power your future

Medium voltage switchgears

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INTRODUCTION

The catalogue presents RELF and RELF ex type medium voltage switchgear:

- air insulated (AIS),
- in metal enclosure,
- metal-clad,
- ,
- with a single busbar
- for a rated voltage up to 36 kV,
- for indoor use.

DESCRIPTION

- The switchgear is designed to operate in distribution transformer stations in industrial sites which generate, distribute and consume electricity.
- The switchgear complies with the requirements of (PN-EN) IEC 62271-200, (PN-EN) IEC 62271-1 and GOST, provides IP4X degree of protection for external enclosures and IP2X for internal partitions in accordance with (PN-EN) IEC 60529. It is designed to work in normal conditions defined by the (PN-EN) IEC 62271-1 standard.
- The switchgear is designed to assure safety during normal operation, inspection and handling.
- The switchgear cubicle is of a frameless construction, made of galvanized steel sheets and fixed with rivets. It is in the form of a multi-compartment cabinet, with walls and partitions that form a self-supporting structure.
- In the switchgear cabinet there are separate compartments containing: connections, busbars, an apparatus with a withdrawable module and an auxiliary circuitry compartment.
- The cabinet's door and side shields of the outermost bays (back shields for wall mounted cubicles) are powder coated.

TYPES OF BAYS

The switchgear may be composed of various functional units.
These are:

- incoming/outgoing feeder bays,
- bus coupler bays,
- bus riser bays,
- metering bays with the possibility of busbars earthing,
- switch disconnector bay,
- others - acc. to arrangements.

The withdrawable module of the switchgear may be equipped with a circuit breaker, contactor, sectionalizer or a set of fused voltage transformers. The withdrawable module may be placed in the positions of: service, test/disconnection and separation.

CHARACTERISTICS AND ADVANTAGES

- air insulated,
- optional electrical drives for all switches - fully automated switchgear
- Loss of Service Continuity category - LSC2B (three MV compartments),
- possibility of equipping with current and voltage sensors - environmentally friendly solution,
- IAC AFLR internal arc classification,
- interlocks and protections against performing incorrect switching operations,
- wall-standing or free-standing options,
- optional thermal imaging measurements of cable connections or temperature monitoring system,
- possibility of expanding the switchgear with additional bays,
- possibility of bay replacement without the need to draw aside the adjacent bays,
- ease of operation.

The switchgear ensures high safety of operation through:

- internal arc resistance of the switchgear enclosure,
- improper switching operations interlocks and door locks and interlocks,
- racking the withdrawable module with doors closed,
- the use of compartments with PM class partitions,
- the possibility of visual control of switching operations through inspection windows,
- the use of blow-out flaps which limit the pressure increase in case of an internal arcing fault,
- optional gas exhausting duct - discharges gases outside of the switching station room,
- bay voltage indication system.

BASIC TECHNICAL DATA

Compliance with standards:

The RELF type switchgear meets the requirements of the following standards:

- **(PN-EN) IEC 62271-1** - „High-voltage switchgear and controlgear. Common specifications",
- **(PN-EN) IEC 62271-200** - „High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV",

The switchgear is certified by appropriate accredited bodies.

Electrical data:

		RELF				RELFex
Rated voltage	[kV]	12	17,5	24	36; 40,5*	12 / 17,5
Main busbars and incoming feeder rated continuous current	[A]	630-4000	630-2500	630-2500	630-1600	630-2500
Rated power-frequency withstand voltage	[kV]	28	38	50	95; 85,5 (5min) /95 (1min)*	28; 38
Rated lightning impulse withstand voltage	[kV]	75	95	125	190	75; 95
Rated frequency	[Hz]	50				
Rated short-time withstand current	[kA/3s]	up to 40	up to 31,5	up to 31,5	up to 25 (up to 31,5/1s)	up to 25
Rated peak withstand current	[kA]	up to 100	up to 80	up to 80	63 /80	up to 63
Withstand for internal arcing fault	[kA]	up to 31,5/1 s up to 40/0,5 s	up to 31,5/1s	up to 31,5kA/1s	up to 25/1s	up to 25/1s
Degree of protection		up to IP4X (IP3X for 4000A)				
Cubicle height	[mm]	2200[1]	2200[1]	2250[1]	2550	2250
Cubicle width	[mm]	600-950 (650-1000)	600-950 (800-1000)	800/1000	1300	650/800/1000
Cubicle depth	[mm]	1250/1575/1675	1250/1575/ 1675	1600/1688/1725	2035	1375/1388
Compliance with standards		(PN-EN) IEC 62271-200; (PN-EN) IEC 62271-1				

Service conditions:

Ambient temperature		Relative humidity of air	
- peak short-time	+ 40°C	- highest day average	95%
- highest day average	+ 35°C	- highest month average	90%
- highest annual average	+ 20°C	- highest day average vapour pressure	2,2kPa
- lowest long-term	- 5°C	- highest month average vapour pressure	1,8 kPa
Atmosphere at the place of installation		no significant contamination with salt, vapour, dust, smoke, flammable or corrosive gasses and lack of icing, frosting and dewing	
Installation altitude		up to 1000 m. a.s.l.[2]	
Vibrations		vibrations caused by external factors or earthquakes negligible	

Note:

[1] - bay height may differ due to construction and height of the LV compartment. Details should be arranged with the manufacturer.

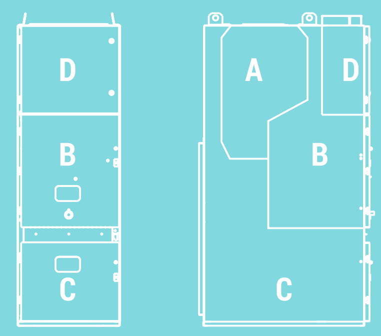
[2] - if the switchgear installation altitude is higher than 1000 m. a.s.l. the switchgear insulation level should be corrected in accordance with the standard.

SWITCHGEAR DESIGN

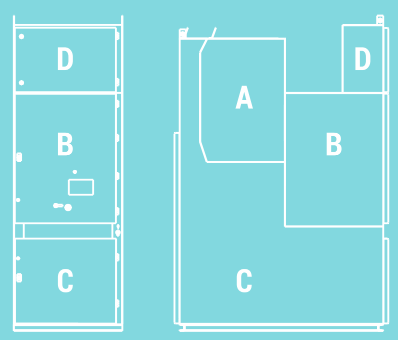
Design

The RELF switchgear bay is designed as a cabinet divided into four separate functional compartments:
A - busbars compartment (medium voltage circuits),
B - main device compartment (medium voltage circuits),
C - cable compartment (medium voltage circuits),
D - auxiliary circuits LV compartment (low voltage circuits).

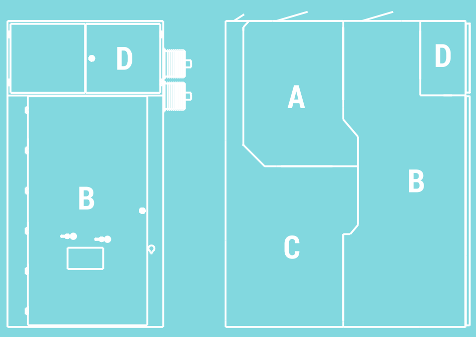
RELF version I



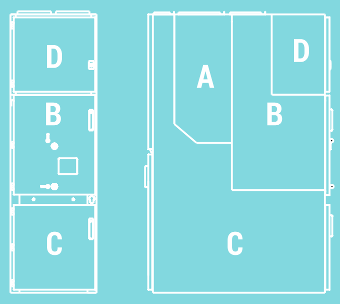
RELF version II



RELF 36



RELF ex



The switchgear cubicle is constructed of bent steel sheets, riveted together, without welding. Walls and partitions create a self-supporting structure. A corrosion-resistant zinc-coated sheet is used for the construction of cabinets.

High-strength round-head steel rivets were used to connect structural elements. Functional compartments are limited by internal vertical and horizontal partitions. The internal partitions are attached to side walls, reinforcing and stabilising the entire enclosure. Additionally, two-part side covers made of painted sheet are bolted to the external walls of the outer bays of the switchgear.

The switchgear may be constructed as free-standing or wall-standing. The front belt between the doors of the main device compartment and the doors to the cable connection compartment and the horizontal partition between these compartments **are removable**[1)], which significantly facilitates maintenance and installations.

[1)] does not apply to the RELF 36 version

Internal partitions allow safe access to main device compartment and cable connection compartment, even when the primary busbars are live.

In accordance with the LSC (Loss of Service Continuity) category, the switchgear meets the criteria of LSC2B. This condition is met by switchgear with three MV compartments and the withdrawable module placed in the test/disconnection position.

