300	13000	16900	18900	25000	
I <sub>NL</sub>	No Load Current	%	0,7	0,5	0,5	0,5	0,5	0,5	
U <sub>SC</sub>	Short Circuit Voltage	%	6	6	6	6	6	6	
L <sub>pA</sub>	Sound Pressure Level	dB	54	55	55	58	60	64	
Me	Winding Material		Al	Al	Al	Al	Al	Al	
Габариты и масса трансформатора									
L	Length	mm	2230	2300	2350	2450	2460	2700	
B	Width	mm	1100	1320	1320	1830	1830	1680	
H	Height	mm	2170	2360	2650	2665	2675	2900	
M	Weight	kg	4050	5100	6100	6900	7800	9300	

Please tick the desired parameters or fill in the blanks

# Configuration Datasheet

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Company Name: \_\_\_\_\_  
TIN: \_\_\_\_\_  
Contact: \_\_\_\_\_  
Phone / Fax: \_\_\_\_\_  
Email: \_\_\_\_\_

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## CAST RESIN TRANSFORMERS DATASHEET

Type: \_\_\_\_\_

Rated Power, kVA: ..... 16 25 40 63 100 160 250 400 630 800 1000 1250 1600 2000 2500 3200 4000 6300 10000 12500 16000 25000

Voltage U1 (grid), kV: ..... 0,23 0,4 0,69 3,15 6 6,3 10 10,5 20 35 (Primary Voltage, U<sub>1</sub>)

Voltage U2 (load), kV: ..... 0,23 0,4 0,69 3,15 6 6,3 10 10,5 (Secondary Voltage, U<sub>2</sub>)

SC Voltage / %: ..... 4 6 8 (Short Circuit Voltage, Impedance; U<sub>k</sub>, E<sub>k</sub>)

Vector Group ..... Dyn11 Dyn0 (Connection Group)

Tap Change: ..... NLTC ±2x2.5% OLTC ±4x2,5 (Mode and depth of voltage control)

Altitude, m : ..... Less than 1,000m (Installation Height Above the Sea Level)

**Climate Class**

- 60 °C to + 45 °C
- 50 °C to + 45 °C
- 60 °C to + 45 °C
- 10 °C to + 50 °C

**Location**

- 1 Outdoors
- 2 Under roof
- 3 Indoors

**Degree of Protection**

- IP33 Protection Enclosure, Outdoors Application
- IP54 Outdoors, Dustproof
- IP00 No Enclosure, Standard Busbars
- IP21 Protection Enclosure
- IP31 Protection Enclosure

**Bushing Connection**

- Busbar:  HV  LV  
Cable:  HV  LV

**Bushing Layout:**

- HV - on the left  
LV - on the right
- LV - on the left  
HV - on the right
- HV, LV - on the top
- HV, LV - on the bottom
- \_\_\_\_\_

**Winding Material:**

- Aluminum, Al
- Copper, Cu

**Loss Level:**

No Load Loss, W (max): \_\_\_\_\_  
Short Circuit Loss, W (max): \_\_\_\_\_

*Mandatory parameter for negotiating Energy Efficient Transformer*

**Packing Material:**

- Stretch Wrap
- Wooden Box

**Optional Components:**

- Thermal Control Units
- Thermal Protection Cabinet
- Optional Fan Set
- Anti-vibration Pads

**Structural Features:**

- Magnet Core stacked by STEP-LAP technique
- Cast Resin Insulation of HV Windings
- Hot Dip Galvanizing of Yoke Beams

*\* HV - higher voltage; LV - lower voltage*

**Phases (left to right):**

- HV Bushings:  A - B - C (standard)  C - B - A (mirror)
- LV Bushings:  c - b - a - 0 (standard)  0 - a - b - c (mirror)

