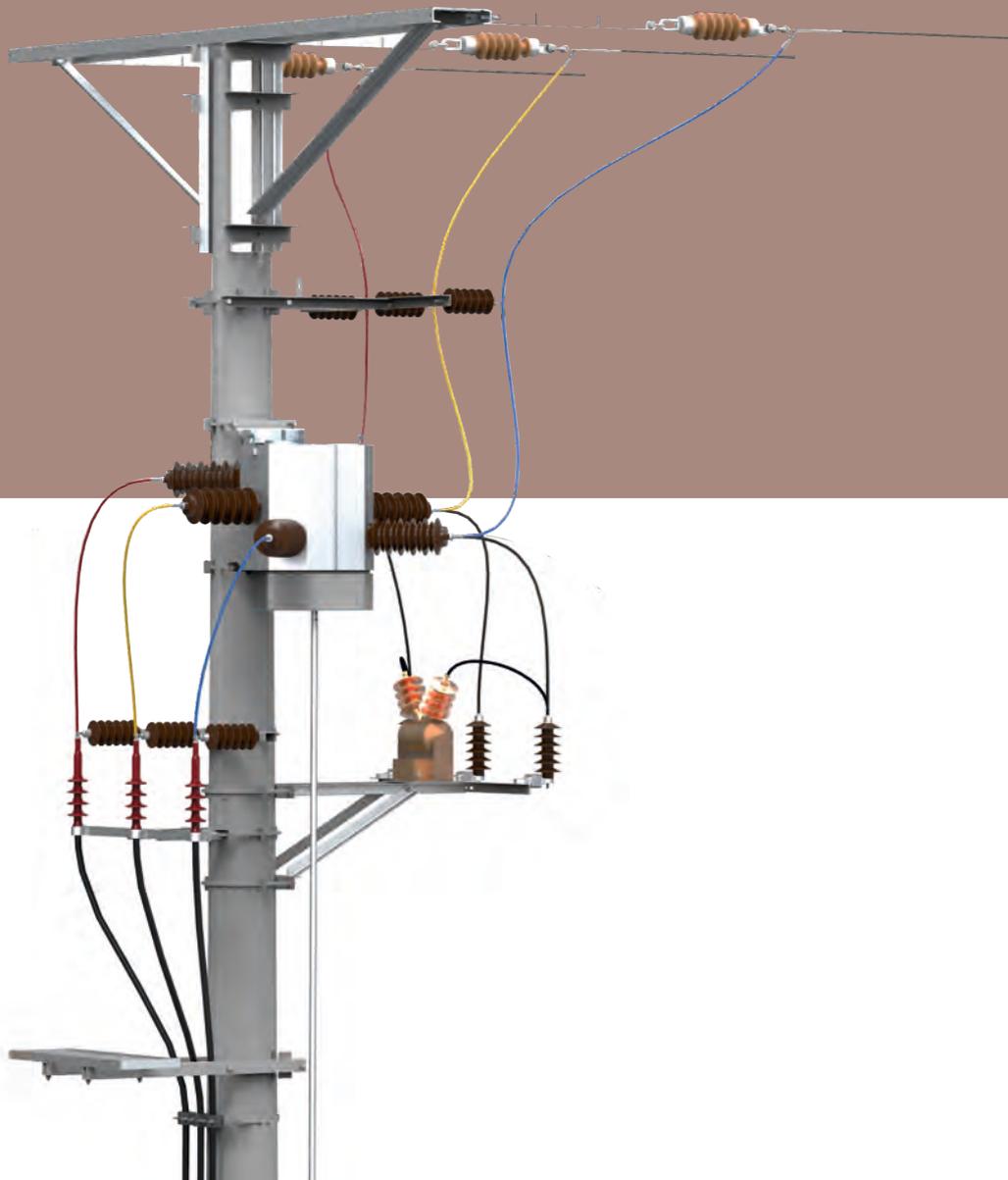


MV and LV overhead lines

1 / Introduction



INTRODUCTION

ZPUE S.A. has been manufacturing overhead MV switches for over 30 years. Over this time our experience and highly specialised engineering knowledge allowed us to design and manufacture a wide array of possible designs of various switching devices that can be found in our offer, starting from simple manually operated disconnectors and switch disconnectors to very individualised and specialised devices, such as THO series switch disconnectors in leak proof tanks and reclosers with full protection automation. By manufacturing almost 6000 of switches per year we have managed to achieve a position of the leader on Polish market leader, and a visible and trusted partner for deliveries on the European and global market.

Ingenious design solutions ensure that all ZPUE S.A disconnectors, reclosers and sectionalisers are adapted to operate with all available SCADA system and with the newest applications, introduced into systems as new solutions, and work great with Smart Grid solutions.

MV overhead switches

1 / Smart Grid in MV networks

Technological progress in MV grid automation was forced by the legislator, introducing progressively more restrictive regulations concerning allowable duration of interruptions in power supplied to customers.

The obligation to publish MAIFI, SAIFI and SAIDI indicators has caused the need of increased expenditures on MV grid automation.

- SAIDI - system average interruption duration index (for long and very long interruptions)
- SAIFI - system average interruption frequency index (for long and very long interruptions)
- MAIFI - momentary average interruption frequency index (for momentary interruptions)

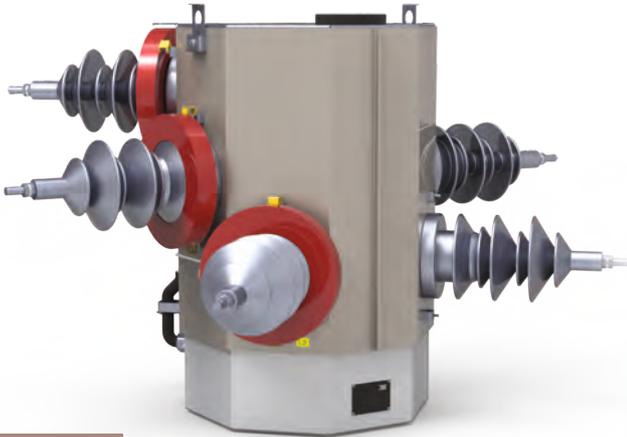
AVERAGE TIMES FOR LOCATING FAULTS ON MV OVERHEAD LINES

- Without switch disconnectors with a remote control system: about 3.5 hours,
- Switch disconnectors with a remote control system: about 30 minutes,
- Switch disconnectors with a remote control system and short-circuit indicators: about 15 minutes,
- Reclosers operated by radio control with protection automation: approx. 5–8 minutes,
- Reclosers operated by radio control with full protection automation, operating with radio control switch disconnectors with protection automation < 3 minutes.

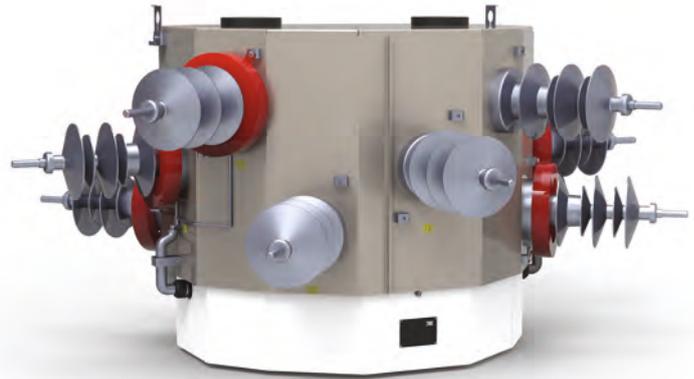
MV overhead switches

2 / THO series disconnecter, sectionalisers
with enclosed design for Smart Grid networks

THO/I



THO/II



DESIGN

The basic element of THO; THO/II series switch disconnecters, sectionalisers is a special design switch disconnecter closed in a leak proof, stainless steel tank filled with SF₆ gas. The tank meets the IEC 56 standard leakage requirements. This means that refilling this element during normal switch disconnecter operation is not required. According to provisions in force relating to the supervision of high-pressure devices, the appliance required to be subject to pressure device supervision because of low SF₆ gas contents in the tank. A modern and reliable radio (remote) control and supervision system guarantee several decades of operation without the need to perform cumbersome inspections, adjustments and maintenance of contacts, which is very important in extensive overhead networks. Switch disconnecter contacts inside the tank are connected with insulating bushings, which allow the installation of "self-cleaning" silicone insulators 24 (25) kV, 36 kV with excellent hydrophobic properties, to which bridges are connected from overhead or buried cable lines. It is also possible to equip them with connector angle terminations. A simple and reliable single or double spring electric drive mechanism was used for remote control, enabling snap action closing and opening of the switch disconnecter primary contacts under 50 ms. Motor drives equipped with THO series switch disconnecters/sectionalisers work with all radio control and supervision systems in the Smart Grid networks.

Electric drives are made in two versions, that is:

- "T-1" single spring motor drive – operation time < 2 seconds for on and off (standard design)
- "T-2" double spring motor drive with a pneumatic stored energy system – operation time for on < 6 seconds; off 0.1 second (custom design)

The aforementioned motor drives can operate with ATS automation; used for fast disconnection of faulty network sections during a de-energized interval, and in state of the art FDIR automation.

A T-1 or T-2 motor drive is installed directly on the switch disconnecter tank and is joined directly to its main operation shaft. It prevents access to the device by unauthorized people, and minimises the possibility of faulty indications and malfunctions. Both the spring mechanism and motor have indication contacts, which send device position information to the SCADA system, a visual indicator, which is visible from the ground level, and a mechanical counter which counts the number of on/off cycles.

Each switch disconnecter is equipped with a manual drive, which allows the operation of the device from the ground. This drive is adapted for mechanical locking in the open or closed position with the possibility of installing a padlock. Special version of the drive marked with "S-coupler" provides additional functionality of decoupling the manual drive from the motor drive when a remote control system is activated. Detailed information concerning switch disconnecters (sectionalisers) are provided at the www.zpue.com website and in the operation & maintenance manuals.

ADVANTAGES, CHARACTERISTICS, PARAMETERS

- no need for regular inspection and maintenance of the switch disconnecter main contacts, which significantly reduces operating costs.
- highest insulation gap at open switch disconnecter contacts (strength of 25kV without the SF₆ insulating gas)
- failure-free operation in extreme weather conditions (rime, icing, wind, forest areas),
- low wear and reduction of the ageing of all active components resulting from the use of SF₆ gas provides higher reliability and excellent mechanical and electrical strength,
- each THO series switch disconnecter is equipped with a pressure indicator, an SF₆ "pressure switch", which constantly controls the tank pressure and is responsible for proper operation of the switch disconnecter, and in case of failure automatically cuts off the motor power supply system, preventing switching operations by electrical motor,
- the THO series switch disconnecters are equipped with an emergency manual drive, which is used to perform the switching operations under full rated current load, in case of the batteries installed in the telemechanics cabinet are discharged.

Parameters of THO series switch disconnectors and sectionalisers		
Type	THO-24 THO-24/II	THO-36
Rated voltage Ur	24 (25)kV	36kV
Rated frequency – number of phases fr	50 Hz - 3	
Rated network frequency withstand voltage – under dry and rain conditions – 1 min Ud		
- to earth and interphase	50kV	70kV
- safe insulation gap	60kV	80kV
Rated withstand lightning surge voltage 1.2/50 μs Up		
- to earth and interphase	125kV	170kV
- safe insulation gap	145kV	195kV
Continuous rated current Ir	630A	
Rated short-time withstand current Ik	16kA (1s)	
Rated peak withstand current Ipk	40kA	
Rated short-circuit making current Ima	40kA	
Rated low inductance circuit breaking current Iload	630A	
Rated ring network circuit breaking current Iloop	630A	
Rated buried cable charging breaking current Icc2	87A	
Rated buried cable charging breaking current Icc1	50A	
Rated earth fault breaking current Iaf1	200A	
Resistance to internal arc effects	16kA (1s)	
Mechanical life mechanical class (cycle is defined as opening and closing)	(M2) 5000	
Operating temperature	- 40°C + 60°C	
Switch disconnecter electrical class	(E3) 100 C-O cycles	
Tank protection rating	IP67	
Drive compartment protection rating	IP54(65)*	
Sf ₆ gas pressure in the tank at 20°C	30 kPa	

* Motor drive with an IP65 protection rating is available at special request by the customer.

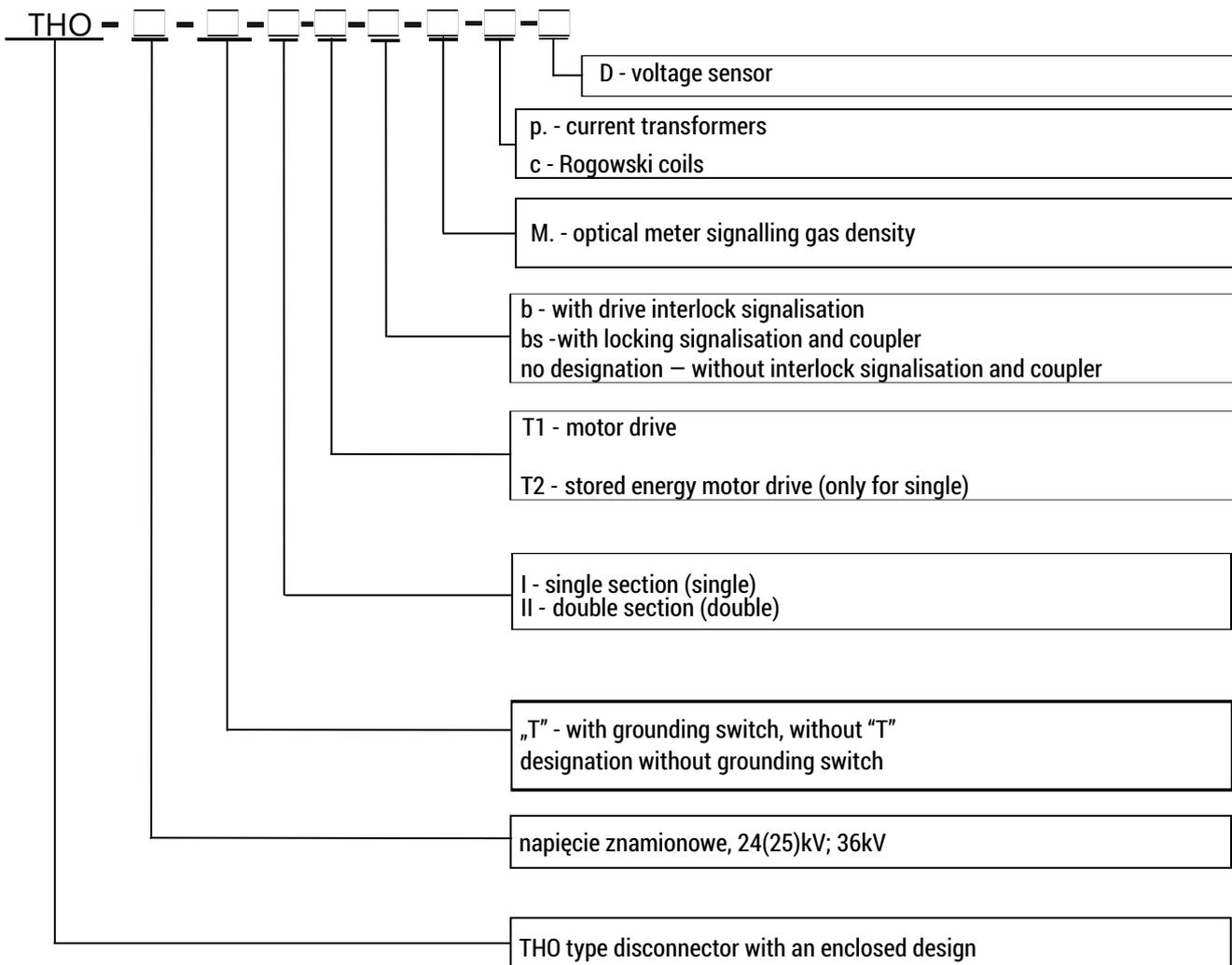
The switch disconnecters have a Conformity Certificate issued by an accredited body: Electrotechnical Institute in Warsaw.

SELECTION AND DESIGNATION

Compliance with standards:

- PN-EN 62271-103 - High-voltage switchgear and controlgear. Switches for rated voltages above 1kV up to and including 52 kV.
- PN-EN 62271-1:2009+A1:2011 - High-voltage switchgear and controlgear. Common specifications.
- PN-EN 62271-1:2018-02 - High-voltage switchgear and controlgear. Common specifications.
- IEC 62271-214:2019 - Internal arc classification.
- PN-EN 60529:2003 - Degrees of protection provided by enclosures (IP Code).
- PN-EN 62271-4:2014-03 - High-voltage switchgear and controlgear. Handling procedures for sulphur hexafluoride (SF6) and its mixtures.
- PN-EN 61140:2005/A1 - Protection against electric shock. Common aspects for installation and equipment.

SELECTION AND DESIGNATION



NOTE!

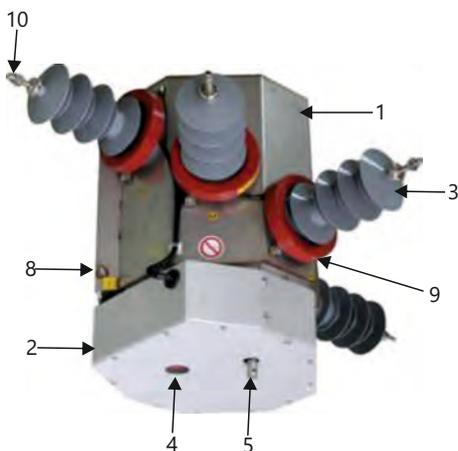
Double-section THO/II disconnector may be equipped only with a T1(b) motor drive and an earthing switch on one of the outgoing feeders.