The MV circuits compartment doors are made of powder coated sheet. Doors use hinges and bolts which can stand up to explosion-type loads. The hinges allow opening the doors by approximately 135º (170º in case of RELF 36). Upper and lower edges of the doors were reinforced by appropriately shaped and welded reinforcing profiles.

Doors to the main device compartment are equipped with an inspection window used for visual control of the position of the withdrawable module and switching operations.

The design of the doors allows the mechanical opening of the circuit breaker in operating position with the doors closed.

Blow-out flaps

All MV compartments have blow-out duct openings in their top zone, closed with flaps. Their task is to discharge any pressure created inside the compartment as a result of an internal arc fault.

A sudden increase of pressure inside the switchgear compartment breaks the plastic bolts and opens the flaps, which may activate limit switches installed at the roof of the switchgear. Limit switches activated by the flaps being opened send an impulse which trips the main circuit breaker. This allows limiting the effects of an arc fault generated inside the cubicle compartment.

Withdrawable module

The withdrawable module is a unit composed of a racking system, and depending on the bay function: circuit breaker, contactor, set of fused voltage transformers, or a sectionalizer. The racking system performs the physical connection of the withdrawable module with the switchgear bay. It's stationary part is connected with the bay by interlocking on both sides in guide rail cut-outs.

The moving part of the racking system is shifted between the service position and the test/disconnection position using a drive screw operated manually with a crank, or with an electric drive, while the doors are closed. The service and test/disconnection position is signalled by position indicators, after the module reaches an appropriate position.

The shutters in the main device compartment are discussed in the main device compartment description.

Cubicle compartments

The **busbars compartment** is inaccessible during normal operation. For maintenance purposes access to busbars is possible from the top of the cabinet, after removing the blow-out flaps (or from the main device compartment side after removing the partition - for RELF 36). It is closed on both sides with gland plates made of non-magnetic steel sheet or insulating material. These plates prevent damage from spreading to adjacent bays in case of an electric arc in the busbars compartment.

Gland plates and bushings insulators are elements which support the busbars. Outgoing busbars branch off from the main busbars and enter the spouts which separate the busbar compartment from the main device compartment.

The **main device compartment** is available after its doors are open in an interlock-controlled mode. The main device compartment contains the withdrawable module and all the elements necessary for its operation with the cubicle bay, such as: withdrawable module guide rails, shutters, spouts with fixed contacts, door interlock and earthing switch interlock elements and auxiliary circuits socket/plug.

The spouts are installed in the partition separating the main device compartment from the cable connection compartment and busbars compartment. Fixed contacts and outgoing busbars are set in the spouts.

The shutters with an unlocking mechanism are installed in the main device compartment. Their task is to separate the compartment space from fixed contacts, which may be live when the withdrawable module is in the test/disconnection or separation position. A safe insulation space remains between the contacts and the closed shutters.

Racking in the withdrawable module from the test/disconnection position to the operating position causes the shutters to slide apart and the fixed contacts to be exposed, allowing the circuit breaker tulip contacts to connect.

Mechanical indicators of the circuit breaker position and drive charging state are visible through the inspection window.

The **cable connection compartment** is designed to connect cables or busbars and is accessible after opening only the front doors (wall-standing cabinet version) or front and rear doors (free-standing version) in an interlock-controlled mode[1)].
This compartment contains current transformers, an earthing switch, and depending on operational requirements, optionally: voltage transformers[2)], earth fault transformers and surge arresters.

Voltage transformers are installed in the front part of the connection compartment (not in RELF 36kV).

The earthing switch is equipped with a manual drive, or a manual and motor drive. Its status is indicated by the position indicator.

The compartment bottom is closed by a split floor cover, which also acts as a cable gland plate. Openings in the plate are covered with rubber cable glands. Cable clamps installed on supports are used to fasten the cables.

The auxiliary circuits LV compartment is constructed in the form of a control cubicle and is completely separated from the high voltage zone of the switchgear. The cubicle has its own sheet metal enclosure and is prefabricated independently of the high power part of the switchgear. It may be equipped with devices on a separate station, and then attached to the switchgear cabinet.

The cubicle is intended for the installation of: protection relays and IEDs, instrumentation & control devices and automation system elements.

It is installed on the roof of the switchgear, above the switching device compartment. In its bottom, top and side walls a series of openings are made for lead and cable glands and cable trays. These openings are covered by plates, in which holes can be made according to design needs. An assembly plate fixed to the rear wall of the LV cubicle was designed for the installation of devices. The devices may be also fixed on the side walls.
On arrangement with the manufacturer, the cubicle design may be adapted to individual needs of the customer and of the design.

1) in the RELF 36 version the connection compartment is accessible after opening the cabinet doors and removing the partition on the side of the switching device compartment.

2) does not apply to the RELF 36 version.

Main busbars

A single, three-phase busbar system is used in the switchgear. The busbars are installed in a separate compartment.

The main busbars are supported by distribution busbars which come out of the spouts and on insulating bushings installed in the side partitions.

Busbar cross-sections are selected in accordance with the rated current of the switchgear.

Insulating elements

The switchgear uses epoxy resin insulators. In the connection compartment the busbars are supported by post insulators.

For supporting the main busbars and passing them through switchgear bays, bushings are used, set in the gland plates of the bay side walls.

The passages through the partition between the switching device compartment and the busbars compartment and the connection compartment are provided by spouts.

Protective earthing

An earthing conductor is placed in every cabinet, in the form of a copper busbar with a cross-section of 40x5 mm or 40x10 mm, placed at the bottom of the cabinet. These busbars are bridged between the cabinets, creating an earthing conduit. The conduit is terminated by terminals on the left and right side of the switchgear, used to connect it to the facility's earthing system.

Cable connections

The connection compartments are designed for entry of single- or multi-core MV cables.

SYSTEM OF INTERLOCKS AND PROTECTIONS

The switchgear may be equipped with a range of standard and additional mechanical and electrical interlocks, intended to improve operational safety:

Mechanical interlocks:

1) prevent racking the withdrawable module in or out of the operating position when the circuit breaker is closed,
2) allow the closing and opening of the circuit breaker only in the operating and test/disconnection positions,
3) allow the closing of the earthing switch only in the test/disconnection or separation position of the withdrawable module,
4) prevent racking in the withdrawable module from the test/disconnection position to the operating position if the earthing switch is closed,
5) prevent opening the switching device compartment door if the withdrawable module is in the operating or intermediate position,
6) prevent opening the cable compartment door (or bay door in the RELF 36 version) if the earthing switch is open,
7) allow changing the position of withdrawable module only when it is locked in a bay,
8) prevent racking in the withdrawable module from the test/disconnection position to the operating position if the compartment door is open (optional),
9) prevent racking in the withdrawable module from the test/disconnection position to the operating position until the circuit breaker control circuits supply plug is connected to the circuit breaker (option - contact the manufacturer),
10) prevent racking in the withdrawable module from the test/disconnection position to the separation position until the circuit breaker control circuits supply plug is set to the separation position (option - contact the manufacturer),
11) a servicing truck for the transporting of withdrawable modules may be equipped with a secure bay coupling mechanism, which prevents changing the position of the racking truck even when its wheels are unlocked (optional),
12) a servicing truck for the transporting of withdrawable modules may be constructed in a way that allows moving the withdrawable module from the truck to the bay only after mechanical coupling of the truck with the bay (optional),
13) a servicing truck for the transporting of withdrawable modules may be constructed in a way that allows uncoupling the truck from the bay only after the withdrawable module is locked in the bay or in the truck,
14) allow locking the drive of shutters which cover the fixed contacts in the switching device compartment (optional),
15) allow locking access to the earthing switch operating mechanism latch.

The cable connection compartment door lock is constructed to allow closing and locking the door after it has been opened and the earthing switch has been set to the OPEN (de-earthed) position with the doors open. Afterwards, the interlock prevents opening the door again until the next earthing operation.

On arrangement with the manufacturer it is possible to use additional key and padlock interlocks.

Electrical interlocks:

1) prevent closing the circuit breaker if its auxiliary circuits are not powered; only mechanical opening of the circuit breaker is possible (optional),
2) prevent racking the withdrawable module to the operating position without power supply to the control circuits (optional),
3) prevent access to the earthing switch drive when closing of the earthing switch requires additional conditions (for example, main busbar earthing switch can be closed only when the withdrawable modules in the particular section are in the test/disconnection position),
4) prevent access to the withdrawable module drive when racking the module requires additional conditions.

Interlocks are always designed to fit to a particular project.

