

POWER VOLTAGE TRANSFORMERS SSVT

- _ UTP Series
- _ UG Series
- _ UTY Series



Power Voltage Transformers (PVT) also known as Station Service Voltage Transformers (SSVT) are used to supply Low Voltage power directly from a High Voltage line up to 550 kV. Located within the own substation they can provide power up to 333 kVA per phase in a reliable and cost-effective way. They offer a wide range of applications, but they excel when substation auxiliary service power supply is needed in remote areas, making them an ideal solution for Renewable Energy substations.

PVTs were firstly used in North America decades ago. Due to the nature of the electrical network, SSVTs were intended to cover the auxiliary power supply needs in switching substations where neither a Power Transformer or a distribution line were available. Since then, the power output capabilities and the applications have expanded dramatically mainly for Renewable Energies.

PVTs design is close to an inductive voltage transformer to satisfy the dielectric requirement, coupled to a larger core similar to that used in distribution transformers. Using advanced materials and design, a fully rated compact dielectric design is developed. Such design is very akin between all kinds of PVTs despite there are different characteristics between them. PVTs are developed in both the oil and SF₆ insulated format, with a direct phase to ground connection and galvanic insulation between primary and secondary windings, which are coiled over the same magnetic core with independent insulation.

Low losses with impedance protection to limit fault currents.

APPLICATIONS

Power Voltage Transformers can be used within any high voltage substation as a low voltage power source to supply the substation auxiliary services (control and protection equipment, air-con, lightning, security systems, etc.). For this application, regulations require two or three reliable and independent sources. PVT is also exclusive and dedicated auxiliary service power source that ensure the reliability of the substation and compliance with the regulations. It can be used as a primary or back-up source.

These are some of the cases where PVTs can be used within substations:

- › **Power supply for switching stations.** Switching substations are used to connect several transmission lines. The difference with usual step-up or step-down substations is that there is not any power transformer, and therefore, auxiliary service power supply cannot be obtained from the power transformer tertiary winding. Moreover, these substations are mostly located in remote areas, so distribution lines are not usually present nearby. The alternative options to PVTs are a new dedicated MV line (high construction and maintenance costs and unreliable) or a Diesel generator (Fuel cost, maintenance, CO₂ emissions).
- › **Power Supply for Renewable Energy Substations.** High Voltage substations are needed to connect renewable energy generation plants such as wind or solar farms, to the main transmission network. These power plants are usually located in isolated areas, so a brand-new infrastructure is often needed (substation,

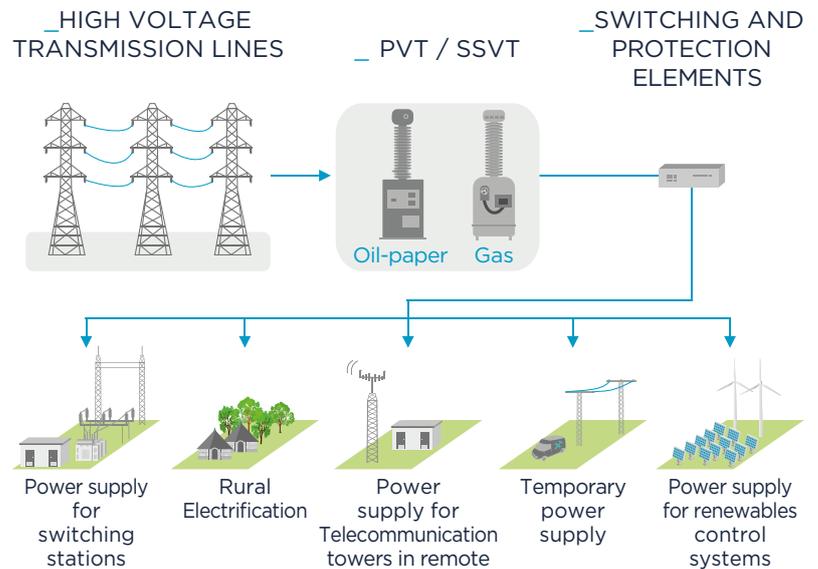
transmission lines, and the like). Depending on the size, location and climate conditions, the LV power needs range between 100-500 kVA. A transmission line connecting this substation to the main transmission system is therefore needed with a typical voltage ranging from 115 to 500 kV. PVTs are located within the HV switchyard, and they can be connected in the busbars or at the entrance of the line, depending on the overall substation design.