- THO-24-T1 designates an overhead switch disconnecter for a rated voltage of 24(25)kV with a standard motor drive.
- THO-24-T1b designates an overhead switch disconnecter for a rated voltage of 24(25)kV with a motor drive with disconnecter interlock signalling.
- THO-24-T1bs designates an overhead switch disconnecter for a rated voltage of 24(25)kV with a motor drive with disconnecter interlock signalling and a coupler (between the manual drive and motor drive)
- THO-24-T2 designates an overhead switch disconnecter for a rated voltage of 24(25)kV with a stored energy motor drive.
- THO/T-24-T1 designates an overhead switch disconnecter with an earthing switch for a rated voltage of 24(25)kV with a motor drive without energy store.
- THO-36-T1 designates an overhead switch disconnecter for a rated voltage of 36kV with a standard motor drive.
- THO-36-T2 designates an overhead switch disconnecter for a rated voltage of 36kV with a stored energy motor drive.
- THO/T-36-T1 designates an overhead switch disconnecter with an earthing switch for a rated voltage of 36kV with a motor drive without energy store.
- THO-24/II-T1 designates an overhead double switch sectionaliser for a rated voltage of 24(25)kV with a standard motor drive.
- THO-24/II-T1b designates an overhead double switch sectionaliser for a rated voltage of 24(25)kV with a standard motor drive and disconnecter interlock signalling
- THO/T-24/II-T1 designates an overhead double switch sectionaliser with an earthing switch for a rated voltage of 24(25)kV with a motor drive without an energy store.

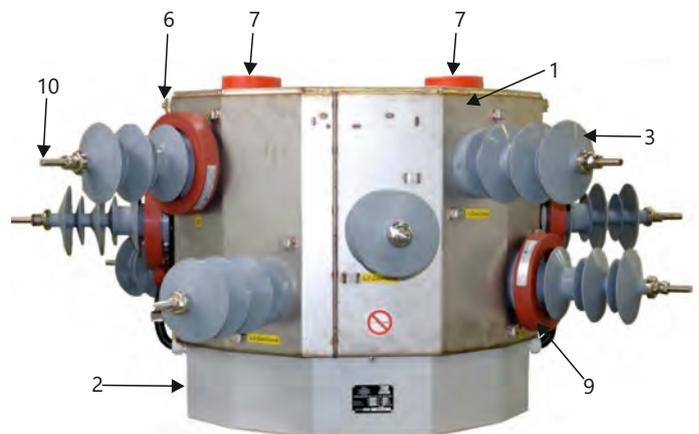
NOTE!

* a b;bs motor drive with an interlock signalling and a coupler is not standard equipment, it should be noted in the design documentation and when ordering.

VIEW, DIMENSIONS AND DESIGN



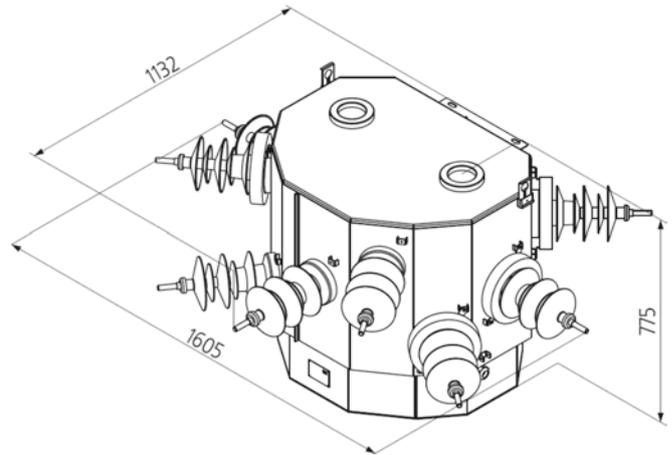
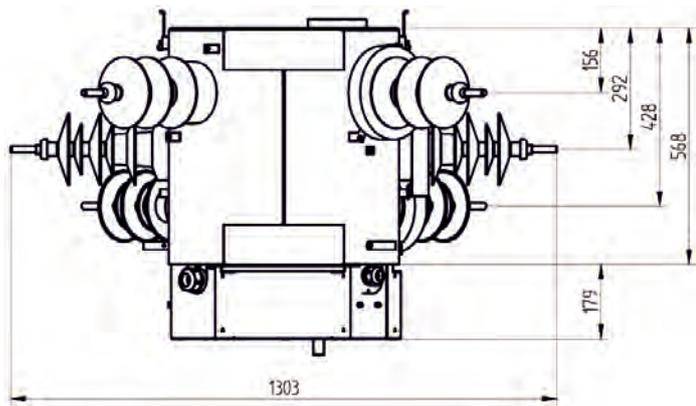
- 1 - stainless steel enclosure of the switch disconnecter
- 2 - motor drive enclosure
- 3 - resin insulating bushing and silicone rubber insulating cover
- 4 - visual position indicator
- 5 - drive shaft for connecting with the manual drive rod



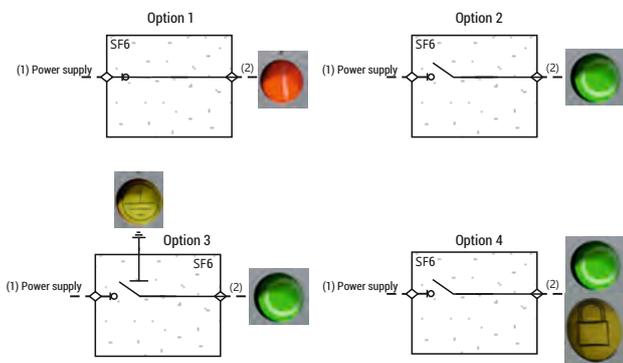
- 6 - integrated transport mounts
- 7 - safety (pressure) valve
- 8 - earthing connection point
- 9 - optional current transformer in Holmgreen connection, used for signalling of short-circuit current flow and for metering (or Rogowski coil)
- 10 - MV cable connection point

NOTE!

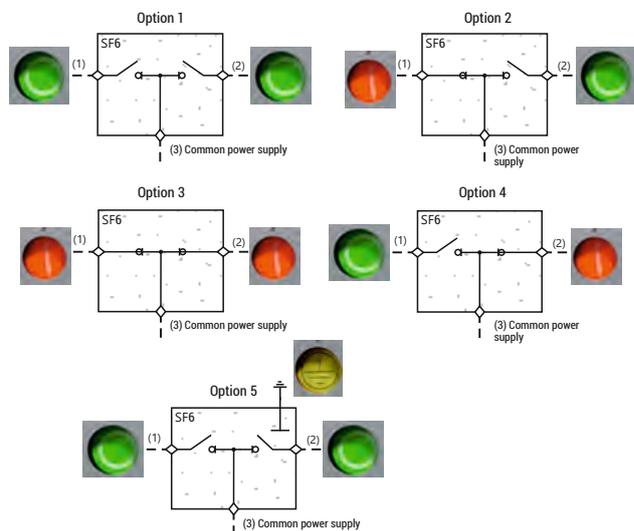
The disconnecter may not be handled by its insulators.



NETWORK SECTIONING OPTIONS FOR THO-24



NETWORK SECTIONING OPTIONS FOR THO-24/II



ADDITIONAL EQUIPMENT, CURRENT AND VOLTAGE METERING (MEASURING SENSORS)

Each THO series disconnector may be equipped with current transformers or Rogowski coils and voltage sensors, this is a new solution for current and voltage measurements for the protection and supervision of medium voltage power grids.

A PR 0,72 or a CTP type current transformer is constructed in a ring design, with the ring placed over the switch disconnector's insulating bushings in Holmgreen connection, and are used to obtain information on earth and interphase short-circuit currents and for current metering, as needed.

For voltage metering the THO series switch disconnectors can be equipped with voltage sensors, which are installed in the switch disconnectors' insulating bushings. The voltage sensor is used to measure the voltage with an accuracy of 1P Each phase sensor connected to a shielded cable, which is connected to the UZW-02 overvoltage protection.

The new solution, in combination with suitably configured telemechanics controllers may operate as an automatic sectionaliser and detect directional earth-fault currents with automatic sectioning of a damaged grid section during the de-energized interval of ATS; as well as in state of the art FDIR automation. More detailed information can be found on the www.zpue.com website and in the switch disconnector documentation.

Parameters of PE-072 and CTP current transformers

Rated primary voltage U_{pr}	0,66kV
Highest allowable transformer voltage U_m	0,72kV
Rated frequency f_r	50Hz
Rated primary current I_{pr} (range)	50A do 600A
Rated secondary current I_{sr}	1A lub 5A
Power	5VA(10)*
Core parameters (Sr, kl., AFL)	5(15)VA; 5P*; AFL-5*

Note* parameters of current transformers are also available in special design with increased parameters.

Parameters of PR-0,72S current sensors (Rogowski coils)

Rated primary voltage U_{pr}	0,66kV
Highest allowable voltage U_m	0,72kV
Rated frequency f_r	50Hz
Rated primary current I_{pr} (range)	0,5 - 2000A
Sensitivity	1mV/1A or 5mV/1A
Rated dynamic current I_{dyn}	75kA
Accuracy	1%

Technical parameters of the voltage sensor in the THO switch disconnecter

Rated primary voltage	15/ $\sqrt{3}$, 20/ $\sqrt{3}$ *
Highest allowable divider voltage	24 kV
Rated insulation test voltage	55 kV
Withstand lightning surge voltage 1.2/50 μ s	125 kV
Capacitance of the upper capacitor installed in the insulator	21 pF
Capacitance of the lower capacitor in the amplifier	200nF / 267nF*
Rated load	$\geq 200k\Omega$
Rated secondary voltage	3,25/ $\sqrt{3}$ V*
Measurement accuracy after taking into account correction factors for voltage amplitude, class	3P (1P)*
System operating temperature	-40°C + 60°C

The listed parameters apply to the voltage sensor installed in the THO switch disconnecter with converters. Converter may be installed in the switch disconnecter or SO control cabinet. The voltage sensor meets the requirements of the following standards: PN-EN 60044-7; PN-EN 61869-6.

SF₆ pressure sensor (option in standard equipment)

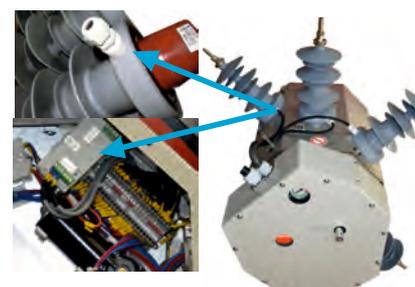
- SF₆ pressure sensor is provided in standard equipment of THO series switch disconnectors
- Nominal relative pressure of SF₆ should amount to 30 kPa at a temperature of 20°C
- The sensor indicates a failure when the internal pressure drops to a level of 5 kPa, this means that the SF₆ is inside the tank and is under pressure. This does not mean an immediate occurrence of an arc fault, but a lowering of dielectric strength.

SF₆ pressure indicator (additional equipment option)

- THO disconnectors may be optionally equipped with an optical SF₆ pressure indicator inside the tank (pressure gauge)
- The pressure gauge is installed in the switch disconnecter drive compartment in such a manner as to ensure its excellent visibility from ground level.

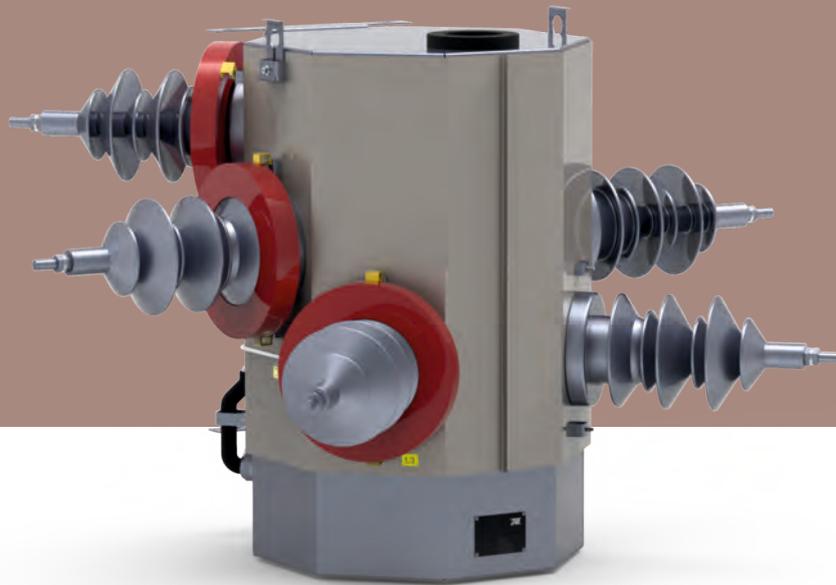
The gauge has a scale divided into 2 zones:

1. green zone (correct SF₆ level), where the indicator is present under normal conditions (takes into account the impact of temperature on pressure changes inside the tank)
2. red zone, where the indicator signals loss of gas (emergency state, where the disconnecting operation may not be performed). Nominal absolute SF₆ gas pressure should amount to 130 kPa (0.130 MPa) at a temperature of 20°C.



MV overhead switches

3 / Automatic overhead circuit breaker
THO-RC27 recloser for Smart Grid networks



DESIGN

Automatic overhead circuit breaker THO-RC27 recloser consists of a THO-RC27 recloser switching unit and an SRC control unit. Each pole of the switching unit has its own vacuum chamber. All poles are mechanically coupled with a synchronizing shaft which guarantees correct three-phase operation. Vacuum chambers are opened and closed by a simple electromagnetic actuator with an effective operating lifespan of thirty thousand operations. The electromagnetic drive is actuated by the energy stored in the capacitors. It contains only one moving part, which differentiates it from ordinary spring charged mechanisms. Vacuum chambers are placed in an IP67 protection rating enclosure.

The switching unit main contacts can be opened manually with a mechanical rod. After being opened manually, the recloser is mechanically and electrically locked out. The recloser state is indicated by a visual indicator placed at the bottom of the enclosure and by the SRC control unit, which monitors the recloser's auxiliary contacts' position. External cover of the bushing insulators is made from hydrophobic silicone rubber for 27 kV. Voltage measurement is performed by capacitive voltage dividers installed inside all the insulating bushings. Voltage measurement is performed with capacitive voltage dividers installed in all insulating bushings. Current measurement is performed by external Rogowski coils placed over insulating bushings, with a transformation ratio of 1 mV/A (optionally 5mV/A) or by current transformers with a 1A secondary current.

The SRC-1 control unit is designed for complex operation of the THO-RC27 recloser. The control unit, the parameters of which are specified in the table below, includes the following components:

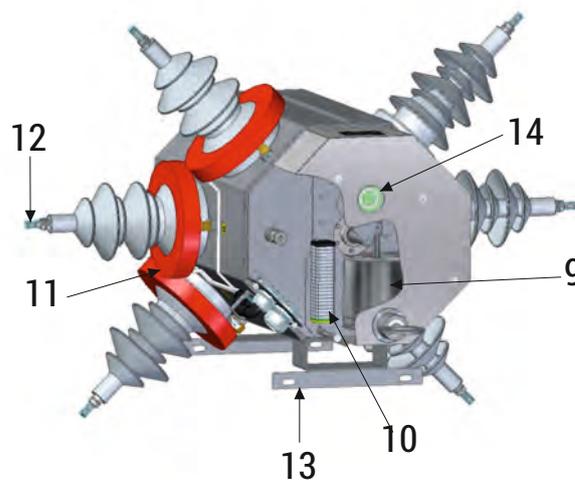
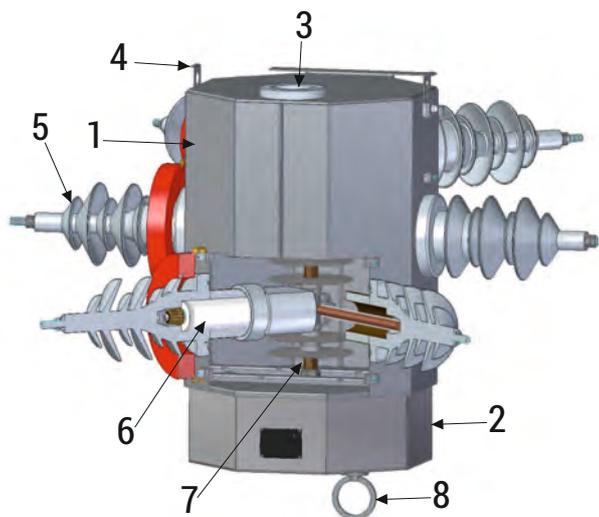
- Type SO-54SR-111-REK-1.4 field controller with protection automation functions
- communication modem for GPRS/UMTS-APN; TETRA; NetMan connectivity;
- 24 V DC battery banks with a charging system,
- electromagnetic drive capacitors (4x0.1 F/100 V DC),
- independent local control buttons,
- recloser's position state signalisation with signalling lamps,
- rotary cam switches for "operating mode selection: remote-off-local", "ATS on-off", "work on the line",
- installation circuit breaker, fuses, terminal strips, LV overvoltage limiter with damage signalling,
- heater with temperature controller (or hygrometer), and 230 V AC service socket,
- the control unit has the following voltage levels available: 230 V AC; 24 V DC; 100 V DC; 12 V DC

A detailed functional description of protection and communication modules is included in separate documentation, which is made available by ZPUE S.A. after an enquiry is made, or in the Technical Documentation.