On arrangement with the switchgear's manufacturer, it is possible to install additional interlocks, which operate based on limiting switches and electromagnetic locks.

The door design allows them to be unlocked in an emergency and the compartment to be accessed when needed.

SWITCHGEAR EQUIPMENT

Switching devices

The switchgear may be equipped as standard with VB-4 (ZPUE), SION (Siemens), VD4 (ABB), HVX (Schneider Electric) vacuum circuit breakers; HD4 (ABB) gas insulated circuit breakers; VSC (ABB) contactors. Other devices may be used on arrangement with the switchgear manufacturer. A fast earthing switch type US1 (ZPUE) or EK6 (ABB) is used to provide the highest level of safety. As standard, NAL/NALF (ABB) type devices are used as switch disconnectors.

Metering instrumentation

Transformers by different manufacturers are used for metering purposes. Bay voltage indication utilizes capacitive insulators or transformers with voltage dividers and a voltage indicator.

Protection devices

The switchgear can be equipped with low voltage devices by any manufacturer, according to the individual needs of the customer.
It is also possible to install any digital protection relay, or IED.

An internal arc protection system can be installed in the switchgear.
The systems sense the internal arc by detecting the flash and an additional voltage or current criteria inside the protected switchgear. When these two events occur simultaneously, the system is activated and a circuit breaker tripping impulse is sent.

DIAGRAMS OF PRIMARY AND AUXILIARY CIRCUITS, SWITCHGEAR AUTOMATION

Primary circuits

Structural diagrams of primary circuit examples are shown on Figure 2, in data sheets provided herein and on the www.zpue.com website. The connection compartment's equipment varies depending on the bay type. Alternative solutions to the ones presented can be implemented on arrangement with the manufacturer.

Auxiliary circuits

LV auxiliary circuits consist of: protection relays, metering, control, automation and signalling systems. An auxiliary circuits compartment located at the front, top part of the switchgear cabinet is intended for the devices of these circuits.

The dimensions of the compartment and example arrangement of devices are presented on figures 3 and 4.

Diagrams of example internal and assembly connections for primary and auxiliary devices for a typical switchgear equipment can be obtained by contacting the switchgear manufacturer.

Switchgear automation

The switchgear is designed to operate in SCADA systems. With this goal in mind it is equipped with digital protection relays (with possible digital communication) and automation systems. The switchgear can then operate in master control systems and automated control systems.

SWITCHGEAR PACKAGING, TRANSPORT AND INSTALLATION

Packaging

Three packaging methods are used for RELF type switchgears:

- **a)** standard packaging - the switchgear cubicle is placed on a pallet and wrapped with shrink wrap,
- **b)** in boxes - switchgear cubicles are packaged as described above and put into boxes,
- **c)** maritime transport packaging - switchgear cubicles with inserted moisture absorbing material are placed in barrier plastic sheet bags, which are evacuated. The switchgears protected in this manner are transported on pallets or in boxes.

Transport

Switchgears are transported as single cubicles. Transport in the room and to the room in which the switchgear is to be installed can be done with a crane, forklift, or on rollers.

For crane transport, the cubicle is equipped with transport lugs. The angle of lifting ropes should not exceed 120°. Attaching the lifting ropes directly to the cabinet structure is prohibited. To enable lifting the switchgear with a forklift, the cubicle is placed on a transport pallet.

During the transport and installation of the switchgear cubicle, special care should be taken to not to damage the paintwork and steel sheet enclosures.

Main devices, such as circuit breakers, contactors, withdrawable modules, and LV devices sensitive to vibrations, are transported separately in the manufacturers' original packages.

Switchgear installation
The manner of switchgear placement and external cable and busbar connections depend on the design of the facility where it will be installed. These connections should be performed according to the instructions established during arrangements with the switchgear manufacturer. The switchgears can be placed directly on concrete floor, on foundation frame attached to the floor, or on a steel or concrete structure of the facility.

Regardless of the type of foundation, switchgears must be placed exactly horizontally and attached to the foundation.

The placement of the switchgear in a room is presented on figures 5a,b,c. The X dimension depends on the manner in which the switchgear is placed:

- for a wall-mounted placement the recommended distance is at least 100 mm,
- for free-standing placement, full opening of the rear doors requires an X not less than the width of the widest bay of the switchgear.

Recommended minimum distance from closed safety flaps on the switchgear roof to the room ceiling: 600 mm."

Due to the switchgear installation technology it is recommended that the Y dimension of the room be at least 1000 mm higher than the total length of the switchgear.

The recommended minimum room doors height A for the switchgear should be higher by at least 350 mm than the height of the switchgear.

On figure 6a,b,c example dimensions for holes to be made in the floor for cable entries are shown. They should be treated as demonstrations, and their exact location agreed upon when ordering the switchgear.

On figure 7a,b the load bearing/installation frame of the RELF and RELFex switchgear is shown, with holes for attaching the switchgears to the foundation, **on figure 8** - methods for attaching the switchgears to the foundation.

STANDARD EQUIPMENT DELIVERED WITH THE SWITCHGEAR

Standard equipment delivered with the switchgear
Each switchgear is equipped with:

- fasteners for connecting all the units together,
- withdrawable module racking crank,
- earthing switch drive crank,
- withdrawable module transport cart (with the exception of RELF 36),
- cabinet key doors.

Documents delivered with the switchgear:

- declaration of conformity,
- switchgear manual,
- operation and maintenance manuals and warranty cards for the used devices,
- as-built documentation for the switchgear,
- warranty card.

DRAWINGS

List of figures:

Figure 1a - RELF bay equipment - version I

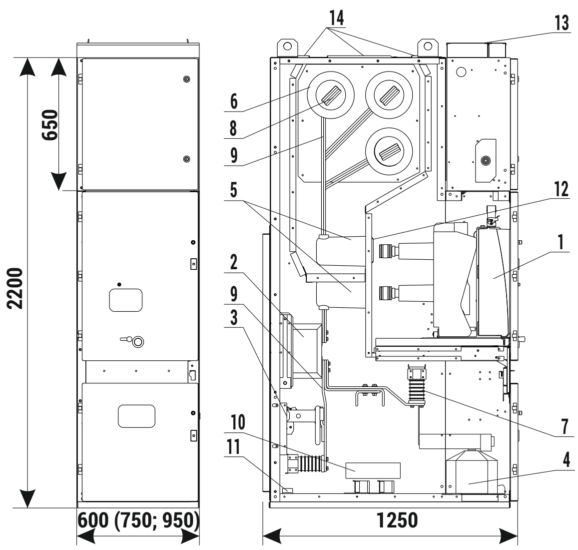
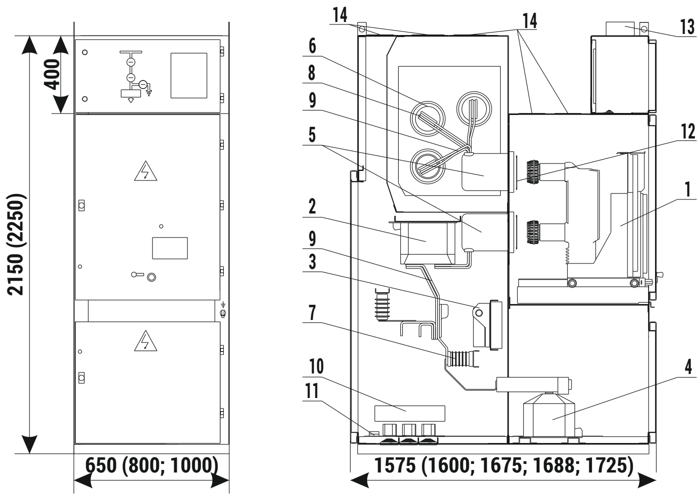
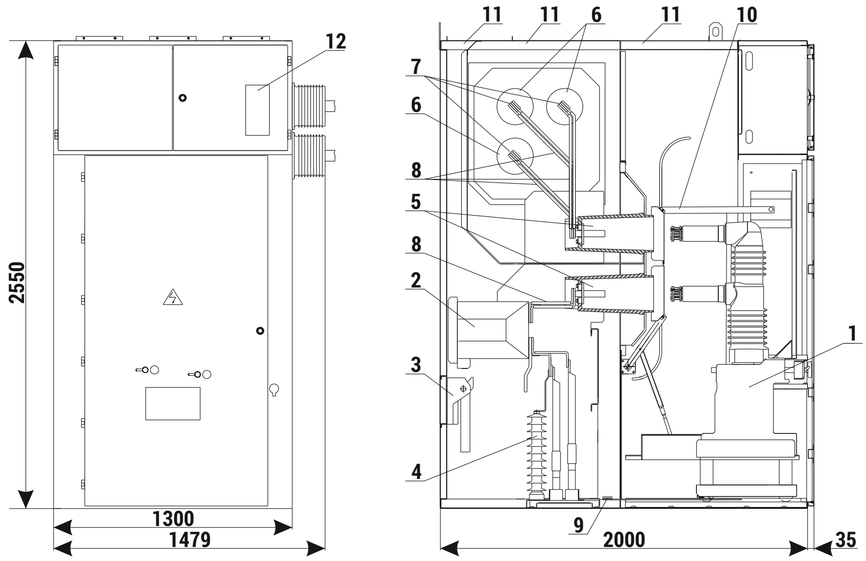