Number of Transformers: \_\_\_\_\_ Delivery Date: \_\_\_\_\_

**Additional Requirements regarding operation or components:**

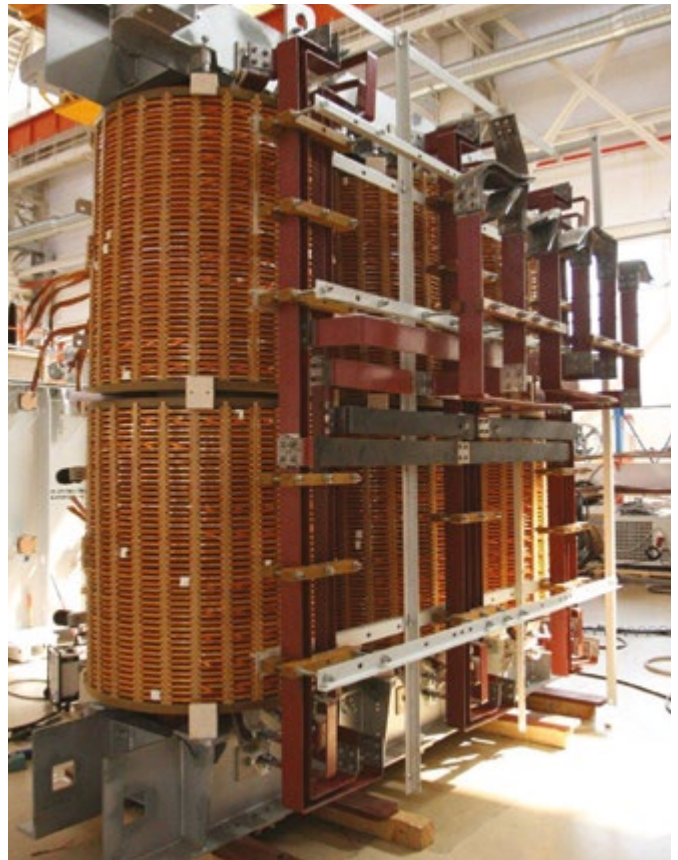
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# RECTIFIER TRANSFORMERS

Rectifying and converter equipment is to rectify AC to DC, invert DC to AC, convert frequency, number of phases, and DC voltage. AC rectifying is particularly widely used as a significant part of the generated electricity is consumed in DC electrical units, for instance, in ferrous and non-ferrous metal processing industry (rolling production), public transport, railway transport, drilling rigs, etc.

Being a part of a rectifier unit, transformers are designated to variate and harmonize output voltage of the rectifier. Using a transformer, DC network can be isolated from AC network, and number of phases of valve-side windings is increased, in order to reduce the ripple of the rectified current, and improve waveform of line current.



SVEL-RosEnergTrans offers transformers with the following vector groups:

- Three Phase Transformer: Yy0, Dy11, Yd5, Yd11, Dd0
- Split Winding Transformer: Dd0y11, Yd11y0, Yd11d11, Dy11y11
- Transformer with connection group: Dauto11
- Transformer with current balancing reactor: Yy0y6
- Transformer with high-legged delta connection

SVEL-RosEnergTrans offers all types of dry rectifiers designed for:

- Excitation System of Turbine and Hydro Electrical Generators
- Power supply for Drilling Rig Electric Drives
- Power supply for Semiconductor Converters of Public Electric Transport Substation (Tram, Trolleybus, Metro)
- Rectifier Units, Electric Units within the system of Railways Traction Power Supply
- Power supply for DC Drives
- Power supply for AC Drives
- Power supply for Solar and Wind Generation.

Each Rectifier Transformer is a unique item of design engineering, customized to meet the requirements of a specific client, taking into account overload schedule, harmonics composition and rectifying parameters. SVEL-RosEnergTrans delivers customer tailored transformers that meet the most specific demands.

All transformers are manufactured as per the requirements of GOST 16772-77, and customer specification.



### Application of Rectifier Transformer

Scope of Application	Rectified Voltage Ud, V	Rectified Current Id, A	Standard Capacity of Transformer, kVA	Line Voltage, kV
Electric Railway Transport	3300; 3700	1250; 1600; 3200	630-2000	6; 10; 35
Electric Urban Transport	600; 825	800; 1250; 1600; 2000; 2500	630-4000	6; 10
Electric Industrial Transport and Local Facility Material Handling	230; 600; 1650	500; 1000; 1600; 2000; 2500; 3200 4000	400-6300	6; 10; 35
Electric Plating Machines, Electrochemical Material Processing Units	12; 24; (36)	100; 320; 400; 630; 1000; 1600; 3200; 6300	25-4000	0,38; 6; 10; 35
DC Drives	115; 230; (345) 460; 660; 825; 1050	25; 50; 100; 200; 320; 400; 500; 630; 800; 1000; 1250; 1600; 2000; 2500; 4000; 5000; 6300; 8000	25-12500	0,38; 6; 10; 35
AC Drives:				
• DC Link Frequency Converters at HV Systems	4000; 8000	500; 800; 1000 1250; 1600; 2000	5000-12500	6; 10; 35
• Directly Coupled Frequency Converters	75; 115; 160; 230; 460; 605; 1200	1300; 2000; 3200; 4000	400-2500	6; 10
Static Excitation of Synchronized Machines	220-1730	20-6300	25-6300	0,38; 3; 6; 10; 13,8; 15,75; 20; 24; (35)