Compliance with standards:

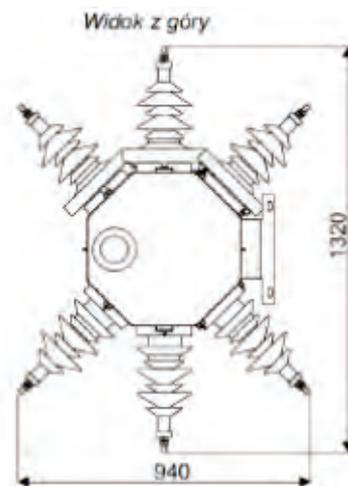
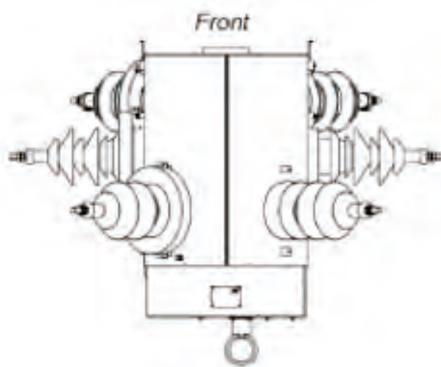
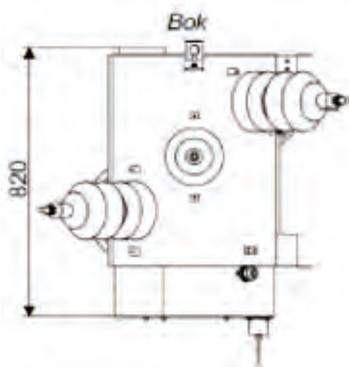
- IEC 62271-111 – High Voltage Switchgear and Controlgear – Part 111: Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV.
- PN-EN 62271-1 – High-voltage switchgear and controlgear. Common specifications
- PN-EN 62271-100 – High-voltage switchgear and controlgear. Alternating-current circuit-breakers
- PN-EN 61140:2005/A1 – Protection against electric shock. Common aspects for installation and equipment

VIEW, DIMENSIONS AND DESIGN OF THE SWITCHING UNIT



- | | |
|--|---|
| 1 - stainless steel enclosure of the recloser | 8 - manual opening and drive interlock handle |
| 2 - electromagnetic drive enclosure | 9 - electromagnetic drive |
| 3 - safety valve | 10 - RX terminal strip (for plug-in connection) |
| 4 - integrated transport mounts | 11 - Rogowski coil or current transformer |
| 5 - resin insulator with a voltage divider installed inside, covered with hydrophobic silicone rubber. | 12 - MV cable connection point (using the ZGU/THO clamp) |
| 6 - recloser chamber installed inside the insulating bushing | 13 - bracket for installation of the recloser on the pole |
| 7 - common main shaft for all three poles | 14 - visual recloser position indicator |

DIMENSIONS AND SIZE



CHARACTERISTICS

- the possibility of installing Rogowski coils or current transformers (depending on customer's requirements) and rapid replacement of the coil or transformer in case of damage, without the need to replace the entire switching unit,
- metering of voltages on both sides with capacitive voltage dividers,
- simple and very fast electromagnetic drive, one for all poles,
- dry air insulation,
- possibility of manually opening and interlocking the recloser without an external power supply.
- possibility of mechanical de-energized closing of the recloser without an external power supply,

THO-RC27 recloser parameters

Rated voltage Ur	27kV
Rated frequency – number of phases fr	50-60 Hz-3
Network frequency withstand test voltage (earth/interphase)	
- dry test (1min.)	60/70kV
- wet test (10 s)	50/ 60kV
Rated withstand lightning surge voltage 1.2/50 μ s (earth/interphase)	125/150kV
Continuous rated current Ir	630A
Rated short-time withstand current Ik	12,5kA
Rated peak withstand current Ipk	32,5kA
Rated short-circuit making current Ima	31,5kA
Rated short-circuit breaking current Isc	12,5kA
Switching life at the rated short-circuit breaking current	200
Mechanical life (cycle is defined as opening and closing)	30000
ATS switching cycle	W-0,5s-ZW-2s-ZW-4s-ZW
Operating temperature	- 40°C + 55°C
Net weight	100 kg
Current measurement	Rogowski coils or current transformers
Voltage measurement	6x capacitive voltage divider
Switching unit enclosure protection rating	IP67
Electromagnetic drive enclosure protection rating	IP54(65)*

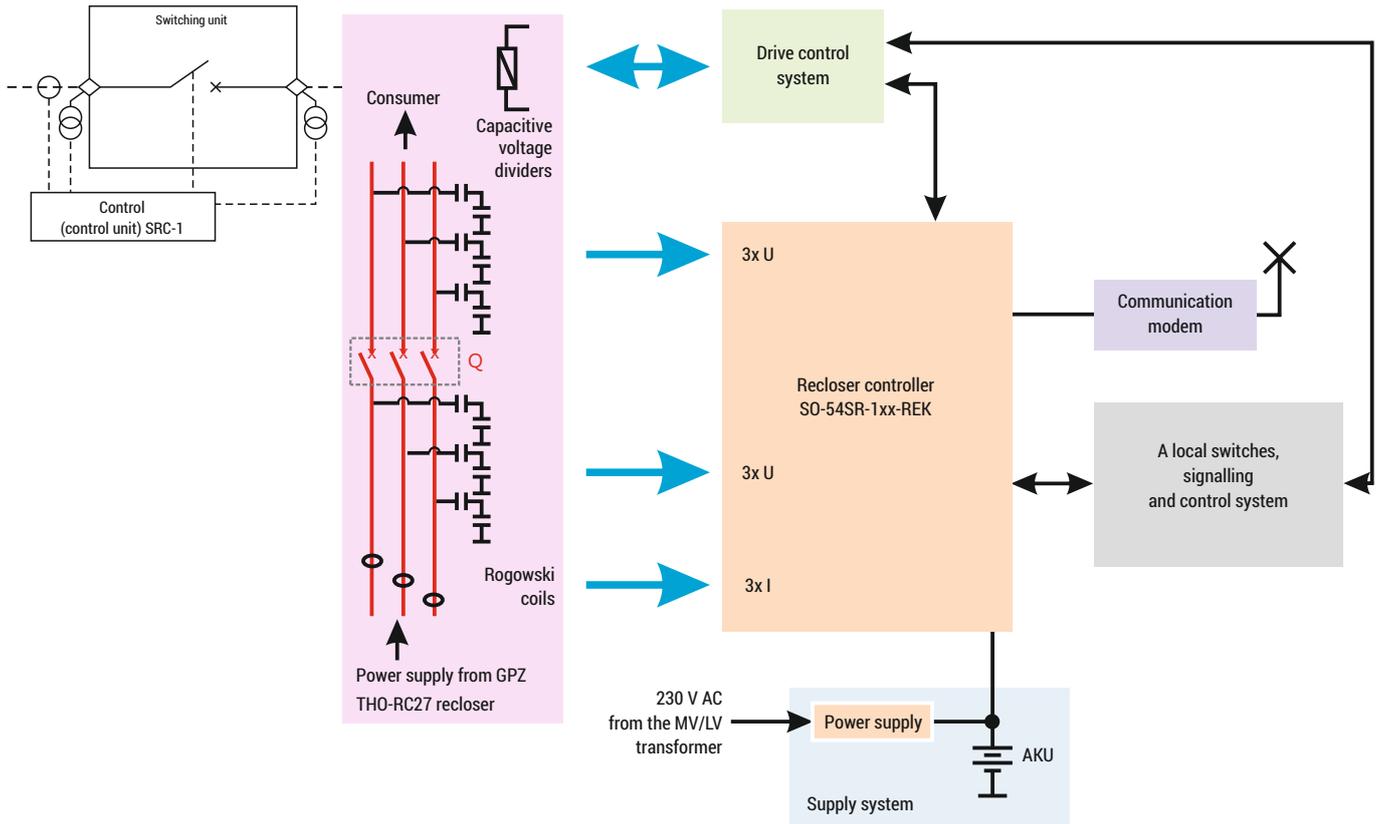
SRC control unit parameters

Rated voltage of the alternating current power supply	230 VAC
Rated voltage of internal systems power supply	24 VDC
Rated voltage of electromagnetic drive power supply	100VDC
Ingress protection rating	IP 54(64)
Operating temperature	-40°C +55°C
The possibility of installing transmission modems	GPRS/TETRA/NET-MAN/TRUNKING
Control unit net weight	~40 kg.

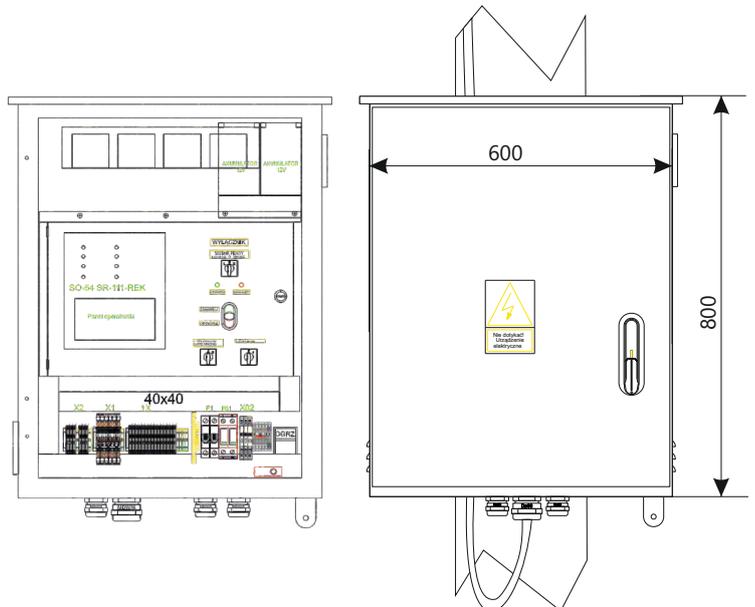
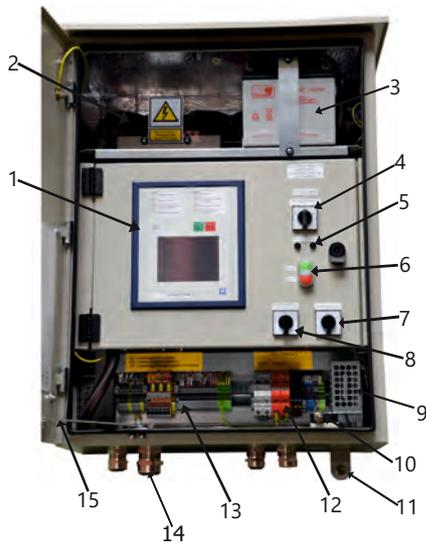
* custom design

The recloser has a certificate of conformity issued by an accredited certification body.

SCHEMATIC DIAGRAM



VIEW, DIMENSIONS AND DESIGN OF THE CONTROL UNIT

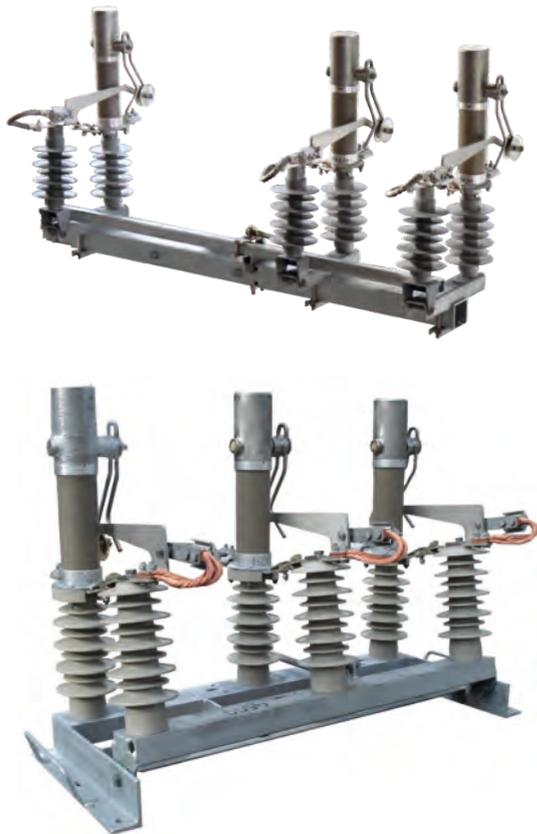


- Aluminium sheet control unit enclosure, powder painted
- 1 - SO-54SR-111-REK-1.4 controller with automatic protection functions
 - 2 - capacitors unit
 - 3 - 2x12 V DC (24 V DC) battery bank
 - 4 - operating mode switch: remote, off, local
 - 5 - recloser's main contacts' position signalling
 - 6 - independent local control buttons
 - 7 - work on the line signalling switch

- 8 - ATS automation activation and deactivation switch
- 9 - heater
- 10 - limit switch signalling the opening of doors
- 11 - earthing connection clamp
- 12 - 230 V AC protection with LV overvoltage limiter
- 13 - terminals strip, plug-in connection
- 14 - brass glands
- 15 - vestibule/closing interlock

MV overhead switches

4 / RPN switch disconnectors with vacuum chambers for Smart Grid



DESIGN

RPN III 24/400 and RPN III 24/400-W type switch disconnectors are manufactured in two versions: a framework version, marked RPN III 24/400 and a modular version, marked RPN III 24/400-W consist of three independent poles placed on a common drive shaft. An appropriately durable construction ensures high reliability and long life. The design enables direct connection of line cables to the disconnector. Each pole is equipped with HASDI type composite insulators with polycarbonate core in HTV rubber or IWN type cycloaliphatic resin cover.

The distance between individual poles can be adjusted within a range of 445 to 650 mm (only in case of a modular switch disconnector). The distance between poles in the framework version is set at 435 mm. The modular design of the unit enables it to be installed on various types of power poles (round pretensioned concrete, square vibrated concrete or lattice towers) without additional support structures. One insulator is permanently fixed to a pole, and the other is mounted on a movable support. The standard installed current terminals allow the installation of insulated or bare aluminium power cables with a cross-section of 16 to 150 mm². The main contacts are of a jaw design. These contacts are made from profiled copper flat bars fastened together with rivets, and a spring installed in stabilization foundations, which ensures a constant pressure force and very good connection of contact surfaces. Contact elements are covered with a silver plating, which ensures long operating time and protects against corrosive environmental conditions. Auxiliary contacts, which operate at the same time as main contacts, are opened after the main contacts open and when they are at a safe distance from each other.

The auxiliary contacts' and quenching chambers' design allows the making and breaking of operating currents up to 400 A. The switch disconnectors are adapted to both manual control with NR... series drives and remote control with NSP-7/SO-2 and NSP-8/SO2 series drives, as well as manual control with a hand crank. RPN series switch disconnectors are approved for use in all Distribution Companies (ZE), switch disconnectors may be equipped with AGCE-24 current transformers, which are used to detect short-circuit currents in MV grids, and combination sensors, e.g. CVS, used to detect short-circuit currents and their direction.

CHARACTERISTICS

- Visible safe isolation gap
- Fault-free operation under extreme weather conditions
- Low wear and reduction of the ageing of all active components resulting from the use of highest quality switching devices, which have excellent mechanical and electrical properties according to the 62271-103 standard
- The possibility of expanding with additional components, e.g. current transformers, overvoltage limiters
- Different versions of device design enable configuration of network nodes, it is possible to install three switch disconnectors on a single pole station.