Figure 1b - RELF bay equipment - version II



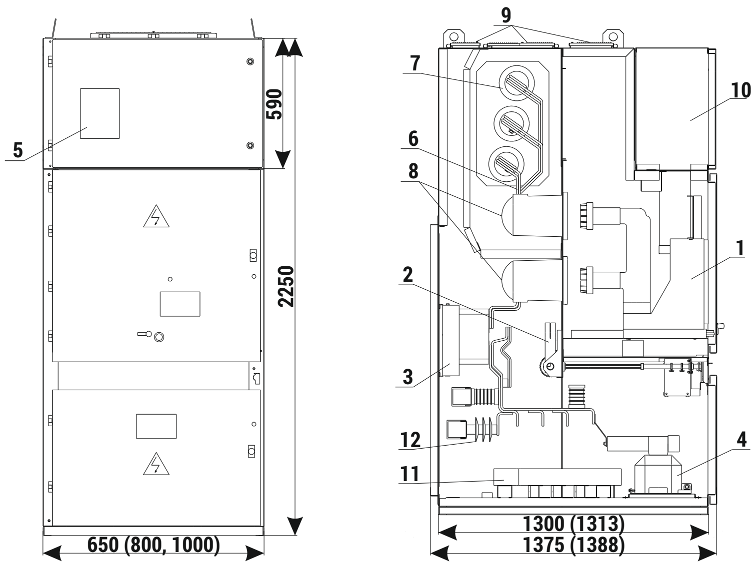
1 - main device: circuit breaker, contactor
2 - current transformers
3 - earthing switch
4 - voltage transformers
5 - spouts
6 - bushings
7 - capacitive post insulators
8 - main busbars
9 - outgoing busbars
10 - earth fault transformer
11 - earthing busbar
12 - shutters
13 - cable tray (optional)
14 - safety flaps

Figure 1c - RELF 36 kv bay equipment



1 - main device: circuit breaker
2 - current transformers
3 - earthing switch
4 - surge arresters
5 - spouts
6 - bushings
7 - main busbars
8 - outgoing busbars
9 - earthing busbar
10 - shutters mechanism
11 - safety flaps
12 - protective relay

Figure 1d - RELF ex bay equipment



1 - withdrawable circuit breakers
2 - earthing switch
3 - current transformers,
4 - voltage transformers (option)
5 - protection relay
6 - outgoing busbars
7 - bushings
8 - spouts
9 - safety flaps
10 - LV compartment
11 - earth fault transformer
12 - surge arresters