# RECTIFIER TRANSFORMERS

## Overload Modes

Load Mode	Output Current, % of rated value	Duration	Cycling	Note
1	100	Continuous	-	-
2	100	Continuous	-	Cycling is specified by standards and specifications on transformers and reactors depending on their groups and types.
	150	1 min		
3	100	Continuous	-	Overloads are cyclic by nature; within this cycle (overload&interval), Current (r.m.s. value) shall not exceed the rated value within the averaging time of less than 10 min.
	150	2 min		
	175	1 min		
	200	15 sec		
	250	10 sec		
4	100	Continuous	-	-
	125	2 hours	Twice a Day	Current (r.m.s. value) within any 8 hours of the day shall not exceed the rated current.
	225	10 sec	75 sec every 2 hours	Current (r.m.s. value) within 75 sec shall not exceed 125% of the rated value.
	350	5 sec	Twice a Day	
5	100	Continuous	-	-
	125	2 hours	Twice a Day	Current (r.m.s. value) within any 8 hours of the day shall not exceed the rated current.
	150	5 min	Once every 30 min	Current (r.m.s. value) within any 30 min shall not exceed the rated current, and if 100% overload occurs within those 30 min, the averaging time shall be 5 min.
	200	1 min		
6	100	Continuous	-	-
	125	15 min	Once every 30 min	Current (r.m.s. value) within any 30 min shall not exceed the rated current.
	150	5 min		
	175	2 min		
	200	1 min		

## Overload Modes

Load Mode	Output Current, % of rated value	Duration	Cycling	Note
7	100	Continuous	Once or Twice a Day	Operation with Superexcitation.
	200	50 sec.		
8	100	Continuous	-	Cycling is specified by standards and specifications on transformers and reactors depending on their groups and types.
	150	2 min.		
	200	10 sec.		
9	100	Continuous	-	Cycling is specified by standards and specifications on transformers and reactors depending on their groups and types.
	125	2 hours		
	200	10 sec.		
10	100	Continuous	-	Cycling is specified by standards and specifications on transformers and reactors depending on their groups and types.
	150	2 hours		
	200	1 min.		
11	100	Continuous	-	Cycling is specified by standards and specifications on transformers and reactors depending on their groups and types.
	150	2 hours		
	300	1 min.		

Detailed performance of SVEL Rectifier Transformer are not included into this booklet. As a rule, client requests are specific calling for individual engineering and design solutions.

In order to ensure compliance of the purchased Rectifier Transformer with loads of the corresponding conversion equipment, it is essential to consider all specific features of rectifying loads.

SVEL Specialists would be happy to assist or consult on any issue at the stage of considering the specific requirements to the equipment with due regard to operation features of rectifying units.

Please tick the desired parameters or fill in the blanks

# Configuration Datasheet

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Contact: \_\_\_\_\_  
Phone / Fax: \_\_\_\_\_  
Email: \_\_\_\_\_

Cut here. To attach this Configuration Datasheet into the Project please cut it off.

## RECTIFIER TRANSFORMERS DATASHEET

Type: \_\_\_\_\_

Rated Power, kVA: ..... 25 40 63 100 160 250 400 630 800 1000 1250 1600 2000 2500 3200 4000 6300 10000 12500 16000 20000

Voltage U1 (grid), kV: ..... 0,4 0,69 3,15 6 6,3 10 10,5 13,8 15,75 20 35 (Primary Voltage, U<sub>1</sub>)

Voltage U2 (load), kV: ..... 0,4 0,69 3,15 6 6,3 10 10,5 (Secondary Voltage, U<sub>2</sub>)

SC Voltage / %: ..... 4 6 8 (Short Circuit Voltage, Impedance; U<sub>k</sub>, E<sub>k</sub>)

Vector Group: ..... Dyn11 Dyn0 Yd11y0 (Connection Group)

Tap Change: ..... NLTC ±2x2,5% OLTC ±4x2,5 (Mode and depth of voltage control)

Altitude, m : ..... Less than 1,000m (Installation Height Above the Sea Level)

Designation \_\_\_\_\_ Pulse Number of Rectification Circuit (6, 12, 24) \_\_\_\_\_

Rectified Voltage U<sub>d</sub>, V (Characteristics of Rectifier. Critical for accurate evaluation of transformer parameters)