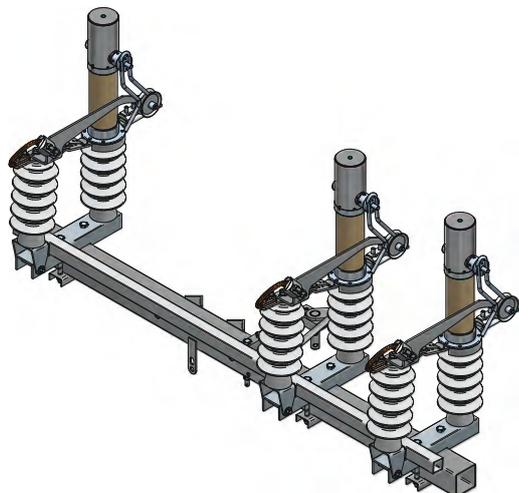
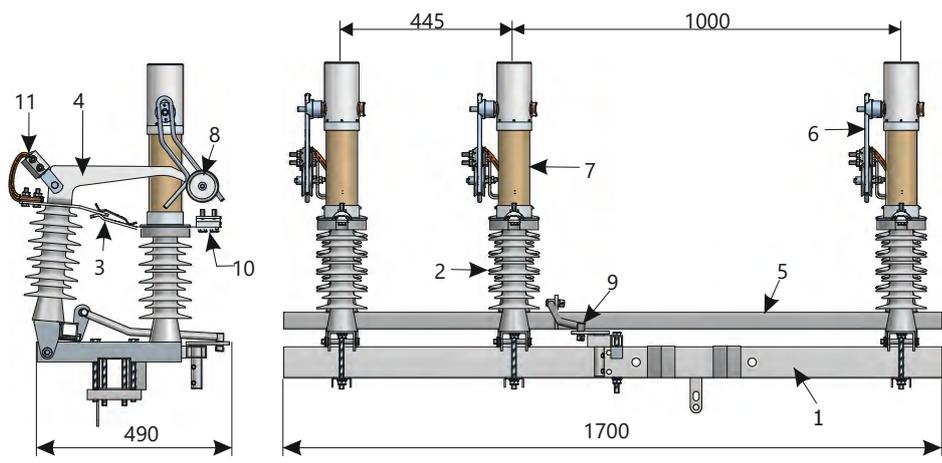
RPN switch disconnector parameters	
Rated voltage U_r	24(25)kV
Rated frequency – number of phases f_r	50 Hz-3
Rated network frequency withstand voltage – under dry and rain conditions – 1 min U_d	
- to earth and interphase	65kV
- safe insulation gap	75kV
Rated withstand lightning surge voltage 1.2/50 μ s U_p	
- to earth and interphase	125kV
- safe insulation gap	145kV
Continuous rated current I_r	400A
Rated short-time withstand current I_k	16kA (1s)
Rated peak withstand current I_{pk}	40kA
Rated short-circuit making current I_{ma}	8kA
Rated low inductance circuit breaking current I_{load}	400A
Rated ring network circuit breaking current I_{loop}	400A
Rated buried cable charging breaking current I_{cc}	30A
Mechanical life (cycle is defined as opening and closing)	(M2) 5000 C-0
Operating temperature	- 40°C + 60°C
Electrical class	(E3) 100 C-0

Compliance with standards:

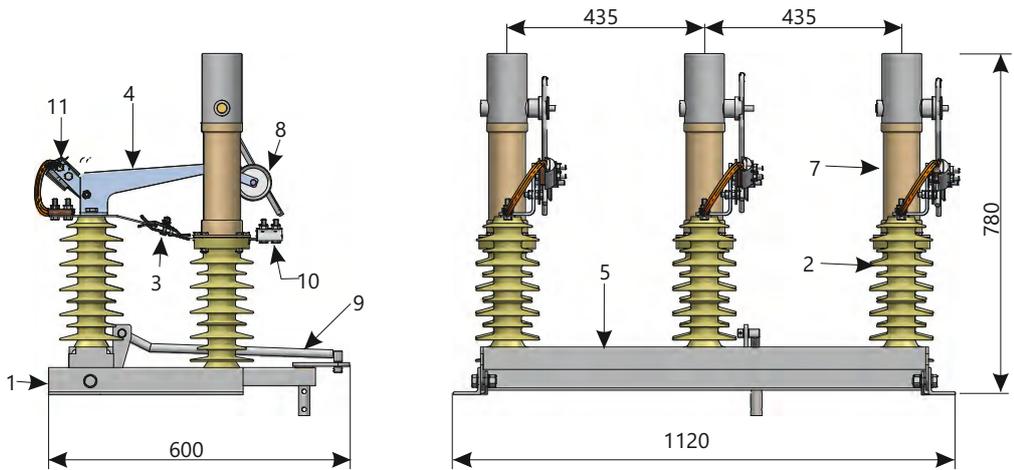
- PN-EN 62271-103 – High-voltage switchgear and controlgear. Switches for rated voltages above 1kV up to and including 52 kV.
- PN-EN 62271-1:2018-02 – High-voltage switchgear and controlgear. Common specifications.
- PN-EN 62271-102; PN-EN 62271-102:2005/A1:2011 – High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches
- PN-EN ISO 1461 – Hot dip galvanized coatings on fabricated iron and steel articles
- PN-EN 61140:2005/A1 – Protection against electric shock. Common aspects for installation and equipment

The switch disconnector has a Conformity Certificate issued by an accredited body.

VIEW, DIMENSIONS AND DESIGN OF RPN III 24/400-W



VIEW, DIMENSIONS AND DESIGN OF RPN III 24/400



- | | |
|---|--|
| 1 - switch disconnector frame (beam) | 7 - pole with vacuum chamber |
| 2 - post insulator | 8 - disc guide |
| 3 - switch disconnector main contacts | 9 - switch disconnector drive lever |
| 4 - moving auxiliary contacts | 10 - connection terminal |
| 5 - moving support | 11 - articulating element with connection terminal |
| 6 - parallel contacts which drive the chamber | |

MV overhead switches

5 / Metering sensors

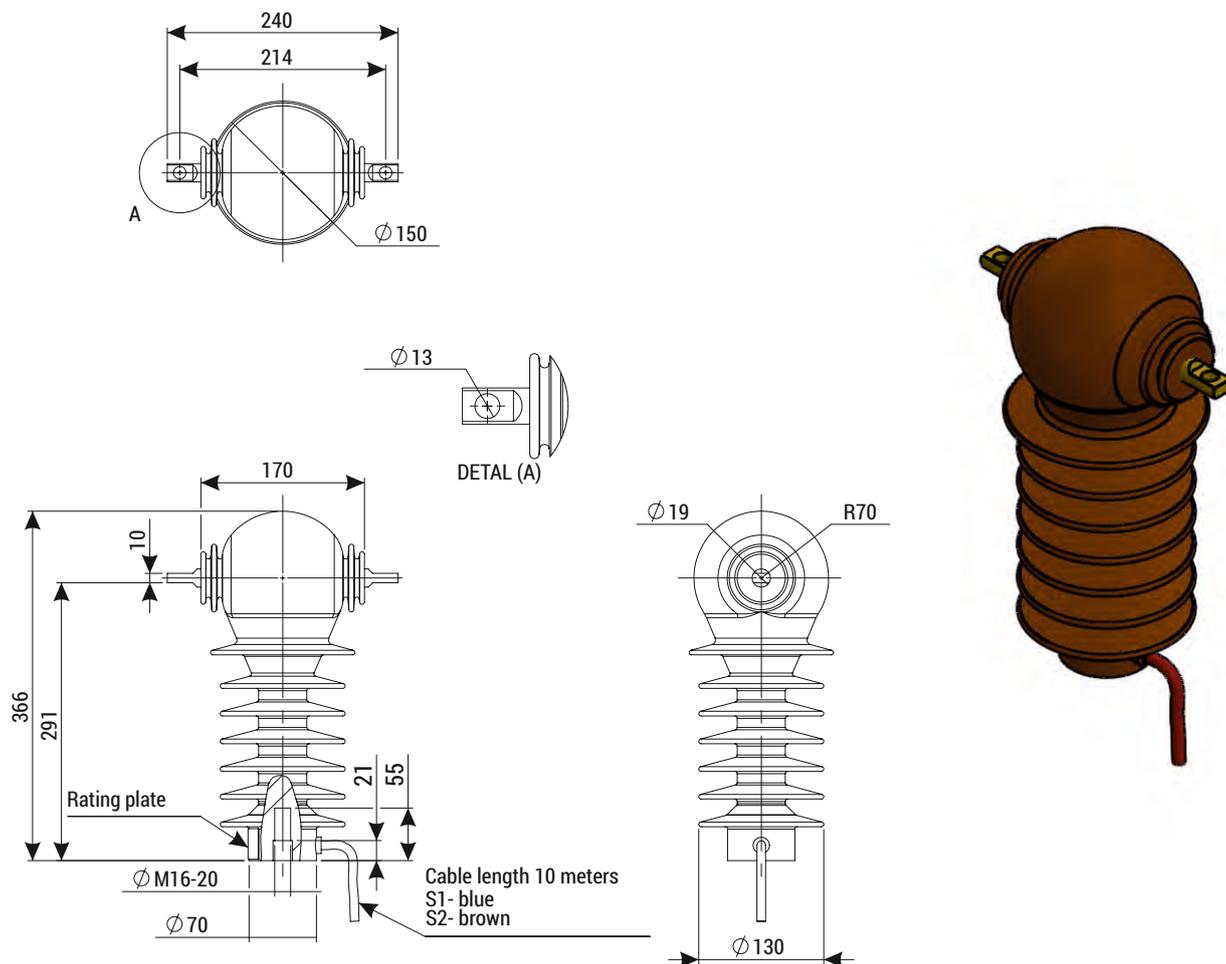
Current transformer (sensor)

Each RPN switch disconnecter may be additionally equipped with AGCE type current transformers, which is a new solution concerning current measurements for the protection and supervision of medium voltage power grids. The AGCE-24 type current transformer is designed for overhead networks with a voltage of 15, 20 kV. It may be used for short-circuit signalling or protection, it may be also used for the metering of current in an MV line. The creepage distance corresponds to an insulation voltage of 24 kV for highest level of contamination and amounts to 31 mm/1 kV. The transformer is constructed in accordance with the standards in force as follows:

AGCE-24 transformer parameters

Highest allowable voltage	24kV
Rated insulation test voltage	50kV
Rated surge test voltage	125kV
Rated primary current I _{pr} (range)	from 200A to 400A
Rated secondary current I _{sr}	1A
Thermal and dynamic strength I _{th} /I _{dyn}	16/40kA
Power	2VA
Accuracy class	1P
Cable length	10mb.

AGCE-24 TRANSFORMER SIZES



MV overhead switches

6 / RN and RUN switch disconnectors with air chambers with a switching current of 100 A



DESIGN

RN III 24/4-100A (RUN III 24/4-100A) type modular overhead switch disconnectors are devices used in 15 and 20 kV overhead distribution networks and are used for breaking and making of load currents up to 100 A. Continuous rated current 400 A. The switch disconnectors consist of three independent poles placed on a common shaft. The distance between individual poles can be adjusted within a range of 450 to 650 mm. The modular design of the device enables the installation of individual elements – load-bearing beam, poles, drive – on a pole station without the use of heavy equipment. The design of the device enables its installation on a standard pole without additional support structures. The switches are equipped with composite insulators with a polycarbonate core in a HTV or LSR rubber cover. Main contacts are made of profiled copper flat bars additionally protected by silver or zinc coating, depending on ZE standards. Contact units with an air quenching chamber are attached to the insulators. Contact units with a breaking contact and spring mechanism are attached to the moving insulators. Poles are supported by brass sleeves. An overhead line connection allows as standard the installation of insulated or bare aluminium power cables with a cross-section of 16 to 150 mm². A flexible contact compensates for the effects of bending on the moving pole of the device. The design of the devices enables the expansion of operating devices with additional modules – earthing switches, extinguishing chamber, overvoltage limiters or additional insulators – enabling their configuration depending on the needs.

The switch disconnectors may be installed in a horizontal or vertical position. The switch disconnectors are adapted for remote control with NSP-7/SO-2 and NSP-8/SO2 series drives, as well as manual control with a hand crank present in the drive, or only with a manual drive (without a motor).

The switch disconnectors are approved for use in all Distribution Companies (ZE), switch disconnectors may be equipped with AGCE-24 current transformers, which are used to detect short-circuit currents in MV grids.

CHARACTERISTIC

- Visible safe isolation gap,
- Fault-free operation under extreme weather conditions,
- Low wear and reduction of the ageing of all active components resulting from the use of highest quality switching devices, which have excellent mechanical and electrical properties according to the newest reference standards.
- The possibility of expanding with additional components, e.g. current transformers, overvoltage limiters,
- High making currents of 100 A without the need to switch off the entire line circuit.

RN III 24/4-100A and RUN III 24/4-100A switch disconnector parameters

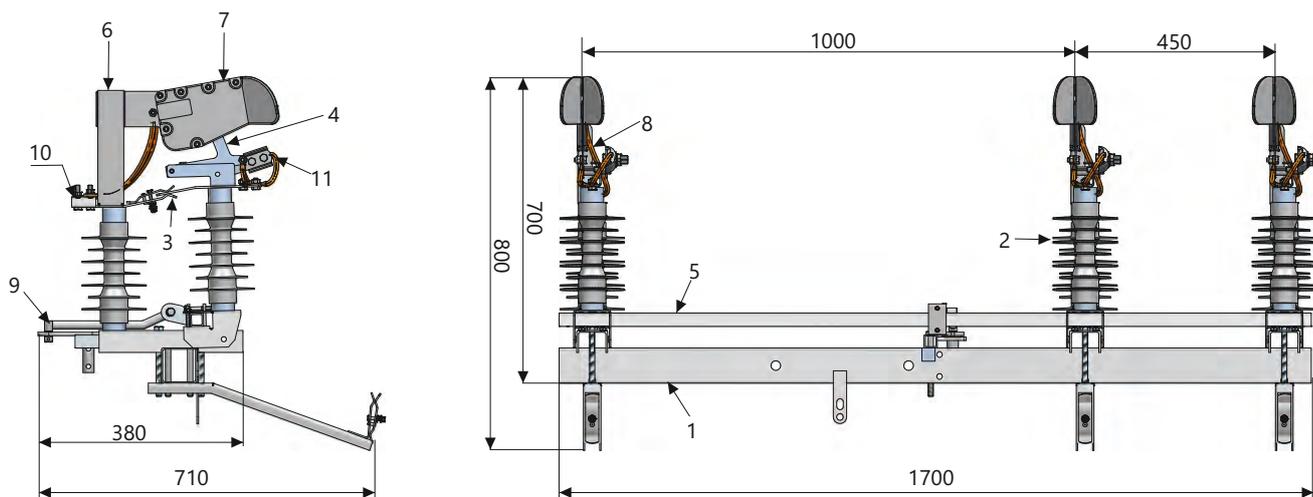
Rated voltage U_r 24(25)kV	
Rated frequency – number of phases fr	50 Hz-3
Rated network frequency withstand voltage – under dry and rain conditions – 1 min U_d	
- to earth and interphase	50kV
- safe insulation gap	60kV
Rated withstand lightning surge voltage 1,2/50ms U_p	
- to earth and interphase	125kV
- safe insulation gap	145kV
Continuous rated current I_r	400A
Rated short-time withstand current I_k	16kA (1s)
Rated peak withstand current I_p	40kA
Rated short-circuit making current I_{ma}	16kA
Rated low inductance circuit breaking current I_{load}	100A
Rated ring network circuit breaking current I_{loop}	100A
Rated buried cable charging breaking current I_{cc}	20A
Mechanical life (cycle is defined as opening and closing)	(M2) 5000 C-O
Operating temperature	- 40°C + 60°C
Electrical class	(E3) 100 C-O cycles

Compliance with standards:

- PN-EN 62271-103 – High-voltage switchgear and controlgear. Switches for rated voltages above 1kV up to and including 52 kV.
- PN-EN 62271-1:2018 – High-voltage switchgear and controlgear. Common specifications.
- PN-EN 62271-102:2005; PN-EN 62271-102:2005/A1:2011 – High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches
- PN-EN ISO 1461 – Hot dip galvanized coatings on fabricated iron and steel articles
- PN-EN 61140:2005/A1 – Protection against electric shock. Common aspects for installation and equipment

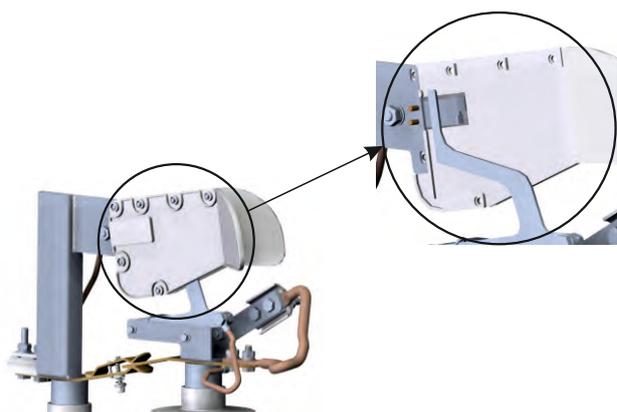
The switch disconnector has a Conformity Certificate issued by an accredited body.

VIEW, DIMENSIONS AND DESIGN

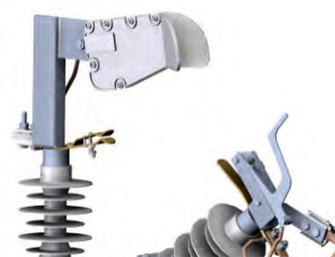


- | | |
|--------------------------------------|---|
| 1. Switch disconnector frame (beam) | 7. 100 A air chamber |
| 2. Post insulator | 8. Flexible connection |
| 3. Switch disconnector main contacts | 9. Switch disconnector drive lever |
| 4. Snap-action moving contacts | 10. Connection terminal |
| 5. Moving support | 11. Articulating element with connection terminal |
| 6. Chamber support element | |

VIEW OF THE 100 A SWITCHING CHAMBER



View of the switching chamber – switch disconnector closed



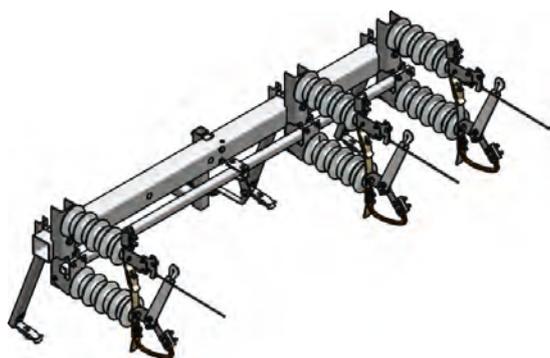
View of the switching chamber – switch disconnector open disconnected

MV overhead switches

7 / Switches with a limited 25 A switching capacity
in framework and modular version



framework version



modular version



framework version



modular version

DESIGN

The switches are three-pole devices with a common drive. Each pole is equipped with two post insulators – fixed and moving. The switches may be equipped with porcelain or composite insulators with HTV or LSR silicone rubber cover, or composite insulators made of cycloaliphatic resins. Brackets with main contact units are attached to the insulators. The main contacts are from profiled copper flat bars, additionally protected by silver or zinc coating. The design of the contacts enables them to be self-guiding and provides a large contact surface and clamping force.