Figure 2a - Structural diagrams of RELF and RELF ex primary circuits

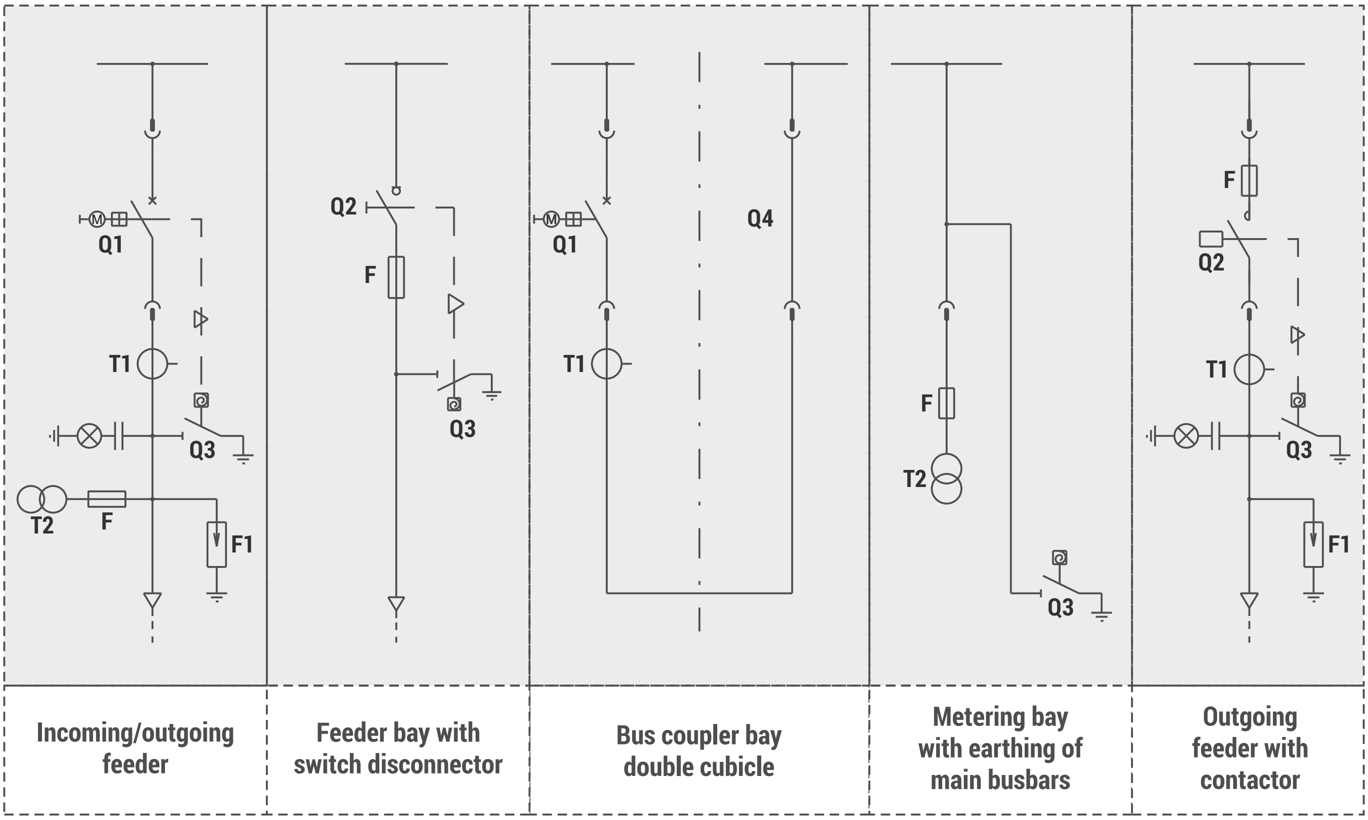


Figure 2b - Structural diagrams of RELF 36 kV primary circuits

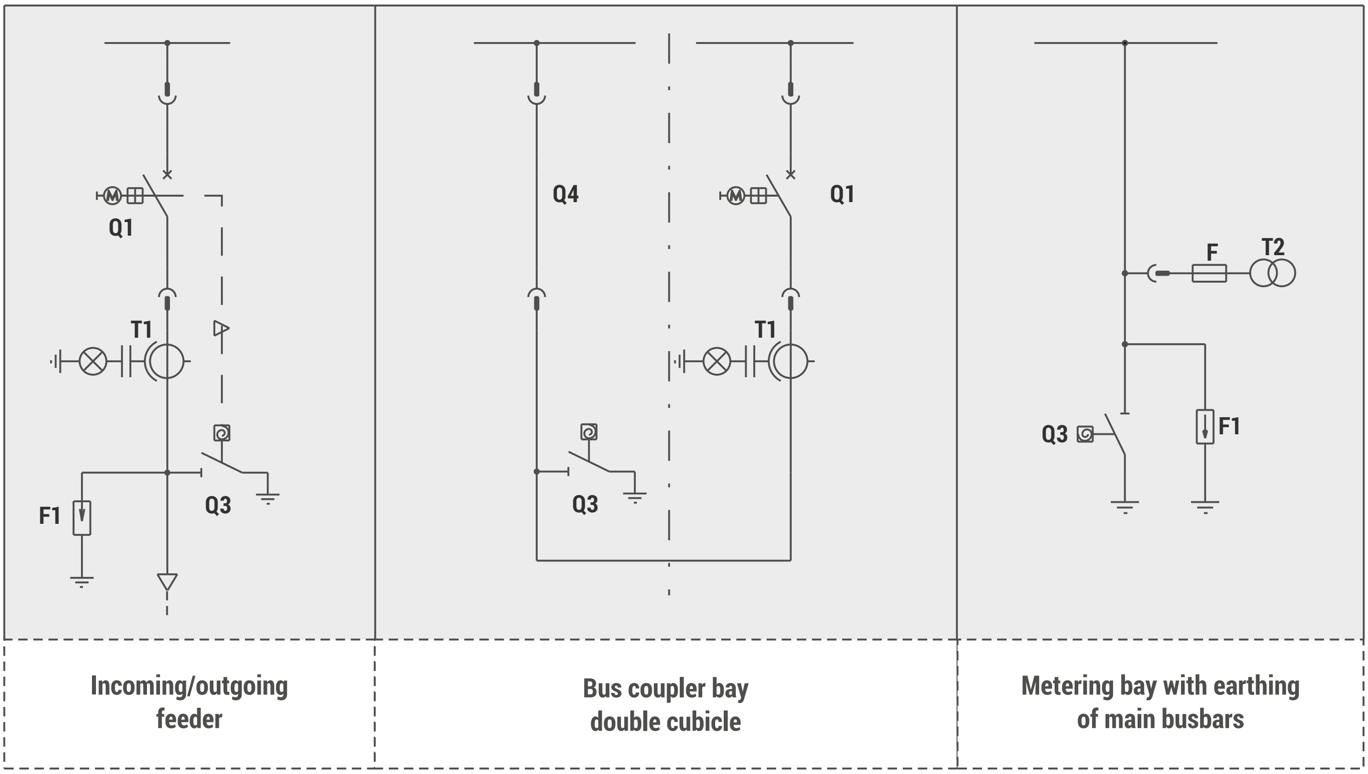


Figure 3a - RELF bay auxiliary circuits compartment - version I

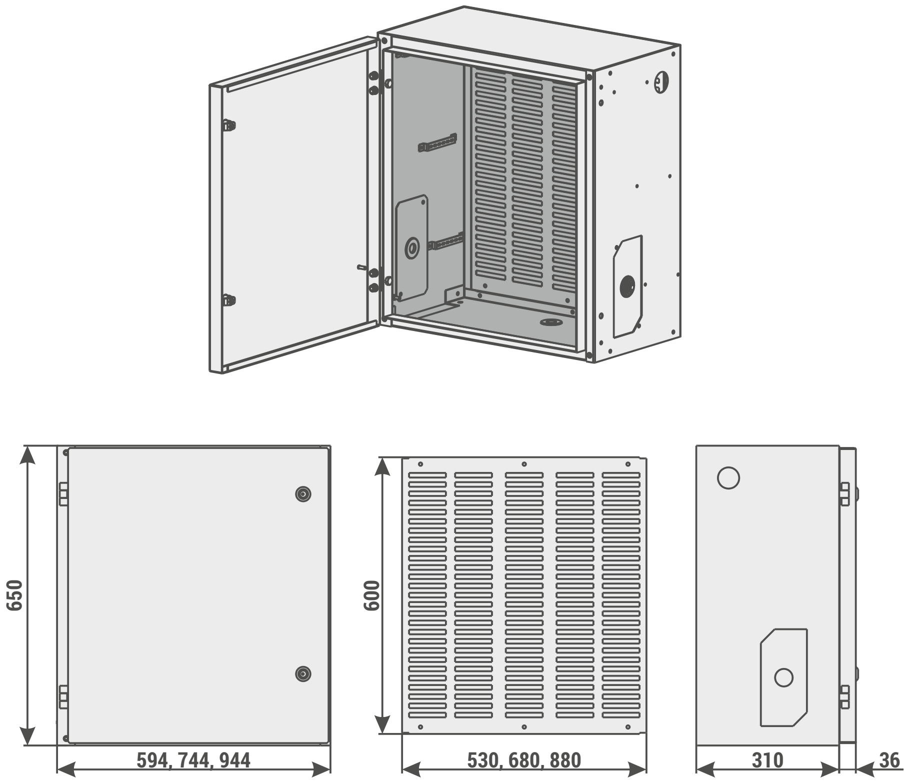
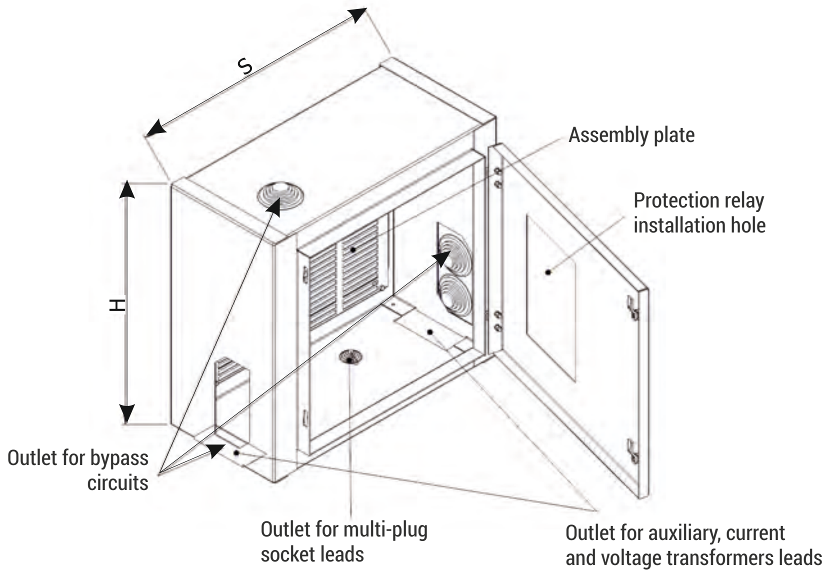
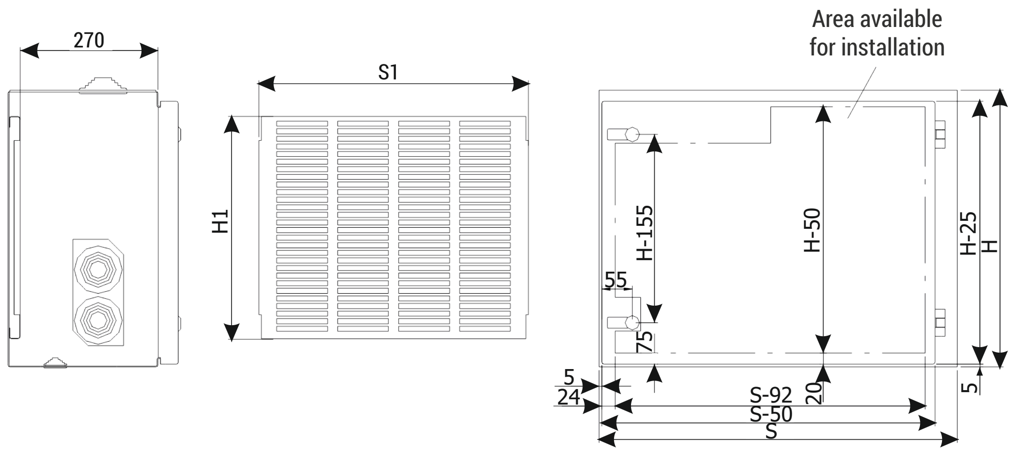


Figure 3b - RELF bay auxiliary circuits compartment - version II





Side wall

Assembly plate

Doors

Dimensions [mm]						
H	600	600	600	400	400	400
S	995	795	645	995	795	645
H1	500	500	500	350	350	350
S1	900	700	550	900	700	550