Rectified Current I<sub>d</sub>, V (Characteristics of Rectifier. Critical for accurate evaluation of transformer parameters)

Overload Class, as per GOST 16772 (Overload Class depends on load type and mode)

Harmonics Content, %:  
5<sup>th</sup> \_\_\_\_\_ 23<sup>th</sup> \_\_\_\_\_  
7<sup>th</sup> \_\_\_\_\_ 25<sup>th</sup> \_\_\_\_\_  
11<sup>th</sup> \_\_\_\_\_ 47<sup>th</sup> \_\_\_\_\_  
13<sup>th</sup> \_\_\_\_\_ 49<sup>th</sup> \_\_\_\_\_

**Climate Class:**  
 - 60 °C to + 45 °C  
 - 50 °C to + 45 °C  
 - 60 °C to + 45 °C  
 - 10 °C to + 50 °C

**Location:**  
 1 Outdoors  
 2 Under roof  
 3 Indoors

**Degree of Protection :**  
 IP33 Protection Enclosure, Outdoors Application  
 IP54 Outdoors, Dustproof  
 IP00 No Enclosure, Standard Busbars  
 IP21 Protection Enclosure  
 IP31 Protection Enclosure

**Bushing Layout:**

PW – on the left  
 VW – on the right

VW – on the left  
 PW – on the right

PW, VW – on the top

PW, VW– on the bottom

\_\_\_\_\_

**Winding Material:**  
 Aluminum, Al  
 Copper, Cu

**Packing Material:**  
 Stretch Wrap  
 Wooden Box

**Bushing Connection:**  
 Busbar:  PW  VW  
 Cable:  PW  VW

**Optional Components:**  
 Thermal Control Units  
 Thermal Protection Cabinet  
 Optional Fan Set  
 Anti-vibration Pads

**Structural Features:**  
 Magnet Core stacked by STEP-LAP technique  
 Cast Resin Insulation of PW Windings  
 Hot Dip Galvanizing of Yoke Beams

\* PW - Power Winding; VW - Valve Winding

**Phases (left to right):**

PW Bushings: ..... VW Bushings:

A - B - C (standard)  c - b - a - 0 (standard)

\_\_\_\_\_  \_\_\_\_\_

Number of Transformers: \_\_\_\_\_ Delivery Date: \_\_\_\_\_

**Additional Requirements regarding operation or components:**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_



# SVEL CAST RESIN TRANSFORMERS IN VARIOUS INDUSTRIES



## POWER GENERATION

- Rosseti
- Rosatom, State Atomic Energy Corporation
- Thermogas Mashala, Ecuador
- Celec, Ecuador
- Kudankulam, India
- Nuclear Power Corporation of India Limited
- Avelar Solar Technology Company
- Inter RAO
- RUSHYDRO
- ENEL Russian
- Unipro
- Fortum
- T Plus
- Samruk Energy
- KEGOC Kazakhstan, Power Grid Management, Telasi

## TRANSPORT

- Russian Railways
- Uzbekistan Railways
- Novorossiysk Commercial Port
- Vanino Commercial Port
- Ust Luga Commercial Port
- Belarusian Railway



## CONSTRUCTION INDUSTRY

- ENKA, Turkey
- Krasnaya Polyana, Gornaya Karussel, Sports and Tourist Center
- URALMASH Sport Complex
- Grinovich, Shopping Mall
- Ekaterinburg EXPO, International Exhibition Center
- Kemerovo State Philharmonic Hall
- The State Hermitage Museum
- Astana Marriott Hotel EXPO-2017, Astana
- Innopolis, New High Tec City
- MEGA, Shopping Mall





## OIL&GAS INDUSTRY

The Linde Group, Germany

Gazprom

Rosneft

Tatneft

Transneft

LUKOIL

Bashneft



## MANUFACTURING INDUSTRY

AvtoVAZ

SIBUR Holding

Alrosa

Arkhangelsk Pulp and Paper Mill

Ilim Group

Kazphosphate

Uralkali

PHOSAGRO

Mechel

Belaruskali

Naftan

## METAL PROCESSING INDUSTRY

NLMK Group

Magnitogorsk Metallurgy Plant (MMK)

Novolipetsk Metal Processing Plant

Mariupol Metal Processing Plant (Metinvest Holding)