The devices are equipped as standard with current terminals, which enable the connection of overhead line insulated or bare aluminium power cables with a cross-section of 16 to 150 mm² (a special version enables the connection of cables with a cross-section of 185 mm²), however the information must be specified at the stage of placing the order or sending a request for quotation. Additionally devices with earthing switches are equipped with a flexible contact compensates for the effects of bending of the cable on the moving pole of the device.

Modular design switches may be expanded by additional elements, such as: overvoltage limiters, additional post insulators, they may also be installed in a horizontal and vertical position.

CHARACTERISTIC

- visible safe isolation gap,
- fault-free operation under extreme weather conditions,
- low wear and reduction of the ageing of all active components resulting from the use of highest quality switching devices, which have excellent mechanical and electrical properties according to the newest standards

SWITCHES WITH A LIMITED 25 A SWITCHING CAPACITY IN A FRAMEWORK VERSION

RN III 24(36)/4; RUN III 24(36)/4; ON III 24(36)/4; OUN III 24(36)/4 Switch parameters				
Switch type	RUN (RN)	RUN (RN)	OUN (ON)	OUN (ON)
Rated voltage Ur	24(25)kV	36kV	24(25)kV	36kV
Rated frequency – number of phases fr	50 Hz-3	50 Hz-3	50 Hz-3	50 Hz-3
Rated network frequency withstand voltage – under dry and rain conditions – 1min Ud				
- to earth and interphase	50kV	70kV	50kV	70kV
- safe insulation gap	60kV	80kV	60kV	80kV
Rated withstand lightning surge voltage 1,2/50ms Up				
- to earth and interphase	125kV	170kV	125kV	170kV
- safe insulation gap	145kV	195kV	145kV	195kV
Continuous rated current Ir	400A	400A	400A	400A
Rated short-time withstand current Ik	16kA (1s)	16kA (1s)	16kA (1s)	16kA (1s)
Rated peak withstand current Ip	40kA	40kA	40kA	40kA
Rated short-circuit making current Ima	2,5kA	2,5kA	-----	-----
Rated low inductance circuit breaking current Iload	25A	25A	-----	-----
Rated ring network circuit breaking current Iloop	25A	25A	-----	-----
Rated buried cable charging breaking current Icc	16A	10A	-----	-----
Mechanical life (cycle is defined as opening and closing)	(M2) 5000	(M2) 5000	(M2) 5000	(M2) 5000
Operating temperature	- 40°C + 50°C	- 40°C + 50°C	- 40°C + 50°C	- 40°C + 50°C
Switch disconnecter electrical durability class	(E3) 100 C-O	(E3) 100 C-O	-----	-----
Grounding switch electrical durability class	E2	E2	E2	E2

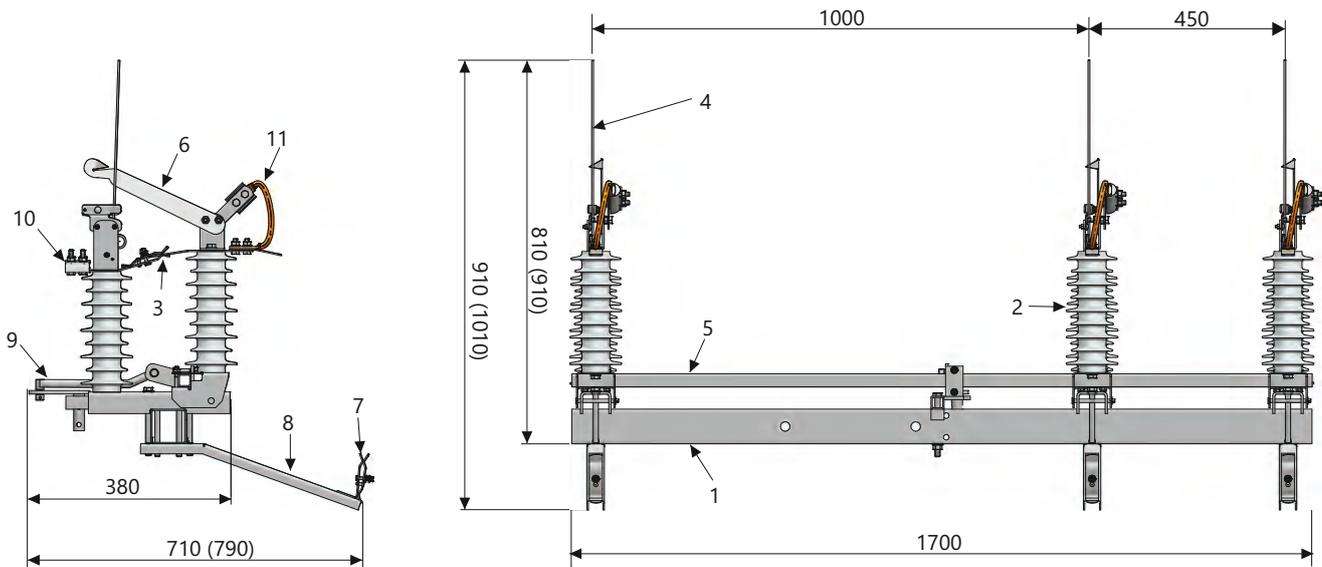
* Parameters are specified for a switch with fixed poles

Compliance with standards:

- PN-EN 62271-103 – High-voltage switchgear and controlgear. Switches for rated voltages above 1kV up to and including 52 kV.
- PN-EN 62271-1:2018 – High-voltage switchgear and controlgear. Common specifications.
- PN-EN 62271-102:2005; PN-EN 62271-102:2005/A1:2011 – High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches
- PN-EN ISO 1461 – Hot dip galvanized coatings on fabricated iron and steel articles
- PN-EN 61140:2005/A1 – Protection against electric shock. Common aspects for installation and equipment

The switch disconnecter has a Conformity Certificate issued by an accredited body.

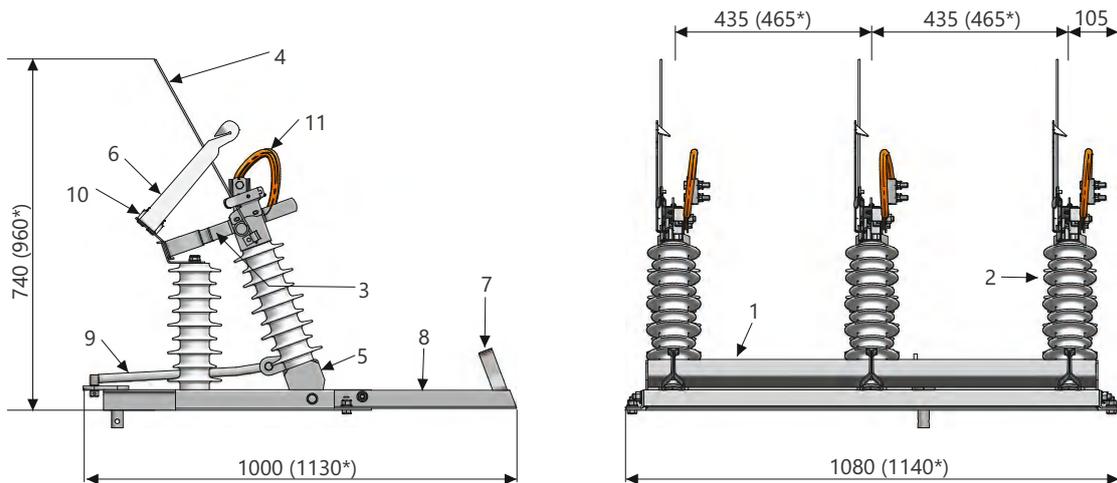
VIEW, DIMENSIONS AND DESIGN OF THE MODULAR SWITCHES



* Dimensions apply to 36 kV switches

- | | |
|---------------------------------------|--|
| 1 - switch disconnector frame (beam) | 7 - earthing switch contact |
| 2 - post insulator | 8 - earthing switch support structure |
| 3 - switch disconnector main contacts | 9 - switch disconnector drive lever |
| 4 - snap-action moving contacts | 10 - connection terminal |
| 5 - moving support | 11 - articulating element with connection terminal |
| 6 - snap-action contact blade | |

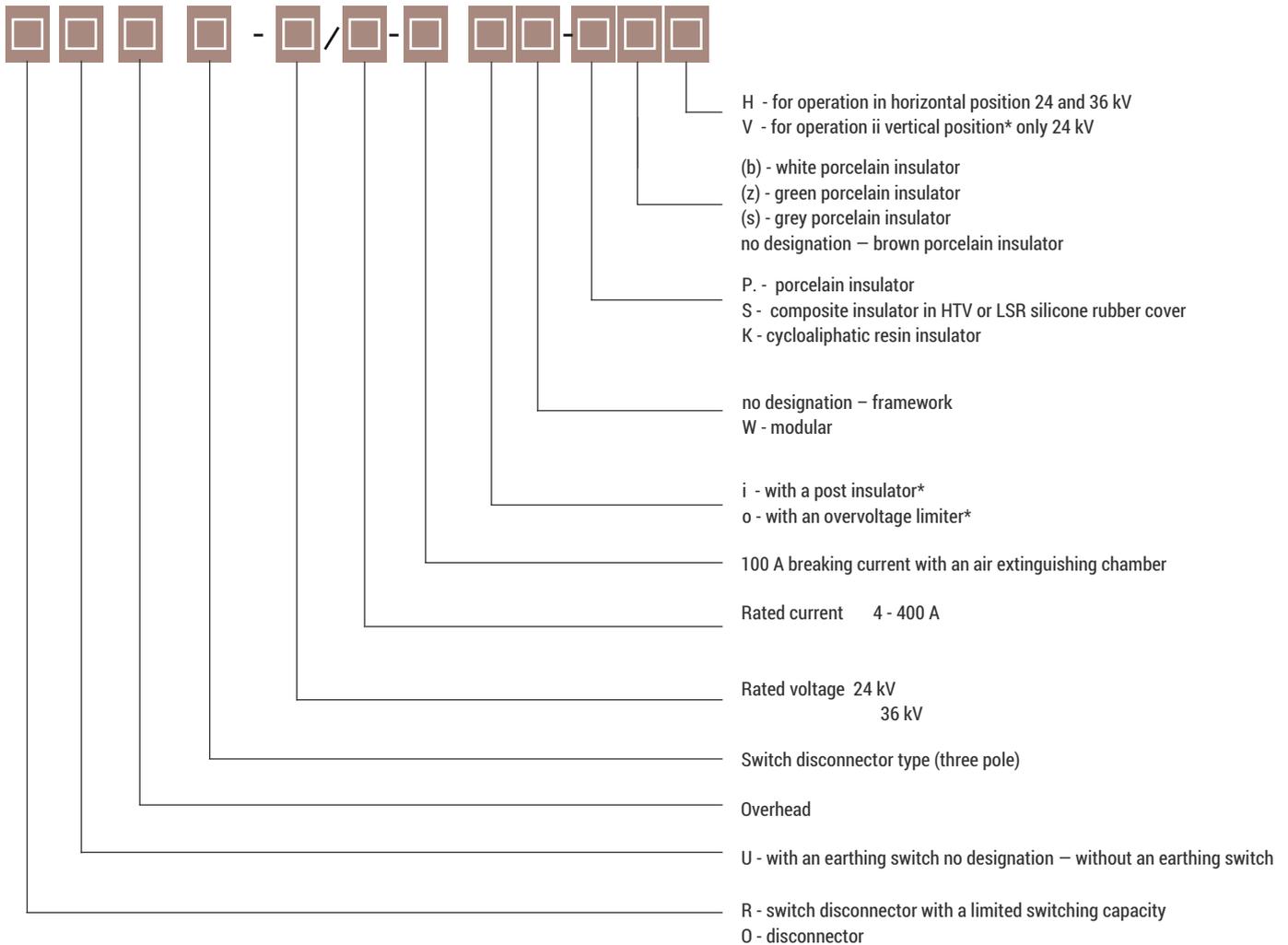
VIEW, DIMENSIONS AND DESIGN OF THE FRAMEWORK SWITCHES



* Dimensions apply to 36 kV switches

- | | |
|---------------------------------------|--|
| 1 - switch disconnector frame (beam) | 7 - earthing switch contact |
| 2 - post insulator | 8 - earthing switch support structure |
| 3 - switch disconnector main contacts | 9 - switch disconnector drive lever |
| 4 - snap-action moving contacts | 10 - connection terminal |
| 5 - moving support | 11 - articulating element with connection terminal |
| 6 - snap-action contact blade | |

SWITCHES WITH A LIMITED SWITCHING CAPACITY DESIGNATION OF SWITCHES



RUN III 24/4 P

stands for an overhead, three-pole switch disconnector with an earthing switch, 24 kV rated voltage, 400 A rated continuous current, brown porcelain insulators

ON III 24/4 P-z

stands for an overhead, three-pole switch disconnector in a framework design, 24 kV rated voltage, 400 A continuous current, green porcelain insulators

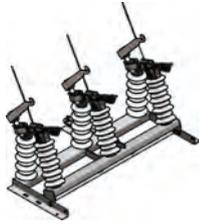
RUN III 24/4 W-S-H

stands for an overhead, three-pole switch disconnector with an earthing switch, 24kV rated voltage, 400 A continuous current, 25 A switching current, composite insulator in silicone rubber cover, for installation in horizontal positions under MV line cables

* refers only to W-modular switches, note ZPUE S.A. recommends the use of switches in a H – horizontal version, in V – vertical system only in special cases when the horizontal version may not be used.

SWITCHES – VERSIONS

Framework switches

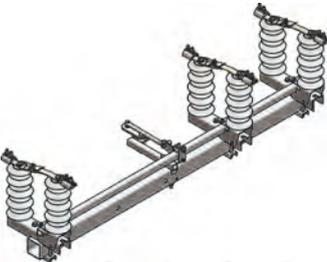
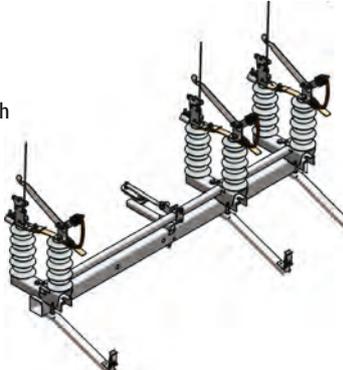
Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Disconnector ON III 24/4 P(S)(K)	 <p>P (51,5 kg) S (41,3 kg) K (47,5 kg)</p>	Disconnector with an earthing switch OUN III 24/4 P(S)(K)	 <p>P (53,5 kg) S (43,3 kg) K (49,5 kg)</p>
Switch disconnector RN III 24/4 P(S)(K)	 <p>P (51,7 kg) S (41,5 kg) K (47,7 kg)</p>	Switch disconnector with an earthing switch RUN III 24/4 P(S)(K)	 <p>P (53,7 kg) S (43,5 kg) K (49,7 kg)</p>
Disconnector ON III 36/4 P(S)(K)	 <p>P (68,7 kg) S (53,3 kg) K (59,5 kg)</p>	Disconnector with an earthing switch OUN III 36/4 P(S)(K)	 <p>P (73,3 kg) S (55,3 kg) K (64,1 kg)</p>
Switch disconnector RN III 36/4 P(S)(K)	 <p>P (69,0 kg) S (53,8 kg) K (59,8 kg)</p>	Switch disconnector with an earthing switch RUN III 36/4 P(S)(K)	 <p>P (73,7 kg) S (55,7 kg) K (64,5 kg)</p>

NOTE!

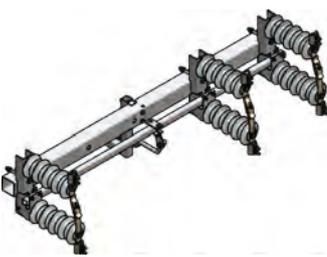
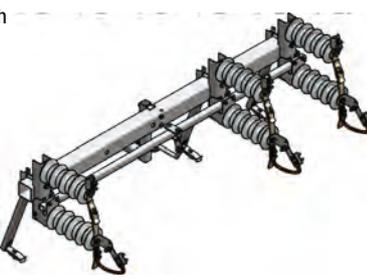
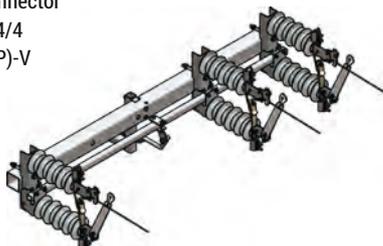
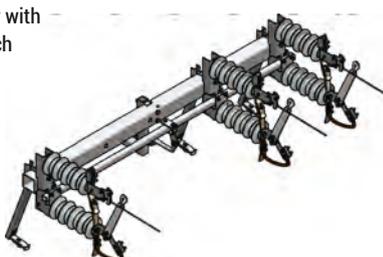
The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

SWITCHES – VERSIONS

Modular switches in a basic version (horizontal)

Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Disconnector ON III 24/4 W-S(K)(P)-H	 <p>P (59,5 kg) S (49,3 kg) K (57,5 kg)</p>	Disconnector with an earthing switch OUN III 24/4 W-S(K)(P)-H	 <p>P (61,5 kg) S (51,5 kg) K (58,5 kg)</p>
Switch disconnector RN III 24/4 W-S(K)(P)-H	 <p>P (61,5 kg) S (51,5 kg) K (59,5 kg)</p>	Switch disconnector with an earthing switch RUN III 24/4 W-S(K)(P)-H	 <p>P (63,5 kg) S (53,5 kg) K (60,0 kg)</p>

Modular switches in a basic version (vertical)

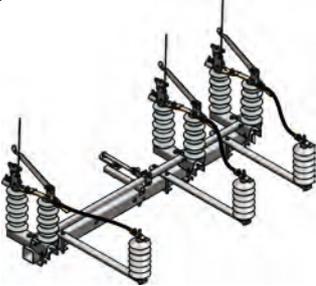
Disconnector ON III 24/4 W-S(K)(P)-V	 <p>P (59,5 kg) S (49,3 kg) K (57,5 kg)</p>	Disconnector with an earthing switch OUN III 24/4 W-S(K)(P)-V	 <p>P (61,5 kg) S (51,5 kg) K (58,5 kg)</p>
Switch disconnector RN III 24/4 W-S(K)(P)-V	 <p>P (61,5 kg) S (51,5 kg) K (59,5 kg)</p>	Switch disconnector with an earthing switch RUN III 24/4 W-S(K)(P)-V	 <p>P (63,5 kg) S (53,5 kg) K (60,0 kg)</p>

NOTE!