- › **Power supply for Conventional Substation Auxiliary services.** Unlike in the switching stations, there are usually distribution lines and/or medium voltage switchyards available within the substation, so the PVT can be used as a backup source.

Out of substations, PVTs can also be used as a LV power source. There are situations where there are not distribution networks in the area and power could be obtained directly from the HV line. Some of these applications are listed below:

- › **Rural Electrification.** PVTs can act as a power source for supplying reliable power to small communities where there are no distribution lines nearby, but there are transmission lines. This application supplies low voltage power directly from HV line in an economical and practical way. With a single instrument transformer, up to 333 kVA can be taken directly from a 245 kV line and hundreds of households can get a cheap and reliable access to electricity. It is estimated that the costs saving compared to the traditional substation range between 60 to 80%.

- > **Power supply for Telecommunication towers in remote areas.** Wide cellphone reception coverage is a demand for telecom companies. Due the relatively short range of each cellphone tower, there is a need to locate many of them in remote locations in order to provide cellphone network coverage to the users (i.e. while traveling along a freeway). Having a nearby transmission line, a PVT can provide the power needed to power up these towers in a reliable and economic way.
- > **Temporary power supply for under construction substations.** Due to the quick erection and location flexibility, the PVT can be used to get electric supply during the construction and then transferred to another location.
- > **Mining, oil & gas pumping stations.** These locations are usually far from electrical distribution networks, so the PVT can supply power from the transmission line already built to supply power to the site.
- > **Railway substations.**
- > **Lighting of towers.**
- > **Voltage elevator** for High voltage electrical test laboratories, and small wind and solar farms.



ADVANTAGES

The conventional solutions used for auxiliary services power supply are a dedicated medium voltage line, diesel generators or the power transformer tertiary winding. ARTECHE'S power voltage transformer has the following advantages:

- › **Reliable power supply:** Since the PVTs are connected in the high voltage switchyard of the substation, there will be power available as long as the line is energized. Since this line is connected to the main transmission system, the power availability is guaranteed.
- › **Maintenance-free** and long-life design.
- › **Quick commissioning:** Delivery time from the factory is similar to the rest of the HV switchyard equipment (circuit breakers, instrument transformers, disconnecting switches or surge arrestors), and the commissioning of the equipment is relatively simple, similar to that of instrument transformers. In addition, it can already supply during construction, if the HV line is already energized.
- › **Reduced environmental impact:** PVTs are part of the HV switchyard, so other than that they do not represent any additional environmental impact. This is particularly remarkable when they are part of a renewable energy project. The units are hermetically sealed avoiding insulation fluid leakages to the environment.
- › **Cost effective:** Compared to the other alternatives PVTs are in many cases a cost-effective solution. Installation costs are generally lower, and the life cost is definitely lower, as there is no need to pay for the energy to 3rd parties.
- › **Robust design.** Based on instrument transformers and tested according the same standards to guarantee the same high reliability as any inductive voltage instrument transformer.

- › **Independent** auxiliary services supply. The user does not have to rely on third parties, such as distribution utilities, fuel suppliers, etc.
- › **Safety and freedom** for power transformer. Power transformer is the core of the substations and LV applications are usually less reliable, therefore there is less operation risks if the tertiary winding is not used for auxiliary services. In addition, if there is already a tertiary winding it can be used for other applications.
- › **Social benefit:** Rural isolated area electrification, emergency supply after natural disasters...
- › **Design flexibility:** Different secondary voltages available. Independent secondary windings. 3-phase/single phase secondary systems using 3, 2 or 1 PVT.
- › **Self-contained** and exclusive power source directly from the transmission line.
- › **High seismic** performance.
- › **Line Discharge:** PVTs can also be used for line discharge, this can be of interest if they are located at the line entrance in the substation.