EVRAZ Holding

TMK

Severstal

RUSAL

Kazchrome

Arcelormittal

Chelyabinsk Pipe Plant

Russian Copper Company



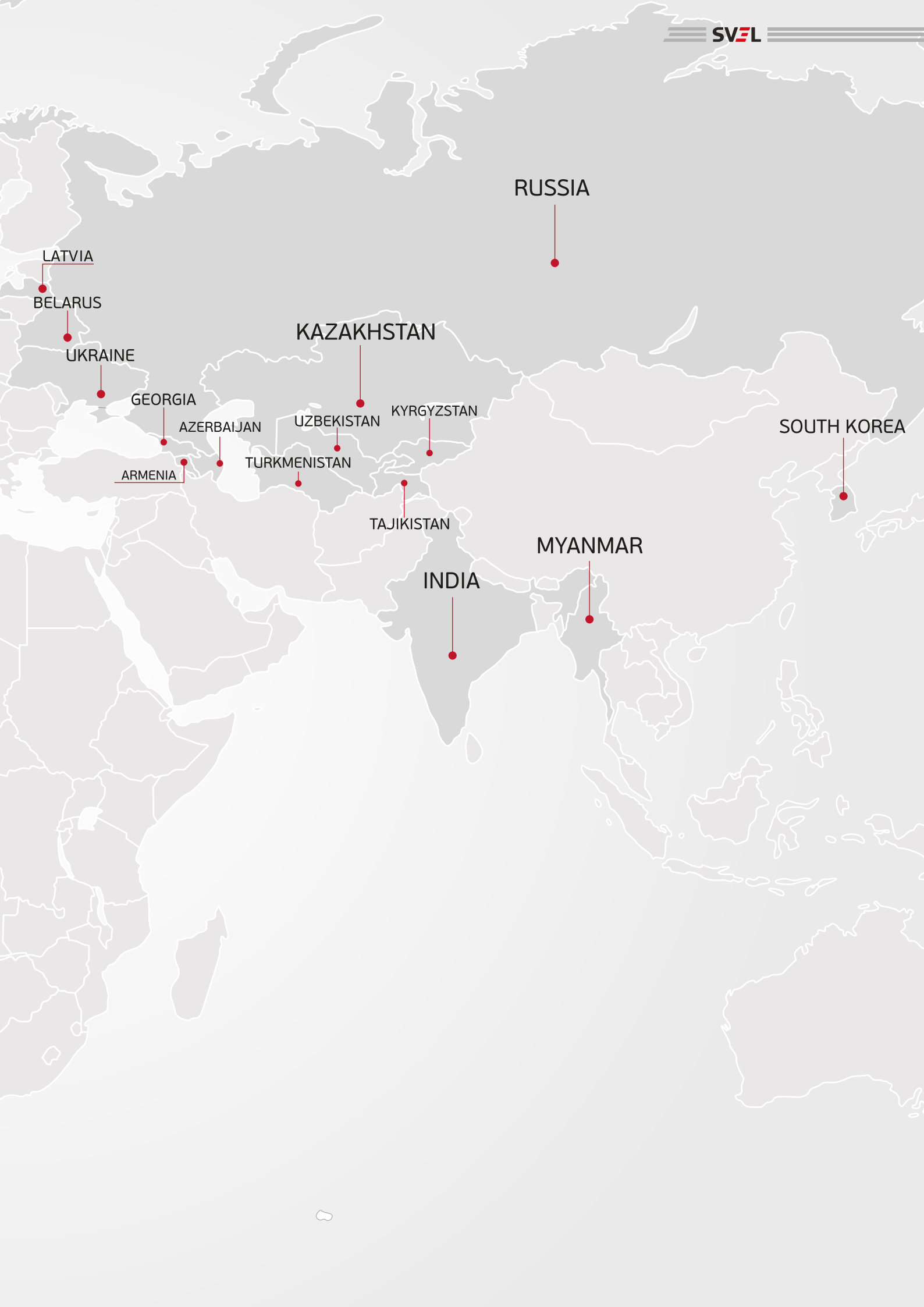
# SALES GEOGRAPHY

NORWAY

CUBA

ECUADOR





LATVIA

BELARUS

UKRAINE

GEORGIA

ARMENIA

AZERBAIJAN

TURKMENISTAN

KAZAKHSTAN

UZBEKISTAN

KYRGYZSTAN

TAJIKISTAN

INDIA

MYANMAR

RUSSIA

SOUTH KOREA

# HISTORY OF OUR SUCCESS

- 2003** Start of commercial operation. SVEL-RosEnergTrans starts manufacturing Cast Resin Transformers. The company engages high skilled and experienced specialists and employees in the area of transformer industry.