The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

SWITCHES – VERSIONS

Modular switches with a design for installation of overvoltage limiters (horizontal)

Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Disconnecter ON III 24/4 o W-S(K)(P)-H	 <p>P (65,5 kg) S (55,3 kg) K (63,5 kg)</p>	Disconnecter with an earthing switch OUN III 24/4 o W-S(K)(P)-H	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>
Switch disconnecter RN III 24/4 o W-S(K)(P)-H	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>	Switch disconnecter with an earthing switch RUN III 24/4 o W-S(K)(P)-H	 <p>P (69,5 kg) S (59,3 kg) K (67,5 kg)</p>

Modular switches with a design for installation of post insulators (horizontal)

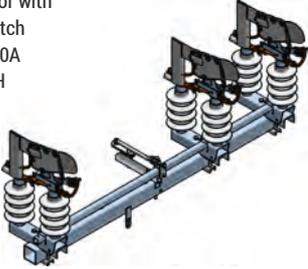
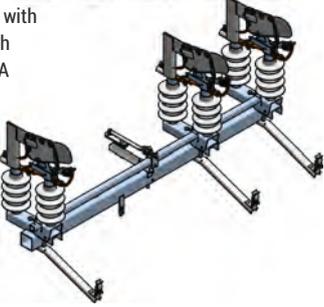
Disconnecter ON III 24/4 i W-S(K)(P)-H	 <p>P (65,5 kg) S (55,3 kg) K (63,5 kg)</p>	Disconnecter with an earthing switch OUN III 24/4 i W-S(K)(P)-H	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>
Switch disconnecter RN III 24/4 i W-S(K)(P)-H	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>	Switch disconnecter with an earthing switch RUN III 24/4 i W-S(K)(P)-H	 <p>P (69,5 kg) S (59,3 kg) K (67,5 kg)</p>

NOTE!

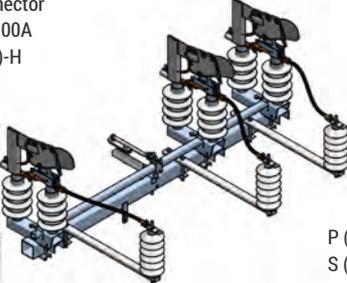
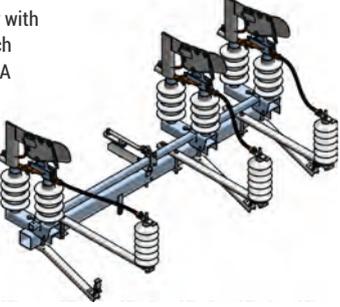
The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

SWITCHES – VERSIONS

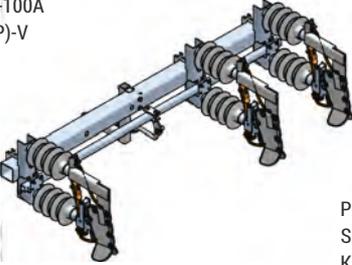
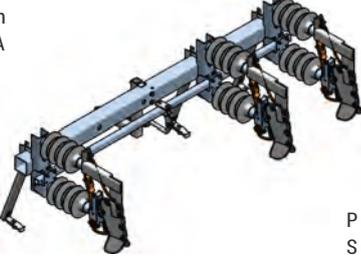
Modular switches with 100 A air chambers (horizontal)

Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Switch disconnecter with an earthing switch RN III 24/4-100A W-S(K)(P)-H	 P (63,5 kg) S (53,3 kg) K (61,5 kg)	Switch disconnecter with an earthing switch RUN III 24/4-100A W-S(K)(P)-H	 P (65,5 kg) S (55,5 kg) K (62,0 kg)

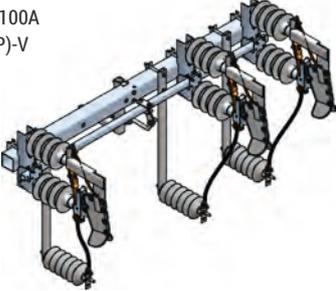
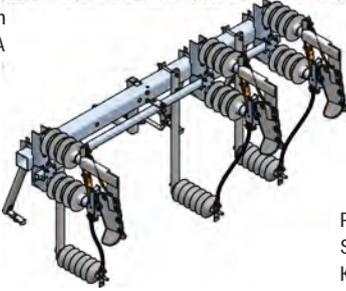
Modular switches with a design for installation of overvoltage limiters (horizontal)

Switch disconnecter RN III 24/4-100A o W-S(K)(P)-H	 P (69,5 kg) S (59,5 kg) K (67,5 kg)	Switch disconnecter with an earthing switch RUN III 24/4-100A o W-S(K)(P)-H	 P (71,5 kg) S (61,3 kg) K (69,5 kg)
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Modular switches with 100 A air chambers (vertical)

Switch disconnecter RN III 24/4-100A W-S(K)(P)-V	 P (63,5 kg) S (53,3 kg) K (61,5 kg)	Switch disconnecter with an earthing switch RUN III 24/4-100A W-S(K)(P)-V	 P (65,5 kg) S (55,5 kg) K (62,0 kg)
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Modular switches with a design for installation of overvoltage limiters (vertical)

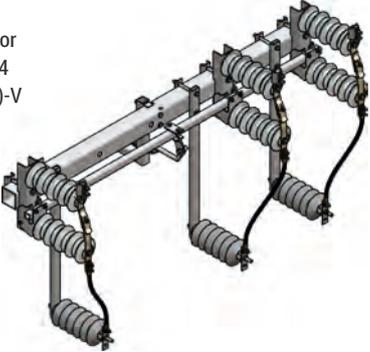
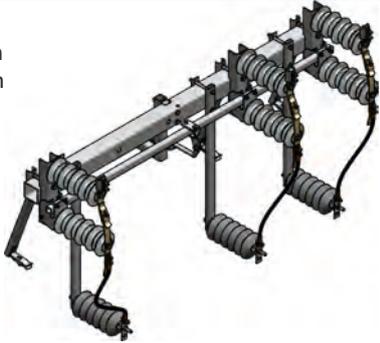
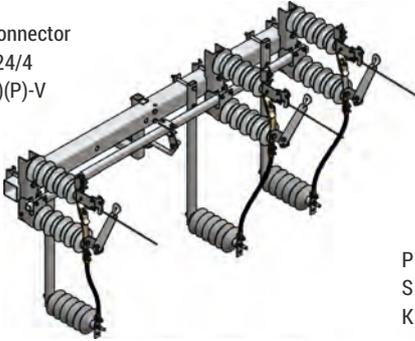
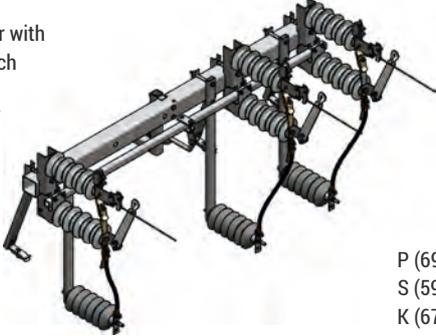
Switch disconnecter RN III 24/4-100A o W-S(K)(P)-V	 P (69,5 kg) S (59,5 kg) K (67,5 kg)	Switch disconnecter with an earthing switch RUN III 24/4-100A o W-S(K)(P)-V	 P (71,5 kg) S (61,3 kg) K (69,5 kg)
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NOTE!

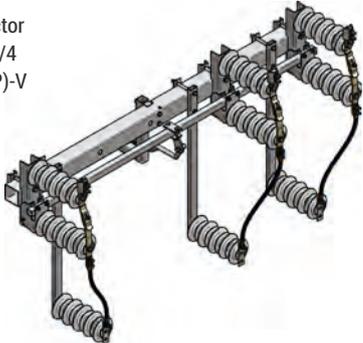
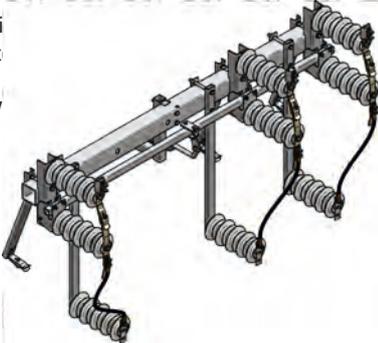
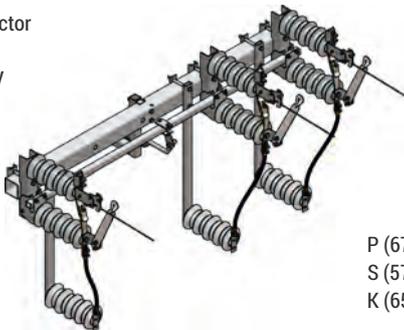
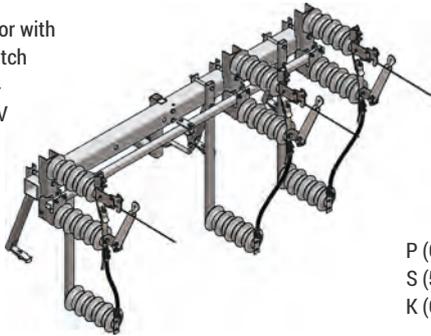
The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

SWITCHES – VERSIONS

Modular switches with a design for installation of overvoltage limiters (vertical)

Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Disconnecter ON III 24/4 o W-S(K)(P)-V	 <p>P (65,5 kg) S (55,3 kg) K (63,5 kg)</p>	Disconnecter with an earthing switch OUN III 24/4 o W-S(K)(P)-V	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>
Switch disconnecter RN III 24/4 o W-S(K)(P)-V	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>	Switch disconnecter with an earthing switch RUN III 24/4 o W-S(K)(P)-V	 <p>P (69,5 kg) S (59,3 kg) K (67,5 kg)</p>

Modular switches with a design for installation of post insulators (vertical)

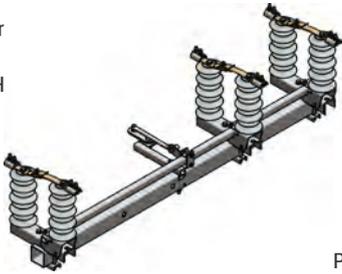
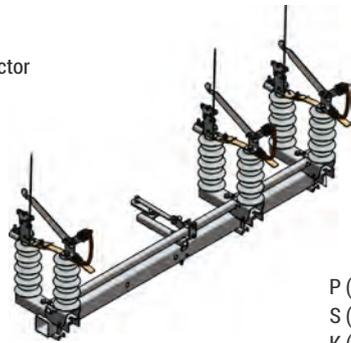
Disconnecter ON III 24/4 i W-S(K)(P)-V	 <p>P (65,5 kg) S (55,3 kg) K (63,5 kg)</p>	Disconnecter with an earthing switch OUN III 24/4 i W-S(K)(P)-V	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>
Switch disconnecter RN III 24/4 i W-S(K)(P)-V	 <p>P (67,5 kg) S (57,3 kg) K (65,5 kg)</p>	Switch disconnecter with an earthing switch RUN III 24/4 i W-S(K)(P)-V	 <p>P (69,5 kg) S (59,3 kg) K (67,5 kg)</p>

NOTE!

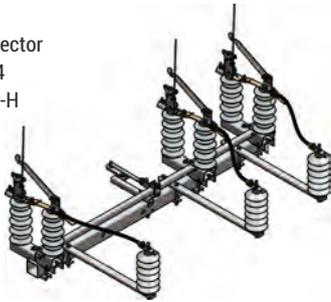
The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

SWITCHES – VERSIONS

Modular switches for 36 kV in a basic version (horizontal)

Device type	Switch drawing and weight	Type of device with the earthing switch	Switch drawing and weight
Disconnector ON III 36/4 W-S(K)(P)-H	 <p>P (64,0 kg) S (54,3 kg) K (62,5 kg)</p>	Disconnector with an earthing switch OUN III 36/4 W-S(K)(P)-H	 <p>P (66,5 kg) S (56,5 kg) K (63,5 kg)</p>
Switch disconnector RN III 36/4 W-S(K)(P)-H	 <p>P (66,5 kg) S (56,5 kg) K (64,5 kg)</p>	Switch disconnector with an earthing switch RUN III 36/4 W-S(K)(P)-H	 <p>P (68,5 kg) S (58,5 kg) K (65,0 kg)</p>

Modular switches for 36 kV with a design for installation of overvoltage limiters (horizontal)

Disconnector ON III 36/4 o W-S(K)(P)-H	 <p>P (73,5 kg) S (64,8 kg) K (72,5 kg)</p>	Disconnector with an earthing switch OUN III 36/4 o W-S(K)(P)-H	 <p>P (76,5 kg) S (67,3 kg) K (75,0 kg)</p>
Switch disconnector RN III 36/4 o W-S(K)(P)-H	 <p>P (77,5 kg) S (66,0 kg) K (75,0 kg)</p>	Switch disconnector with an earthing switch RUN III 36/4 o W-S(K)(P)-H	 <p>P (79,5 kg) S (68,5 kg) K (77,5 kg)</p>

NOTE!

The manufacturer reserves to introduce design changes at any time, which may change the dimensions and weight.

MV overhead switches

8 / Manual drives for switches

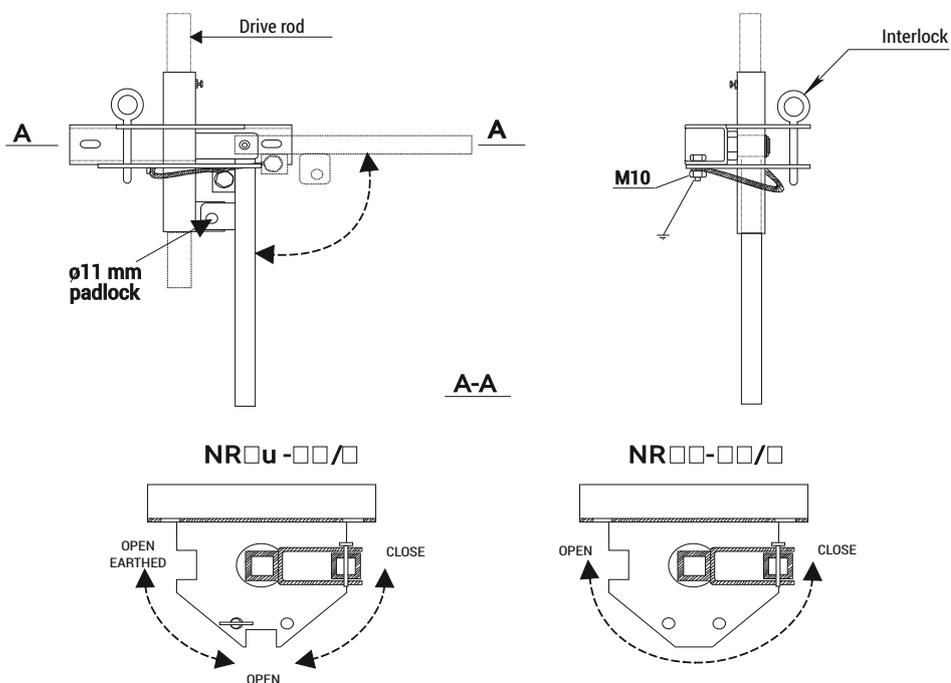
DESIGN

Manual drive is used to operate ON, OUN, RN, RUN, RPN series overhead switches.

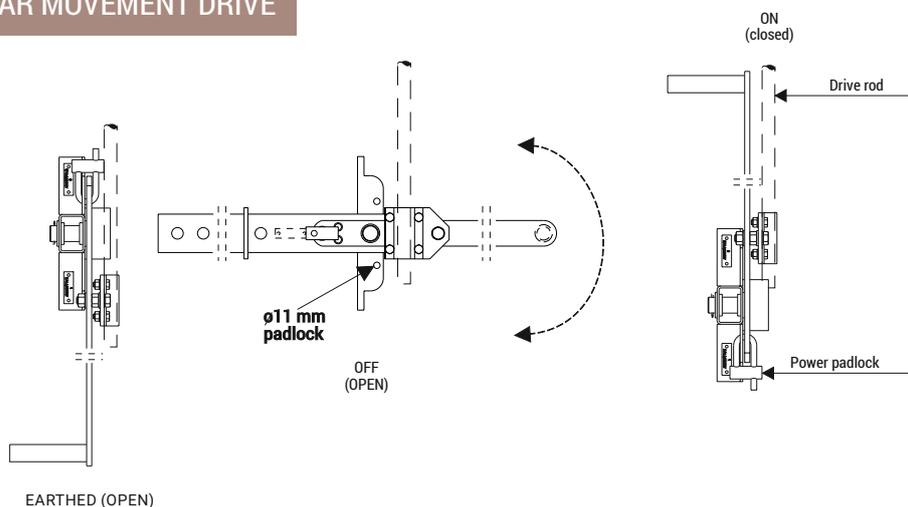
Manual drive consists of a manual lock, rods connecting the switch with the manual lock, and guide rails used to guide the rods over the pole.