COMPARISON BETWEEN PVTs AND CONVENTIONAL SOLUTIONS TO SUPPLY AUXILIARY POWER

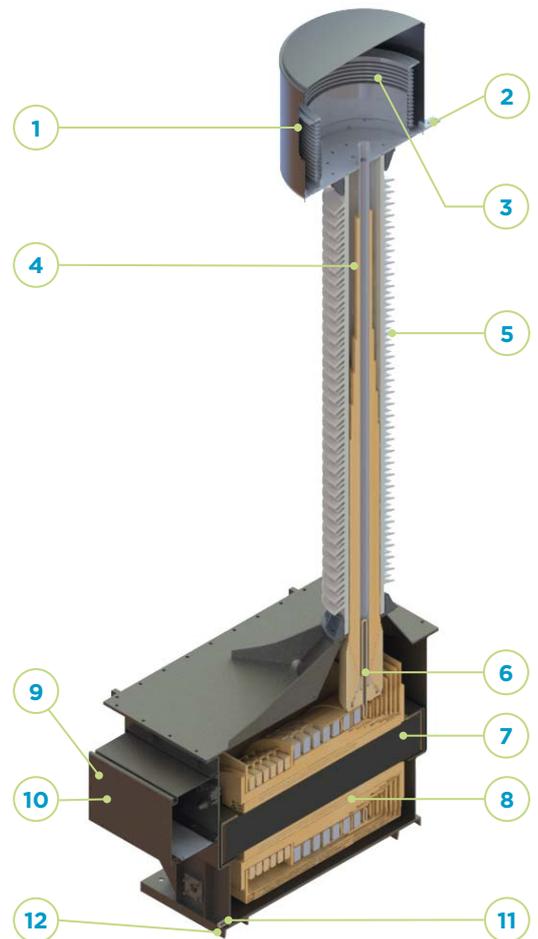
	Initial Cost	Life cost	Reliability	Maintenance	Environmental impact	Commissioning time	Independence
PVT	oo	-	ooo	-	-	o	ooo
Distribution Line + Distr. Transformer	ooo	o	oo	o	oo	ooo	o
Diesel Generator	o	ooo	oo	oo	ooo	o	o
PT Tertiary	oo	-	ooo	o	-	oo	ooo

UTP SERIES

Oil-paper insulation:
model UTP up to 362 kV
and 333 kVA.



1. Oil level indicator
2. Primary terminal
3. Oil volume compensating system
4. Capacitive bushing
5. Insulator
6. Primary winding
7. Core
8. Secondary windings
9. Secondary terminals
10. Secondary terminal box
11. Oil sampling valve
12. Grounding terminal



DESIGN AND MANUFACTURING

PVTs with oil-paper insulation are made with a magnetic core inside a metallic tank with its primary and secondary windings around it. The primary conductor is enclosed by a capacitive bushing consisting of shields and layers of insulating paper filled with oil. There is an oil compensating system that effectively regulates changes in oil volume mainly caused by temperature. The oil can be analyzed through an oil sampling valve located on the tank.

OPTIONS:

- › Porcelain or silicone rubber insulator.
- › Terminal for main insulation monitoring (tangent δ measurement).
- › Inner temperature monitoring sensor.
- › Over-pressure relief valve with connection capability to SCADA system.
- › Additional secondaries for measuring and/or protection.
- › Taps for voltage regulation.

RANGE

This series is named with the letters UTP followed by 3 numbers indicating the maximum service voltage for which they have been designed.

The table shows the range currently manufactured by ARTECHE. These characteristics are merely indicative. ARTECHE can manufacture these transformers to comply with any domestic or international standard.