Figure 3c - RELF 36 kV bay auxiliary circuits compartment

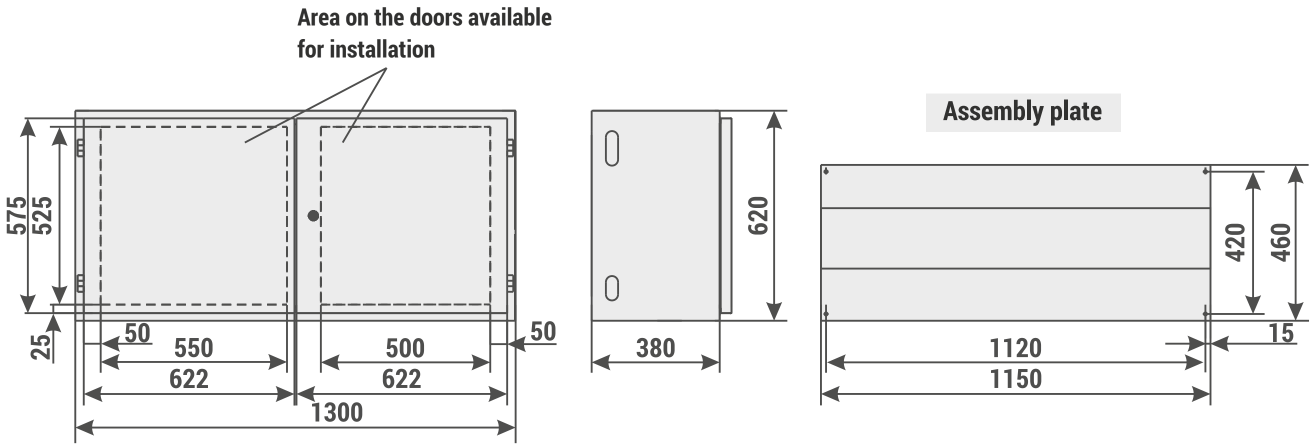
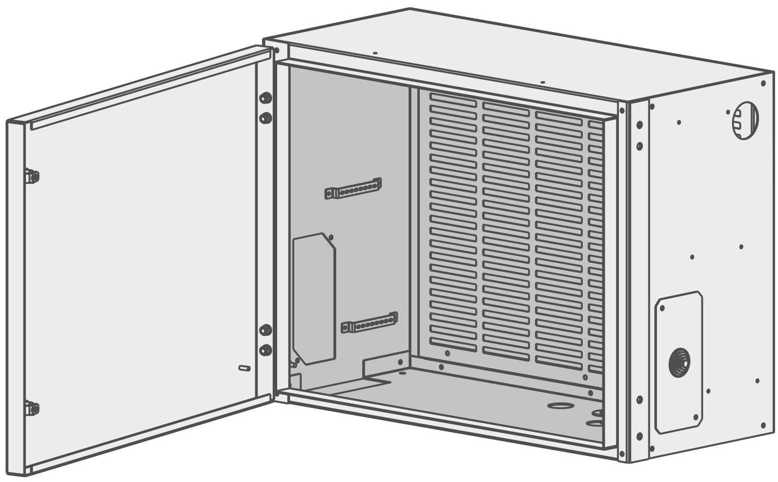


Figure 3d - RELF ex auxiliary circuits compartment



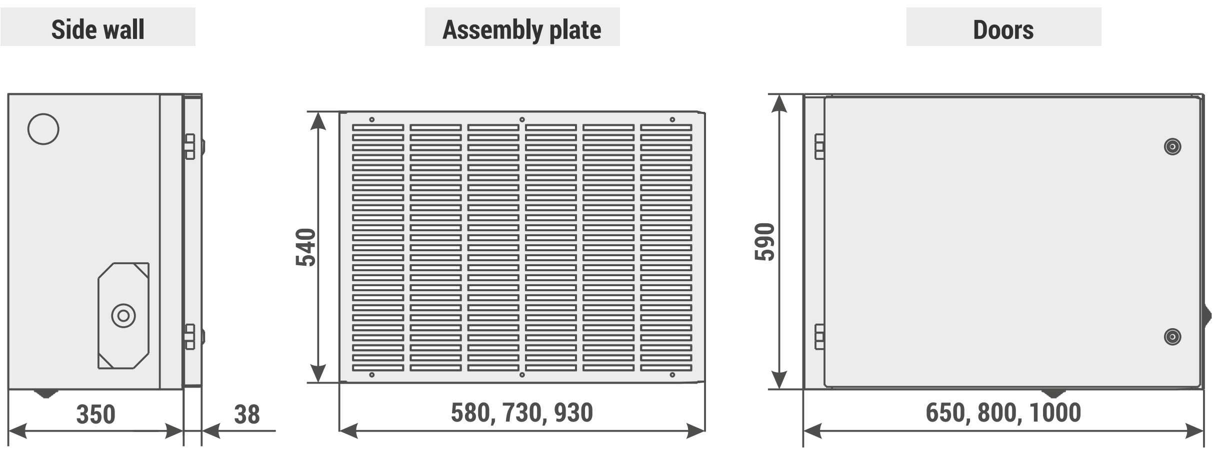
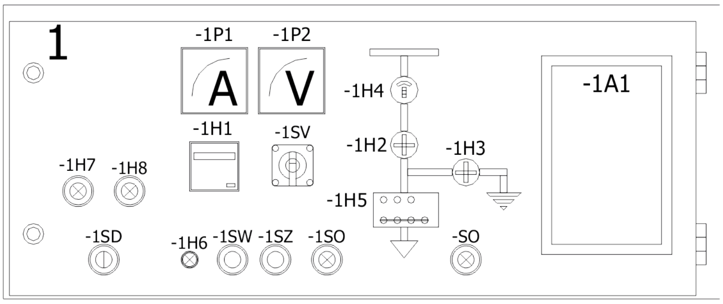
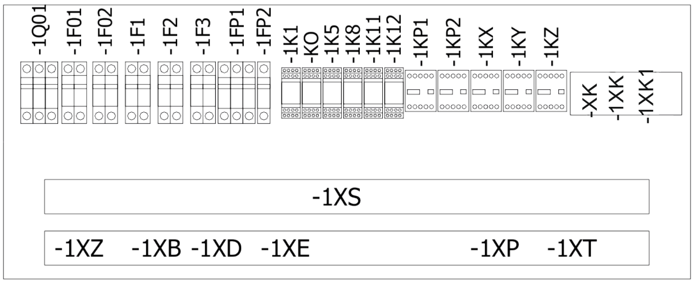


Figure 4a - Examples of device layout in the RELF bays auxiliary circuits compartment

FRONT VIEW

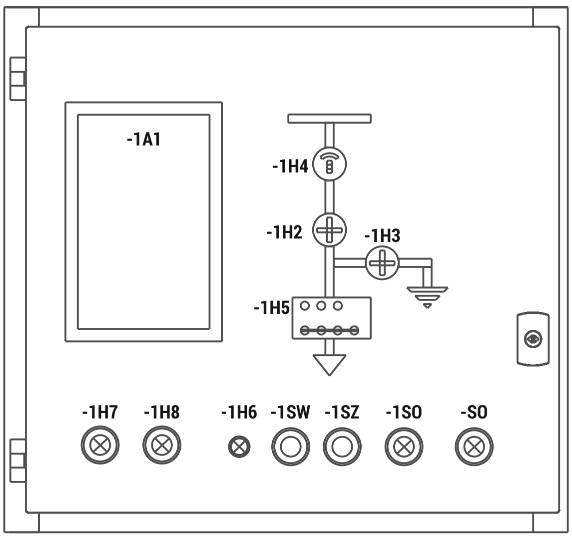


INSIDE VIEW



-1P1	Current measurement
-1H1	Loss of control voltage
-1H6	Tripping coil ready
-1SW	Open circuit breaker
-SZ	Close circuit breaker
-1SO	Unlock racking of circuit breaker
-SO	Unlock earthing switch latch
-1H7	Interlock active
-1H8	Interlock deactivated
-1SD	Parallel operation interlock 0 - Active 1 - Deactivated

Figure 4b - Examples of device layout in the RELF ex bays auxiliary circuits compartment



-1H6	Tripping coil ready
-1SW	Open circuit breaker
-1SZ	Close circuit breaker
-1SO	Unlock racking of circuit breaker
-SO	Unlock earthing switch latch
-1H7	Interlock active
-1H8	Interlock deactivated