**2012** For the first time in Russia, Cast Resin Transformer with OLTC is designed and manufactured for EES, Federal Grid Company.
- 2004** Product range is broadened by developing various models of bushing layout and enclosure types.

**2013** First in Russia Cast Resin Transformer with the Magnet Core made of Amorphous Steel, rated power 250kVA, manufactured basing on SVEL R&D. SVEL-RosEnergTrans' Test Laboratory is accredited in the United National Accreditation System.
- 2005** Cast Resin Rectifier Transformer 3,200kVA/6kV, for moderately cold climate, is designed and manufactured (able to run up to -60°C).

**2014** Transformer 25kVA to 63kVA is upgraded to ensure full compatibility if integrated into power cells of various manufacturers. General Performance of new models is improved.
- 2006** Power Transformer with Copper Winding adds to the product line.

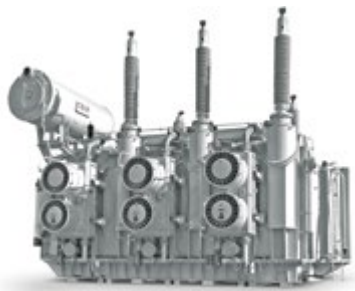
**2015** Another Siberian representative office opens in Irkutsk. SVEL Dry Transformers are awarded with the Golden Certificate of compliance with International Electrotechnical Commission standard IEC 60076-11, upon the results of Audit and Testing by KEMA Laboratories, The Netherlands. R&D on Cast Resin Transformer with the Rated Voltage 110kV for Federal Grids. SVEL is now ready to manufacture Cast Resin Transformers with Rated Power up to 25MVA, Voltage Class up to 35kV.
- 2007** Quality Management System (QMS) is certified as per ISO 9001:2000, confirmed by the Certificate of Compliance issued by BSI Group (who pioneered the development of management systems standards). More products are added to the product range of Rectifier Transformer.

**2016** Production of Transformers for renewable energy (solar power plants, wind turbines) is established with due regard to the specifics of this industry. Cooperation with the leading renewable energy fabricators is initiated. SVEL Group is successfully accredited in-house Test Center united all test laboratories at all sites. SVEL Test Center is capable to conduct almost the whole range of testing on the manufactured equipment.
- 2008** Nationwide expansion. SVEL opens representative offices in Moscow, St. Petersburg, Krasnoyarsk, Krasnodar, and Kiev. SVEL Group is established bringing together two sites: SVEL-RosEnergTrans and SVEL – Power Transformers.

**2017** Today, over 10,000 of SVEL Cast Resin Transformers successfully run at our clients' sites. The experience generated in the course of equipment production and operation allows improving our product and offer the most advanced solutions addressing all modern requirements of power industry.
- 2009** Cast Resin Transformer 12,500kVA/10.5kV for Russian Railways Company designed and manufactured. Product range is broadened by Heavy Duty Cast Resin Transformers (up to 16MVA).

**2018** Promotion of SVEL Transformers to foreign markets, mainly, European and Middle East, initiated.
- 2010** New representative offices open in Astana, Kazan and Novosibirsk. Cast Resin Transformer, Voltage Class up to 35kV added to the product line. Design and development of power equipment for NPP is licensed. Since then, SVEL Group became a reliable partner of State Corporation Rosatom in terms of design and delivery transformer equipment to Rosatom's sites.
- 2011** One more representative office opens in Khabarovsk. Transformers for various climate areas and environment conditions added to the product line that allow selling SVEL products abroad.

# OTHER SVEL PRODUCTS



**OIL TRANSFORMERS**



**REACTORS**



**INSTRUMENT TRANSFORMERS**



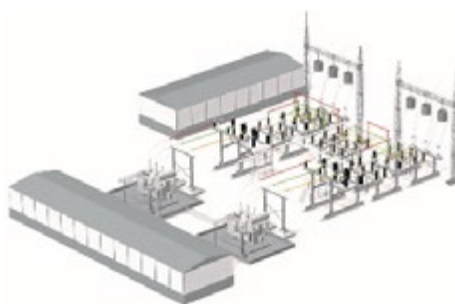
**PACKAGED SWITCHGEARS**



**PACKAGED SUBSTATIONS**



**HV EQUIPMENT**



**LV PACKAGED SWITCHBOARDS**

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[youtube.com/user/SVELcorporate](https://youtube.com/user/SVELcorporate)





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