Oil-paper insulation > Model UTP

Model	Highest Voltage (kV)	Rated insulation level			Max. Power Output per phase (KVA)	Standard creepage distance (mm)
		Power frequency (kV)	Lightning impulse (BIL) (kVp)	Switching impulse (kVp)		
UTP-123	123	230	550	-	100	4525
UTP-145	145	275	650	-	100	4525
UTP-170	170	325	750	-	100	5285
UTP-245	245	395	900	-	333	6125
		460	1050			
UTP-362	362	510	1175	950	167	9050
		575	1300			

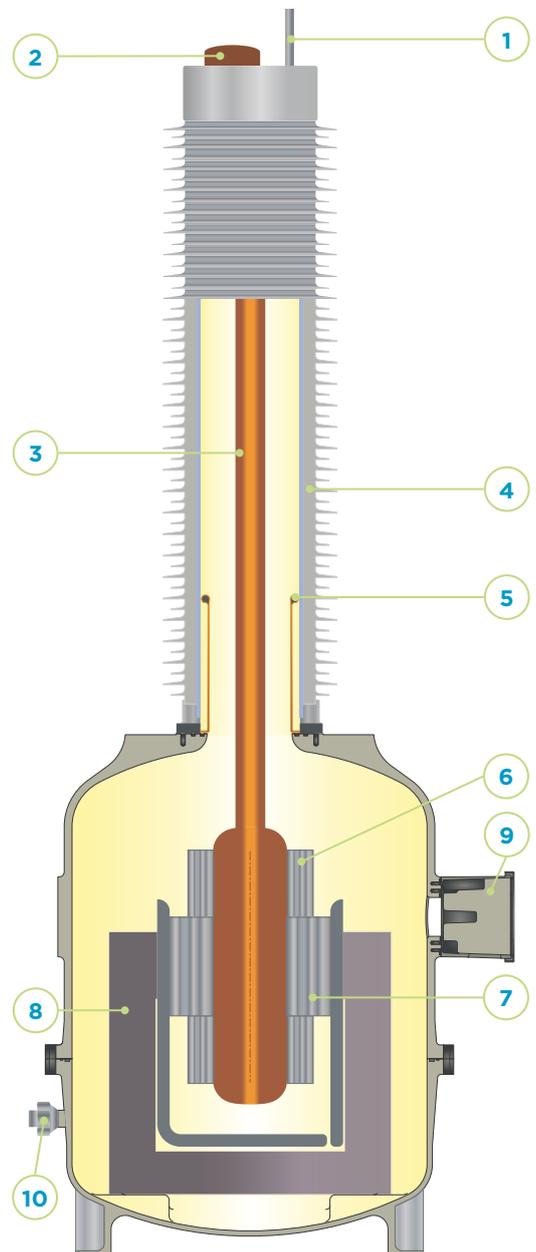


UG SERIES

Gas insulation:
model UG up to 550 kV and
125 kVA.



1. Primary terminal
2. Pressure relief device
3. HV Electrode
4. Insulator
5. LV Electrode
6. Primary windings
7. Secondary windings
8. Core
9. Secondary terminal box
10. Gas filling valve



DESIGN AND MANUFACTURING

PVTs with gas insulation are made with a magnetic core inside a metallic tank with its primary and secondary windings around it. These windings are made of heat-resisting electric wires coated in synthetic resin and a layer of plastic with a high dielectric resistance and excellent thermal and mechanical performance. The SF₆ and this plastic layer form the electrical insulation. An input valve for SF₆ gas is provided on a side of tank together with a manometer for monitoring gas pressure.

The silicone rubber insulator guarantees safety during transportation and service.

The transformer is equipped with temperature compensated densimeter with two levels of alarm that can be wired to the control equipment for remote monitoring. In case of a working pressure drop, the PVT can still withstand rated voltage with internal atmospheric gas pressure.

Safe design, Internal arc class II as per IEC 61869, thanks to:

- › Active parts located inside metallic tank, separated from the insulator.
- › Pressure relief device located on the upper part.
- › Electrical connections resistant to short circuit.

Designed to minimize gas volume, pressure and leaks, with a leakage rate <0.5%/year (lower values available upon request), thus reducing its environmental impact.

Tanks and insulators are designed, manufactured and tested according to international pressure vessel standards.

OPTIONS:

- › Inner temperature monitoring sensor.
- › Actual pressure value monitoring signal.
- › Additional secondaries for measuring and/or protection.

RANGE

This series is named with the letters UG followed by 2 or 3 numbers indicating the maximum service voltage for which they have been designed.