Figure 5a - Placement of the RELF switchgear

Side view | **Top view**

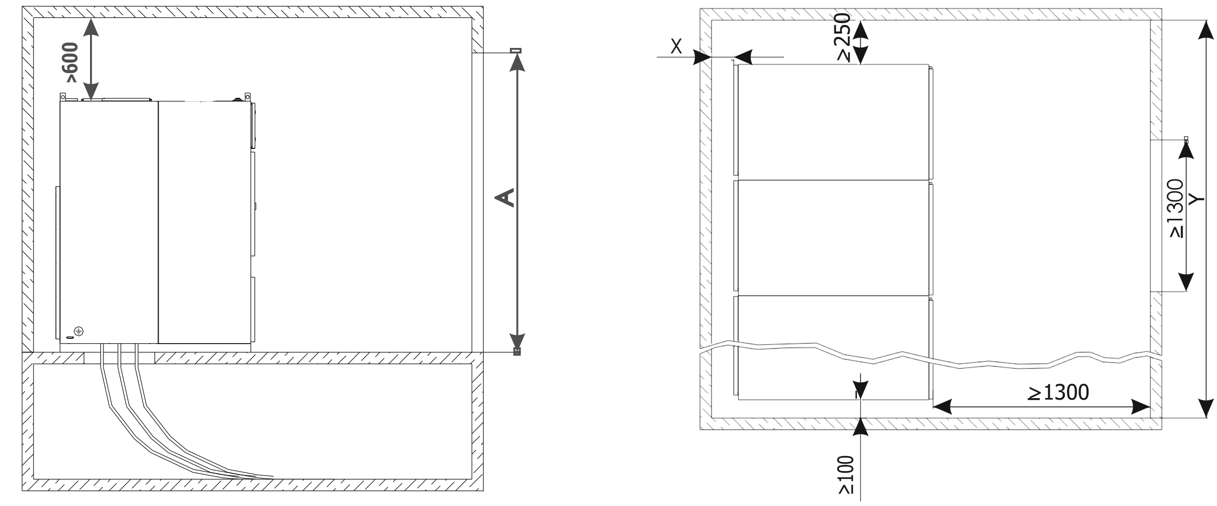


Figure 5b - Placement of the RELF 36 kV switchgear

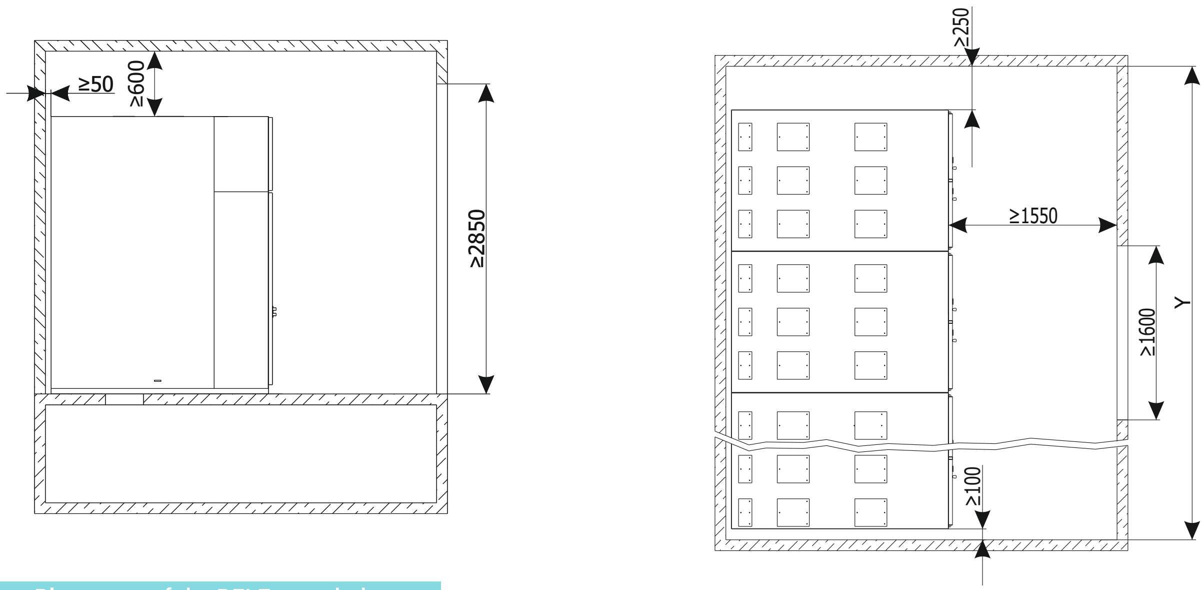
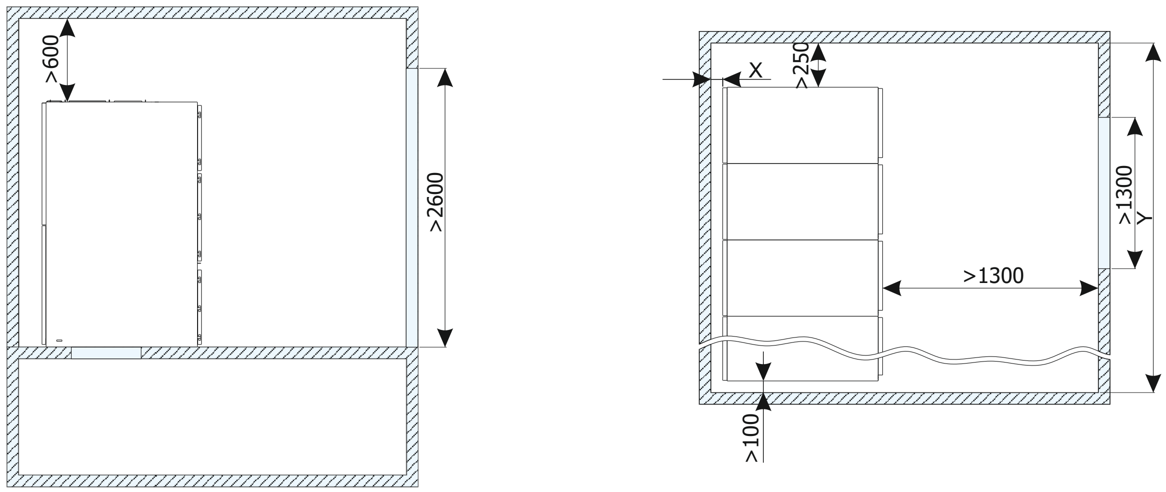


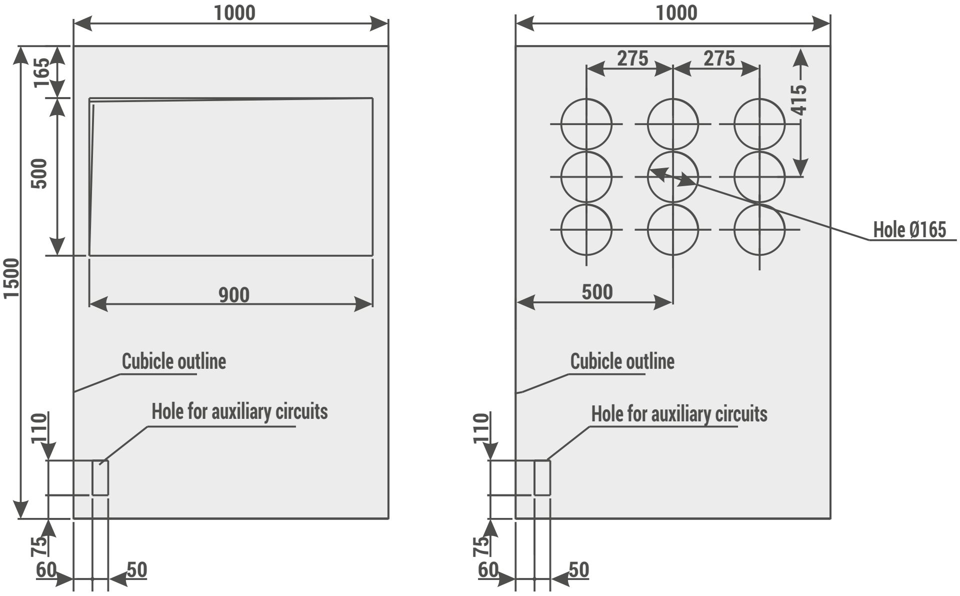
Figure 5c - Placement of the RELF ex switchgear



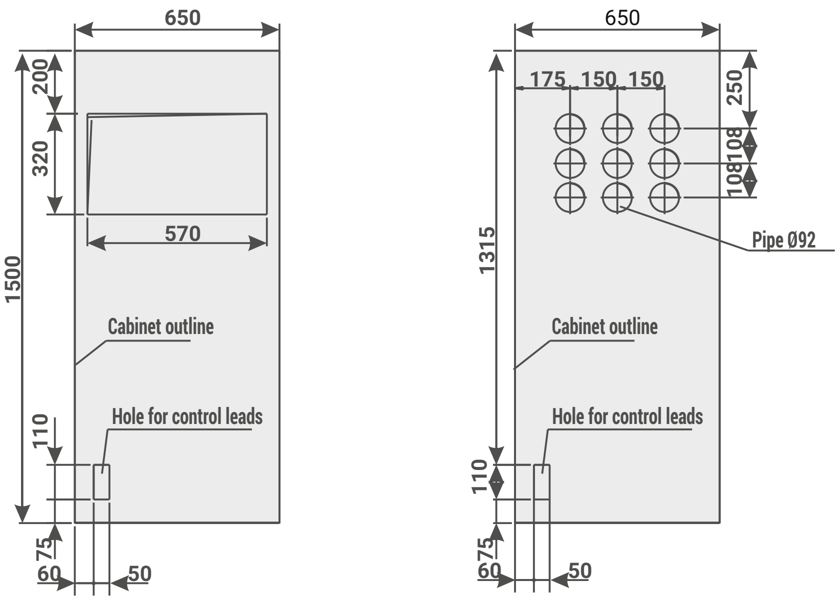
Note:
In case of specific requirements which impact the presented dimensions, please contact the switchgear manufacturer.