Manual drives are constructed in two versions, with a rotating movement and with a linear movement, with the standard solution being rotating drives.

ROTATING MOVEMENT DRIVE



LINEAR MOVEMENT DRIVE



Manual drives adapted to market requirements and in accordance with individual customer's requirements are also available.

MV overhead switches

9 / Motor drives for remote control in Smart Grid networks

DESIGN

The NSP-7/SO2 and NSP-8/SO2 type motor drives by ZPUE are adapted for operating RN and RPN group switches with a rotating movement, instead of used manual drives, with a functionality significantly exceeding other solutions used in power engineering. Motor drive enclosures are made from powder painted aluminium sheet (it is also possible to order drives in stainless steel sheet enclosures), NSP-7/SO2 series drive (requires a separate plant controller installed in a separate plant cabinet).

An NSP-8/SO2 series drive may be equipped with any telemechanics controller, buffer power supply for battery charging, 2x12 V DC battery banks, short-circuit indicator. NPS series motor drives have a rotating movement with a rotation angle of 180° with the possibility of rotation angle adjustment.

The T1 and T2 motor drives are dedicated to only THO series switch disconnectors and were described in the subsection "Switch disconnectors THO sectionalisers in leak proof tanks for Smart Grid networks, parameters were specified in the table below.

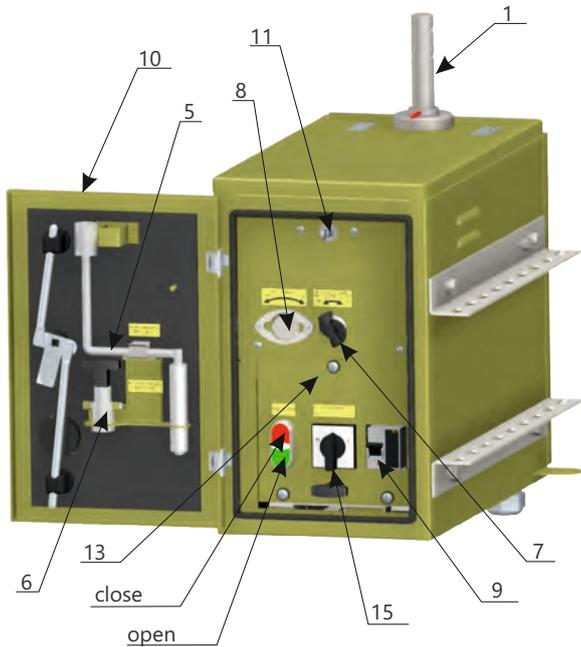
Compliance with standards:

- PN-EN 61439-1:2011 – Low-voltage switchgear and controlgear assemblies. General rules;
- PN-EN 60529:2003 – Degrees of protection provided by enclosures (IP Code).
- PN-EN 60439-5:2008 – Low-voltage switchgear and controlgear assemblies. Particular requirements for assemblies for power distribution in public networks
- PN-EN ISO 1461:2011 – Hot dip galvanized coatings on fabricated iron and steel articles
- PN-EN ISO 12944-2:2001P – Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments
- PN-EN 60529: 2003 – Degrees of protection provided by enclosures (IP Code) and related standards
- PN-EN 62262:2003 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
- PN-EN 61140:2005/A1:2008 – Protection against electric shock. Common aspects for installation and equipment
- PN-EN ISO 12944-2:2001P – Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments.

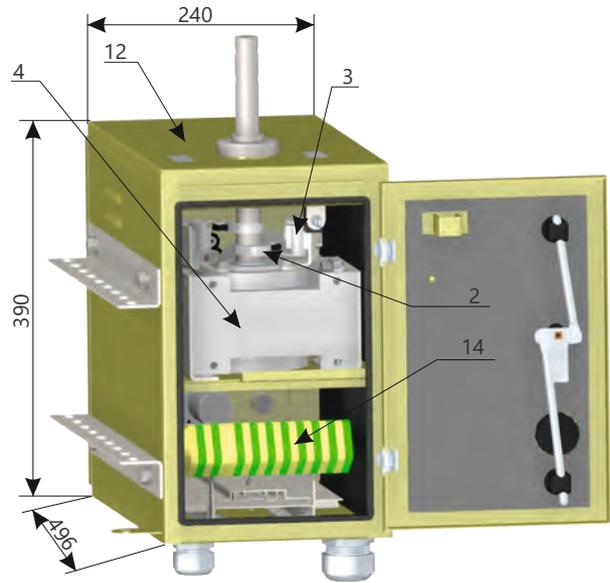
Types of motor drives and basic technical parameters

Drive type	T-1	T-2	NSP-7/SO2	NSP-8 with telemechanics
Power supply voltage	24V DC	24V DC	24V DC	230V AC/ 24V DC
Motor power	80W*	160W	400W	400W
Peak start-up current draw	6A	6,8A	15A	15A
Average time(*) of close/open switching operations	<2s	close <6 open 0.1 s	<2s	<2s
Drive weight	23kg	29kg	38,6kg	65kg

So2 side view



Drive side view



- | | | | |
|---|--|----|--|
| 1 | - main shaft | 9 | - power supply protection with a time switch |
| 2 | - control cam | 10 | - enclosure door |
| 3 | - limit switch, position signalling | 11 | - door opening signalling |
| 4 | - gear-motor | 12 | - drive enclosure |
| 5 | - crank for emergency manual operation | 13 | - SO2 control panel |
| 6 | - motor drive mechanical interlock | 14 | - terminal strip with signal connections |
| 7 | - manual drive socket mechanical interlock | 15 | - operating mode switch (remote, off, local) |
| 8 | - manual drive socket | | |

OPERATING PRINCIPLE

The NSP-7/SO2 drive is a 24 V DC electrical drive equipped with an SO2 control panel. The drive is provided with a 24 V DC motor, single stage gear unit and an electrical control system SO2. Operating the switch disconnector consists of rotating the main shaft by an angle of 180°. The drive design enables operating the drive from ground level. The drive has a mechanical operation interlock, used to protect against drive activation when working on the line.

A mechanical interlock enables the permanent locking of the switch disconnector in the "OPEN" or "CLOSED" position. In order to lock the drive the manual drive socket mechanical interlock (7) should be opened and the mechanical interlock of manual drive (6) should be inserted in a way that ensures the interlock splines fit in the cut out of the manual drive socket (8), close the enclosure doors (10).

OPERATING PRINCIPLE

Opening the manual drive socket interlock causes simultaneous disconnection of the drive power by an activation of the limit switch. Unlocking is performed by removing the mechanical interlock (6) from the manual drive socket (8) and closing the manual drive socket interlock (7). Operating the switch disconnecter may be performed remotely or electrically from the SO2 control panel.

There are following buttons on the control cubicle panel:

“CLOSE” – sending an impulse to close the switch disconnecter;

“OPEN” – sending an impulse to open the switch disconnecter;

Selection of switch disconnecter control is performed with the operation mode selection switch (15):

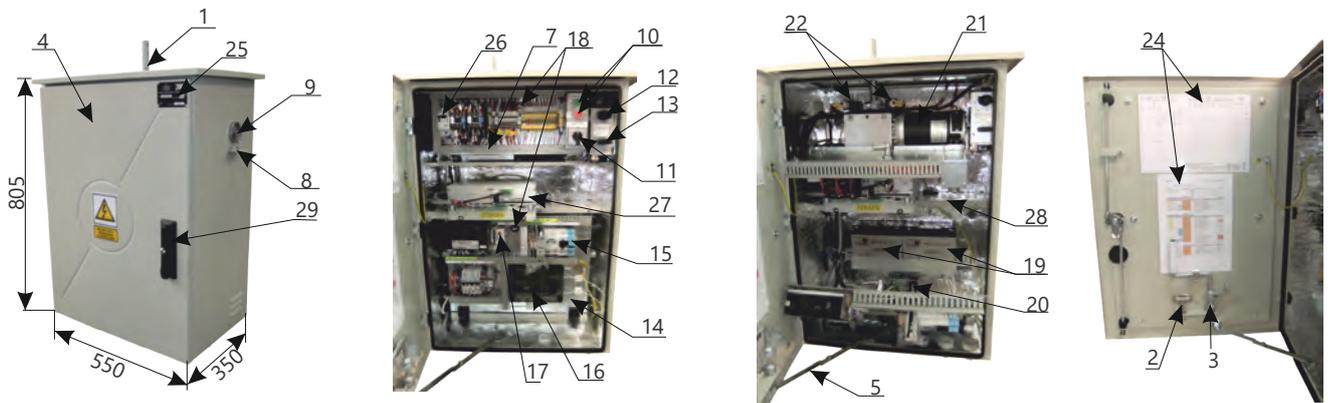
1. REMOTE – remote (radio) control of the switch

0. OFF – control deactivated

2. LOCAL – operating the switch with buttons on the SO2 control panel in the drive

Detailed information about the drive are specified in the O&M documentation.

NSP-8/SO2 motor drive with a telemechanics system



- | | |
|---|--|
| 1 - main drive shaft | 15 - main overcurrent protection with fuse switches Tytan (4A) |
| 2 - espagnolette key for opening the panels | 16 - earth fault indicator (option depending on the controller type) |
| 3 - manual drive crank | 17 - temperature regulator |
| 4 - drive enclosure | 18 - espagnolette key for opening the panels |
| 5 - door opening interlock | 19 - 2x12 V DC battery bank |
| 6 - terminal for earthing the drive enclosure | 20 - 030 W heater |
| 7 - SO2 control panel | 21 - gear-motor |
| 8 - place for a mechanical interlock padlock installation | 22 - limit switches of drive shaft position indication |
| 9 - manual drive socket | 23 - optical shaft position indicator (by the main shaft 1) |
| 10 - local control buttons
(close/open) | 24 - electrical diagrams |
| 11 - control mode selection switch
(remote/off/local) | 25 - rating plate |
| 12 - manual drive lever interlock | 26 - 24V DC drive power supply circuit breaker |
| 13 - manual drive interlock lever | 27 - plant controller (depending on the manufacturer) |
| 14 - assembly plate with devices | 28 - radio modem (e.g. TETRA) installation location |
| | 29 - padlockable lock |

DRIVE DESIGN

The NSP-8 drive is installed in powder-painted aluminium sheet enclosure with thermal insulation (it can also be made from stainless steel sheet at special request), and is additionally equipped with a Master Key type lock with the possibility of being locked with a padlock. The construction of the drive allows its operation from the ground level. The drive is fixed to the pole in a manner allowing the connection of the main NSP drive shaft to the switch disconnecter drive crank. The rods which connect the switch disconnecter with the NSP-8 drive are delivered as the drive's equipment. The drive is equipped with a motor and a single stage gear unit and an electric control system.

Operating the switch disconnecter consists of rotating the main shaft by an angle of 180°.

For correct operation, the NSP-8 drive requires an external 230 V power supply from an auxiliary transformer, installed on the pole station. Moreover the electric drive has a place for the installation of a plant controller on a DIN bus and additionally has a place for the installation of an external ground and interphase short-circuit indicator. A diagram of connecting the NSP-8 drive with the controller and a part of the assembly plate is shown in some of the drive O&M documentation. Before commencing switching operations using remote control or control cubicle panel control, one should acquaint oneself with the operation of the manual drive, in particular with the possibility of mechanically interlocking the drive, which is described in detail in the O&M documentation.

Operating the switch disconnecter may be performed remotely or electrically from the SO2 control panel. There are following buttons on the control cubicle SO-2 panel (10):

“CLOSE” – sending an impulse to close the switch disconnecter;

“OPEN” – sending an impulse to open the switch disconnecter;

Selection of switch disconnecter control is performed with the operation mode selection switch (11):

1. REMOTE – remote (radio) control of the switch
0. OFF – control deactivated without the possibility of remote and local control
2. LOCAL – operating the switch with buttons (10) on the SO2 control panel

Detailed information about the drive are specified in the O&M documentation.

SO series plant cabinets for remote supervision of switches in Smart Grid networks

The “SO” plant cabinets are intended for comprehensive operation of remotely controlled switches made by ZPUE. The plant cabinet enclosure is constructed of powder-painted aluminium sheet. The cabinet enclosure uses a special drainage system, which prevents infiltration of contaminants. The cabinet enclosure doors are equipped with a padlockable Master-Key type lock and with an interlock preventing accidental closing. Plant cabinets may be equipped with a 230 V AC servicing socket, internal lighting, 30 W power heater and an exhaust ventilator.

At the bottom of the plant cabinet metal glands with diameters of DN 36 and DN 29, through which control cables from the disconnecter drive, antenna cable and power supply from the auxiliary transformer or other power sources pass (the glands are individually adapted at the manufacturing stage). Plant cabinets contain space for the installation of telemechanics controllers available on the market, and for communication modems by any manufacturer, which integrate the following functions: metering, protection, motor drive control, telemechanics, automation and multi-channel fault recorder, as well as collecting and processing information about network parameters and events, and provide appropriate communication with the SCADA system. Detailed functional description of the controllers and communication modules is contained in the separate documentation of the controllers by individual manufacturers.

SO plant cabinet parameters

Rated voltage of the alternating current power supply	230VAC
Rated voltage of internal systems power supply	24/12VDC
Protection rating	IP54 (64)*
Ambient temperature range	-40°C +60°C
The possibility of installing data transmission modules	GPRS/TETRA/NET-MAN/TRUNKING
Mechanical impact protection rating	IK10
Net weight	35-50kg*

* Net weight depends on the version of equipment and number of operated switches.

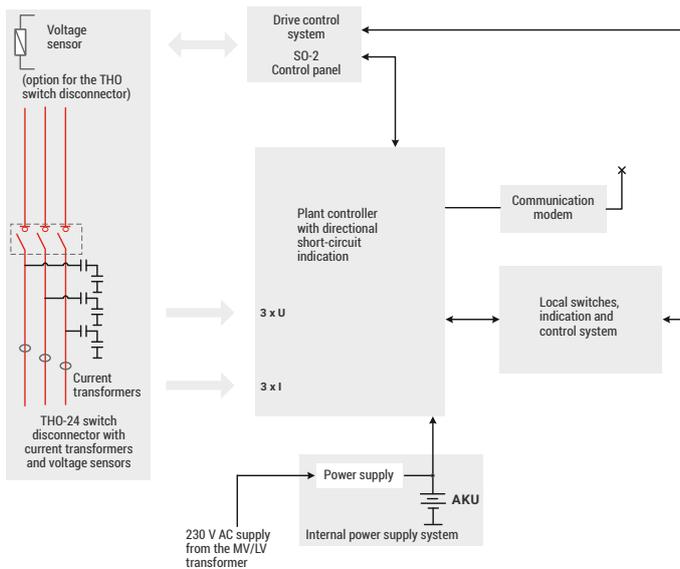
* IP rating possible for construction depending on the customer's requirements

* Possible version with external 110 V AC power supply

Compliance with standards:

- PN-EN 62271-1 – High-voltage switchgear and controlgear. Common specifications.
- PN-EN 61439-1:2011 – Low-voltage switchgear and controlgear assemblies. General rules.
- PN-EN 60529:2003 – Degrees of protection provided by enclosures (IP Code).
- PN-EN 60439-5:2008 – Low-voltage switchgear and controlgear assemblies. Particular requirements for assemblies for power distribution in public networks.
- PN-EN ISO 1461:2011 – Hot dip galvanized coatings on fabricated iron and steel articles.
- PN-EN ISO 12944-2:2001P – Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments.
- PN-EN 60529: 2003 – Degrees of protection provided by enclosures (IP Code) and related standards.
- PN-EN 62262:2003 – Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
- PN-EN 61140:2005/A1:2008 – Protection against electric shock. Common aspects for installation and equipment.
- PN-EN ISO 12944-2:2001P – Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments.

Block diagram of the “SO” plant cabinet



Communication with control centres within Smart Grid networks



S01-THO-T1 plant cabinet with SO-54SR-3xx controller

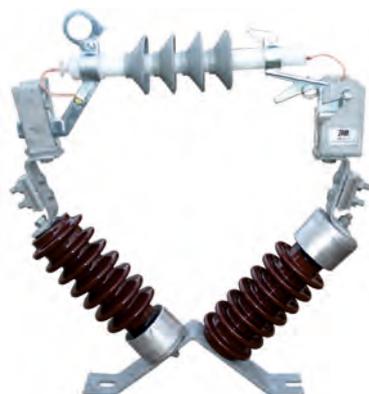


SO-5-THO-T1 plant cabinet with Ex-micro_xx controller



SO1_2-THO-T1 plant cabinet with SO-54SR-4xx controller

Overhead fuse bases



PBNV-24



PBNW-24



PBNV-24_R-S



PBNW-24_R-S

CHARACTERISTICS AND USE

Overhead fuse bases are used to protect transformers in pole transformer stations and to protect MV voltage transformers in overhead metering systems.

The PBNW overhead fuse bases are intended for operation with pipe type fuse links with a length of 442 mm, e.g. HH24...A; VVC...A; EPA/FPA...A type.

The PBNV overhead fuse bases are intended for operation with WBGnp, OWBNG fuse links with up to 40 A fuse elements. The fuse bases may be optionally equipped with an MV overvoltage limiter – as an option replacing one of the post insulators.