The table shows the range currently manufactured by ARTECHE. These characteristics are merely indicative. ARTECHE can manufacture these transformers to comply with any domestic or international standard.

Gas insulation > Model UG						
Model	Highest Voltage (kV)	Rated insulation level			Max. Power Output per phase (KVA)	Standard creepage distance (mm)
		Power frequency (kV)	Lightning impulse (BIL) (kVp)	Switching Impulse (kVp)		
UG-72	72.5	140	325	-	75	1800
UG-145	123	230	550	-	125	3125
	145	275	650	-	125	3625
	170	325	750	-	125	4230
UG-245	245	460	1050	-	125	6125
	300	460	1050	850	125	7350
UG-420	362	510	1175	950	125	9050
	420	630	1425	1050	125	10300
UG-550	550	680	1550	1175	125	13750

For detailed values please consult with Arteche.
For higher rated power values consult with Arteche.

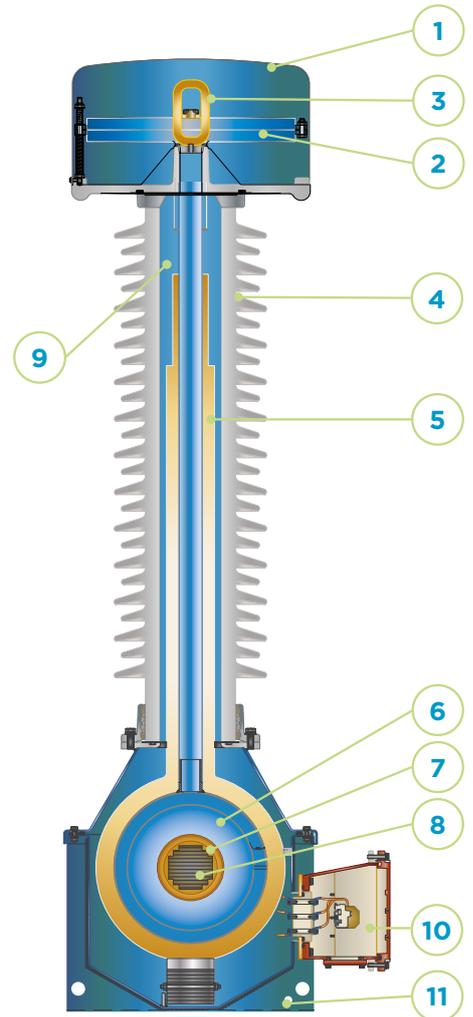


UTY SERIES

Oil-paper insulation:
model UTY up to 245 kV
and 16 kVA.



1. Top cover
2. Oil volume compensating system
3. Oil level indicator
4. Insulator
5. Capacitive bushing
6. Primary windings
7. Secondary windings
8. Core
9. Insulating oil
10. Secondary terminal box
11. Grounding terminal



DESIGN AND MANUFACTURING

PVTs with oil-paper insulation are made with a magnetic core inside a metallic tank with its primary and secondary windings around it. The primary conductor is enclosed by a capacitive bushing consisting of shields and layers of insulating paper filled with oil. There is an oil compensating system that effectively regulates changes in oil volume mainly caused by temperature. The oil can be analyzed through an oil sampling valve located on the tank.

OPTIONS:

- › Porcelain or silicone rubber insulator.
- › Terminal for main insulation monitoring (tangent δ measurement).

RANGE

This series is named with the letters UTY followed by 2 or 3 numbers indicating the maximum service voltage for which they have been designed.

The table shows the range currently manufactured by ARTECHE. These characteristics are merely indicative. ARTECHE can manufacture these transformers to comply with any domestic or international standard.

Oil-paper insulation > Model UTY

Model	Highest Voltage (kV)	Rated insulation level			Max. Power Output per phase (KVA)	Standard creepage distance (mm)
		Power frequency (kV)	Lightning impulse (BIL) (kVp)	Switching impulse (kVp)		
UTY-72	72.5	140	325	-	10	1825
UTY-145	145	275	650	-	16	3625
UTY-245	245	460	1050	-	10	6125