Compliance with standards:

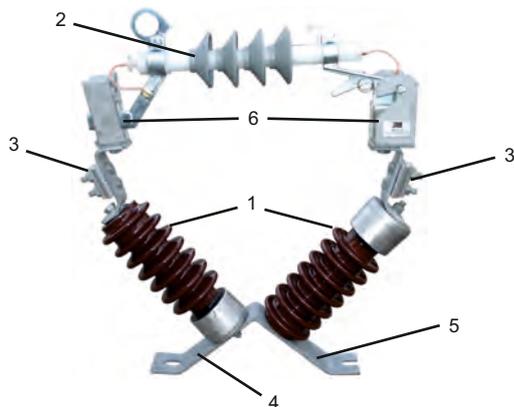
Fuse bases meet the requirements of the latest PN-EN standards and have a certificate of conformity from an accredited certification body.

Technical parameters of fuse bases

Rated voltage U_r	24kV	36kV
Rated surge insulation test voltage		
- earth and inter-pole	125kV	170kV
- inter-terminal	145kV	195kV
Rated insulation alternating test voltage		
- earth and inter-pole	50kV	70kV
- inter-terminal	60kV	80kV
Rated frequency	50 Hz	
Rated continuous current of the base	PBNV-40A PBNW-100A (depending on the used link)	
Rated continuous currents of the fuse links	PBNV-24 (from 2 to 40A) PBNW-24 (from 0,5 to 80A)	
Rated breaking current	6,3kA	
Link type	For PBNV-24 For PBNW-24	WBGnp-17,5; 24, OWBG-36 HH 24...A; VVC; EPA/FPA...A
Post insulator type	CH-4-125; HASDI; ISWN; SGT	CH-4-170; HASDI; ISWN

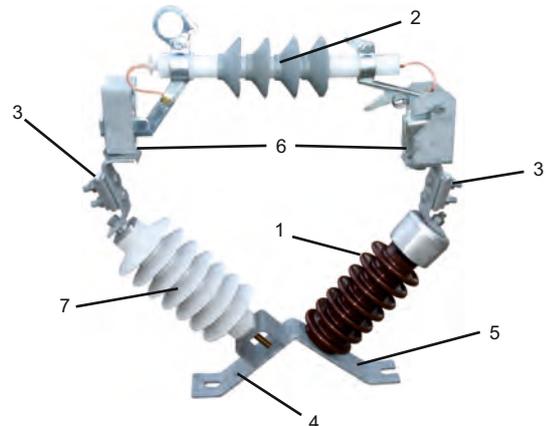
DESIGN

PBNV-24



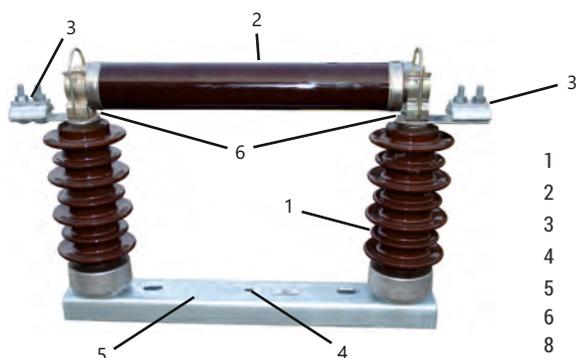
- 1 - porcelain or composite post insulator
- 2 - WBGnp, OWB fuse link
- 3 - current terminal
- 4 - earthing terminal
- 5 - mounting element of the base
- 6 - main contacts of the base
- 7 - earthing cone (optional equipment for each base)

PBNVo-24/D w I



- 1 - porcelain or composite post insulator
- 2 - WBGnp, OWB fuse link
- 3 - current terminal
- 4 - earthing terminal
- 5 - mounting element of the base
- 6 - main contacts of the base
- 7 - MV overvoltage limiter (optional equipment)
- 8 - earthing cone (optional equipment for each base)

PBNW-24



- 1 - porcelain or composite post insulator
- 2 - HH, EPA/FPA fuse link
- 3 - current terminal
- 4 - earthing terminal
- 5 - mounting element of the base
- 6 - main contacts of the base
- 8 - the (R) designation means an earthing cone (optional equipment for each base)

Type E spun concrete poles

11 / Pre-tensioned spun concrete poles and prefabricated foundations

SPUN CONCRETE POLES

The type E pre-tensioned spun concrete poles offered by ZPUE S.A. are highest quality products, compliant with the international EN 12843 standard. The use of state-of-the-art concrete mixture compaction technology by using the spinning method enables the achieving of high degree of compaction and a smooth surface, which guarantees the high durability and load-bearing capacity of spun concrete poles. Minimum concrete compressive strength C40/50 and on special customer request C50/60 acc. to EN 206-1.

The entire pole manufacturing process is strictly followed and supervised acc. to certification of the Factory Production Control 1487-CPR-2/ZKP/14.

CHARACTERISTICS

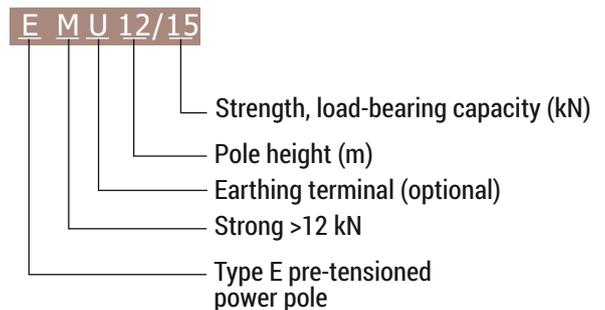
- designed working life of 50 years without the need for maintenance,
- low water absorption <3.5%, high frost resistance, exposure class XC4, XF2 acc. to the EN 206-1 standard confirmed by tests conducted by an accredited research body,
- aesthetic design, scratching and cracking resistance of the smooth surface,
- limiting the amount of land excluded from agricultural use,
- enabling the increase of span length, lower number of poles per 1 km of transmission line,
- easy foundation in the ground,
- replacing of extended tower structures with a single pole.

USE

- supports for overhead and overhead and buried cable MV and LV lines and telecommunications lines, train and tram overhead lines,
- various general purpose support structures.



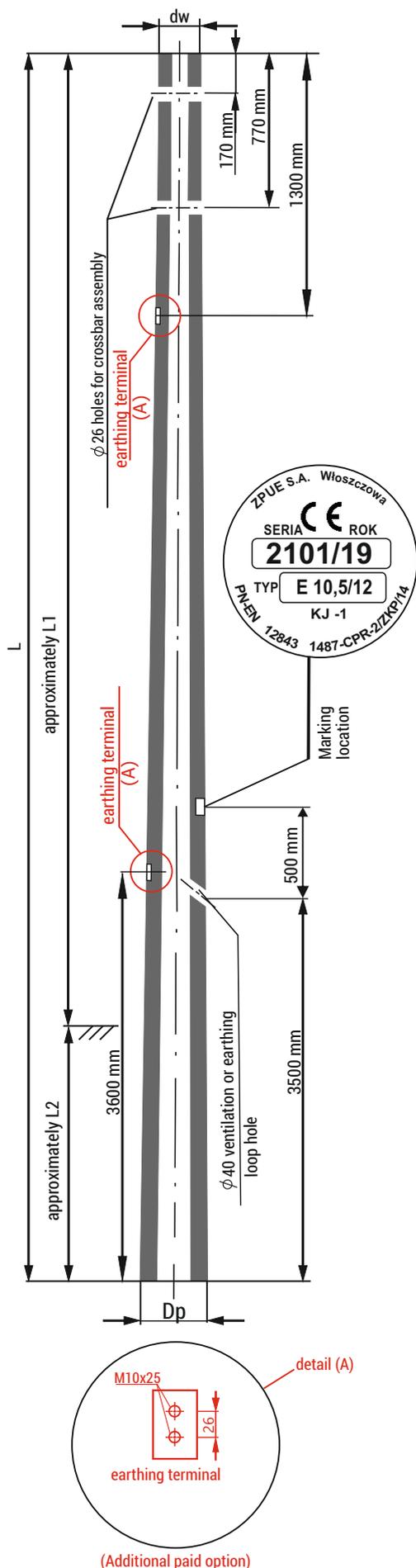
POLE DESIGNATIONS



Legend

- L** - total length of the pole
- dw** - outside diameter of the apex
- Dp** - outside diameter of the base

TECHNICAL PARAMETERS OF E TYPE POLE



Pole type	Effective strength [kN]	Breaking strength [kN]	Theoretical weight [kg]	Dimensions					Strength colour designation
				[M.]			[mm]		
				L	L1	L2	dp	dw	
1 E 6,7/12	12	21,6	850	6,7	6,7	1,5	353	218	yellow
2 E 7,5/12	12	21,6	980	7,5	6,7	1,5	330	218	yellow
3 E 8,2/4,3	4,3	7,7	987	8,2	6,7	1,5	353	218	blue
4 E 8,2/6	6,0	10,8	990	8,2	6,6	1,6	341	218	black
5 E 8,2/10	10,0	18,0	1100	8,2	6,6	1,6	341	218	red
6 E 8,2/12	12,0	21,6	1150	8,2	6,6	1,6	341	218	yellow
7 E 8,2/15	15,0	27,0	1150	8,2	6,6	1,6	341	218	green
8 E 9/2,5	2,5	4,5	775	9,0	7,4	1,6	308	173	white
9 E 9/4,3	4,3	7,7	845	9,0	7,4	1,6	308	173	blue
10 E 9/6c	6,0	10,8	845	9,0	7,4	1,6	308	173	black
11 E 9/6	6,0	10,8	1162	9,0	7,7	1,6	353	218	black
12 E 9/10	10,0	18,0	1200	9,0	7,2	1,8	353	218	red
13 E 9/12	12,0	21,6	1224	9,0	7,2	1,8	353	218	yellow
14 E 9/15	15,0	27,0	1180	9,0	7,2	1,8	353	218	green
15 E 10,5/2,5	2,5	4,5	988	10,5	8,7	1,8	330	173	white
16 E 10,5/4,3c	4,3	7,7	1048	10,5	8,5	2,0	330	173	blue
17 E 10,5/4,3	4,3	7,7	1308	10,5	8,5	2,0	375	218	blue
18 E 10,5/6 c	6,0	10,8	1048	10,5	8,5	2,0	330	173	black
19 E 10,5/6	6,0	10,8	1308	10,5	8,5	2,0	375	218	black
20 E 10,5/10	10,0	18,0	1476	10,5	8,3	2,2	375	218	red
21 E 10,5/12	12,0	21,6	1568	10,5	8,3	2,2	375	218	yellow
22 E 12/2,5	2,5	4,5	1156	12,0	10,0	2,0	353	173	white
23 E 12/4,3c	4,3	7,7	1298	12,0	9,8	2,2	353	173	blue
24 E 12/4,3	4,3	7,7	1605	12,0	9,8	2,2	398	218	blue
25 E 12/6c	6,0	10,8	1298	12,0	9,8	2,2	353	173	black
26 E 12/6	6,0	10,8	1605	12,0	9,8	2,2	398	218	black
27 E 12/10	10,0	18,0	1822	12,0	9,5	2,5	398	218	red
28 E 12/12	12,0	21,6	1930	12,0	9,5	2,5	398	218	yellow
29 E 12/15c	15,0	27,0	2090	12,0	9,5	2,5	398	218	green
30 E 13,5/2,5	2,5	4,5	1668	13,5	11,3	2,2	375	173	white
31 E 13,5/4,3c	4,3	7,7	1168	13,5	11,1	2,4	375	173	blue
32 E 13,5/4,3	4,3	7,7	1887	13,5	11,1	2,4	420	218	blue
33 E 13,5/6	6,0	10,8	2047	13,5	11,0	2,5	420	218	black
34 E 13,5/10	10,0	18,0	2230	13,5	10,8	2,7	420	218	red
35 E 13,5/12	12,0	21,6	2394	13,5	10,8	2,7	420	218	yellow
36 E 15/2,5	2,5	4,5	1690	15,0	12,5	2,5	398	173	white
37 E 15/4,3c	4,3	7,7	1913	15,0	12,3	2,7	398	173	blue
38 E 15/4,3	4,3	7,7	2374	15,0	12,3	2,7	443	218	blue
39 E 15/6	6,0	10,8	2379	15,0	12,2	2,8	443	218	black
40 E 15/10	10,0	18,0	2657	15,0	12,0	3,0	443	218	red
41 E 15/12	12,0	21,6	2809	15,0	12,0	3,0	443	218	yellow





TECHNICAL PARAMETERS OF EM >12kN TYPE POLE

	Pole type	Effective strength [kN]	Breaking strength [kg]	Theoretical weight [kg]	Dimensions					Strength colour designation
					[m]			[mm]		
					L	L1	L2	dp	dw	
42	Em 9/20	20,0	36,0	1508	9	7,2	1,8	353	218	brown
43	Em 10,5/15	15,0	27,0	1875	10,5	8,3	2,2	420	263	green
44	Em 10,5/15	15,0	27,0	1785	10,5	8,3	2,2	375	218	green
45	Em 10,5/17,5	17,5	31,5	1907	10,5	8,3	2,2	420	263	orange
46	Em 10,5/20	20,0	36,0	1991	10,5	8,3	2,2	420	263	brown
47	Em 10,5/20	20,0	36,0	1878	10,5	8,3	2,2	420	218	brown
48	Em 10,5/25	25,0	45,0	2082	10,5	8,3	2,2	420	263	violet
49	Em 12/15	15,0	27,0	2225	12,0	9,5	2,5	443	263	green
50	Em 12/17,5	17,5	31,5	2383	12,0	9,5	2,5	443	263	orange
51	Em 12/20	20,0	36,0	2492	12,0	9,5	2,5	443	263	brown
52	Em 12/20	20,0	36,0	2306	12,0	9,5	2,5	443	218	brown
53	Em 12/25	25,0	45,0	2518	12,0	9,5	2,5	443	263	violet
54	Em 12/30	30,0	54,0	3017	12,0	9,5	2,5	488	308	grey
55	Em 12/35	35,0	63,0	3096	12,0	9,5	2,5	488	308	grey
56	Em 13,5/15	15,0	27,0	2499	13,5	10,8	2,7	420	218	green
57	Em 13,5/15	15,0	27,0	2841	13,5	10,8	2,7	465	263	green
58	Em 13,5/17,5	17,5	31,5	2893	13,5	10,8	2,7	465	263	orange
59	Em 13,5/20	20,0	36,0	2568	13,5	10,8	2,7	420	218	brown
60	Em 13,5/20	20,0	36,0	3042	13,5	10,8	2,7	465	263	brown
61	Em 13,5/25	25,0	45,0	3086	13,5	10,8	2,7	465	263	violet
62	Em 13,5/30	30,0	54,0	3609	13,5	10,8	2,7	511	308	grey
63	Em 13,5/35	35,0	63,0	3714	13,5	10,8	2,7	511	308	grey
64	Em 15/15	15,0	27,0	2914	15,0	12,0	3,0	443	218	green
65	Em 15/15	15,0	27,0	3131	15,0	12,0	3,0	488	263	green
66	Em 15/17,5	17,5	31,5	3131	15,0	12,0	3,0	488	263	orange
67	Em 15/20	20,0	36,0	3225	15,0	12,0	3,0	488	263	brown
68	Em 15/25	25,0	45,0	3225	15,0	12,0	3,0	488	263	violet
69	Em 15/30	30,0	54,0	4250	15,0	12,0	3,0	533	308	grey
70	Em 15/35	35,0	63,0	4406	15,0	12,0	3,0	533	308	grey

Colour designations were assumed using generally used guidelines, possible colour designation acc. to individual customer requirements.

The possibility of constructing the pole in different dimensions, as in the table.



PREFABRICATED FOOTING ELEMENTS

Prefabricated concrete elements designed for foundations of poles and transformer stations in MV and LV overhead networks. Prefabricated concrete footing and foundation elements are made of grade C30/35 concrete. Selection of footing elements should be made based on soil parameter assessment acc. to principles established in harmonised standards concerning the footing of support elements in the soil.

List of footings and foundations			
	Footing type	Type	Footing elements
1	Slab footing	UP 1 - 7	U slab - 85 U slab - 130 Footing slab 0,3 x 0,3 Clamping ring OU-1, OU-2, OU-6/VE
2	Slab footing	UP 11 - 18	U slab - 85 U slab - 130 Element ES-2 Footing slab 0,3 x 0,3
3	Beam footing	For ŽN and BSW poles	B beam - 60 B beam - 80 B beam - 90 B beam - 150
4	Prefabricated foundation	SFP 111, 122, 133 SFP 21/L, 22/L, 23/L SP 1, 2, 3 SP 11, 22, 33	PD bottom slab PS slab 120 PS slab 160 PS slab 200 SFP/L screw connections
5	Prefabricated foundation	FP 11, 12, 13 FP 21, 22, 23	Element EF P slab - 120 P slab - 160 P slab - 200 Assembly bolts

Element name	Element symbol	a [cm]	Element weight [kg]	Element drawing
SLAB FOOTING	P - 120	120	675	
	P - 160	160	900	
	P - 200	200	1125	

Element name	Element symbol	a [cm]	Element weight [kg]	Element drawing
BEAM FOOTING	PS - 120	120	400	
	PS - 160	160	530	
	PS - 200	200	660	
	U - 85	77		
	U - 130	156		
	Bottom slab PD	510		

Element name	Element symbol		Element drawing
FOOTING ELEMENTS	B - 60	23	
	B - 80	38	
	B - 90	72	
	B - 150	120	
FOOTING ELEMENTS	EF	1060	