Figure 6a - Example dimensions of the cubicle bases and floor holes for RELF bays

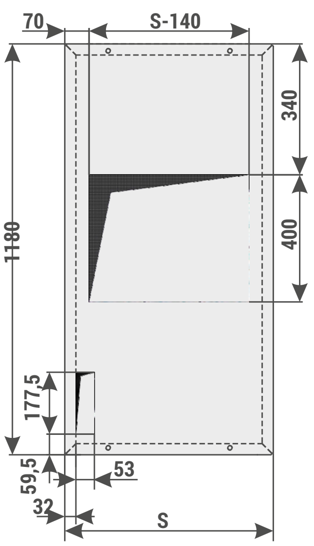
Floor hole layout for cubicles with a width of 1000 mm



Floor hole layout for cubicles with a width of 650 mm



Floor hole layout for the range of cubicles with a depth of 1250 mm

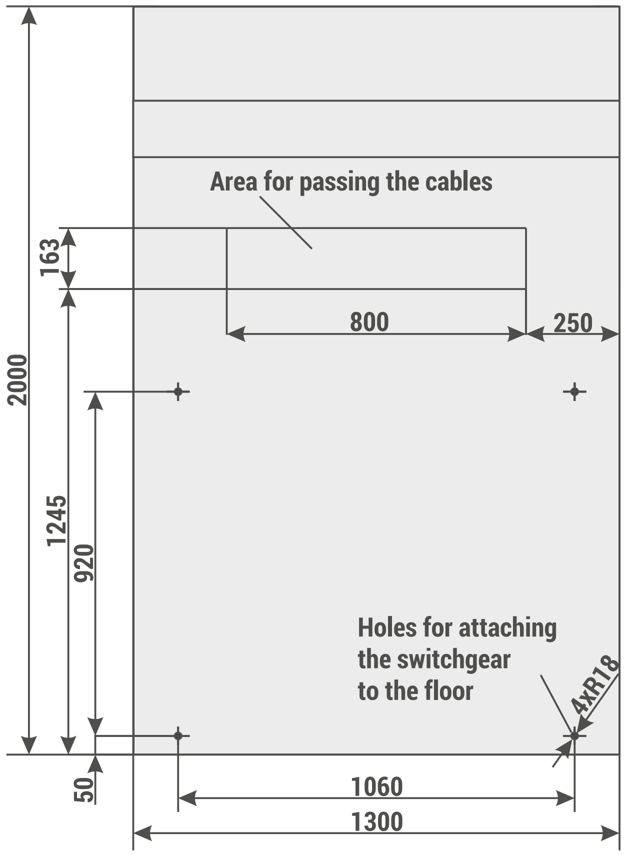


Dimensions [mm]			
S	600	750	950

Note:

The presented solutions are just examples. Solutions for specific projects are available after contacting the manufacturer.

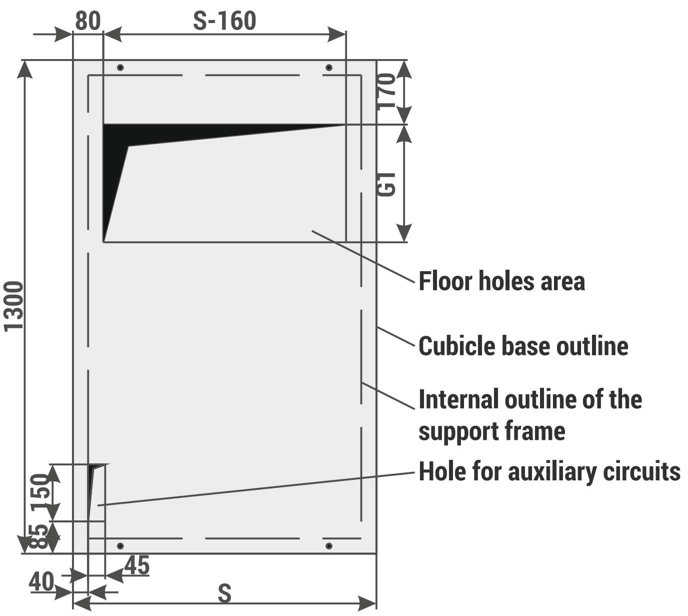
Figure 6b - Example dimensions of the cubicle bases and floor holes for RELF 36 kV bays



Note:

The presented solutions are just examples. Solutions for specific projects are available after contacting the manufacturer.

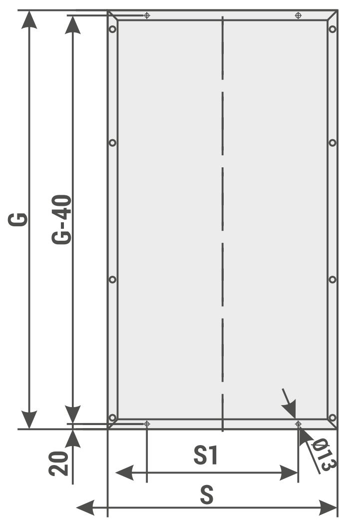
Figure 6c - Example dimensions of the cubicle bases and floor holes for RELF ex bays



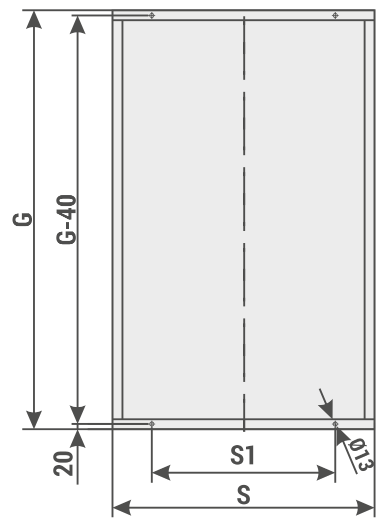
Dimensions [mm]			
S	650	800	1000
G1	310 mm - for 2 cables/phase 560 mm - for 4 cables/phase		

Figure 7a - RELF switchgear support frame

Version I



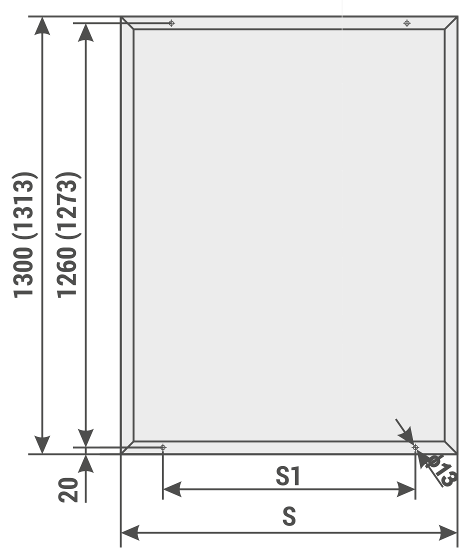
Version II



Dimensions [mm]			
G	1180	1180	1180
S	600	750	950
S1	350	500	700

Dimensions [mm]								
G	1500		1550	1563		1600		1650
S	650	800	650	800	1000	800	1000	1000
S1	400	500	400	500	700	500	700	700

Figure 7b - RELF ex switchgear support frame

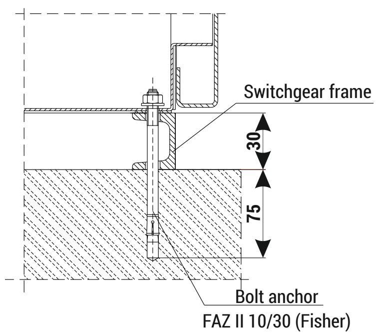


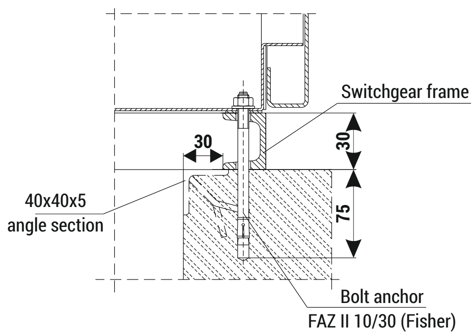
Dimensions [mm]			
S1	400	550	750
S	650	800	1000

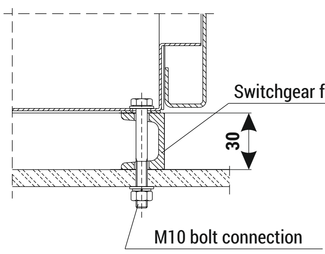
Figure 8 - Mounting the switchgear on the floor

RELF 12 kV and 17.5 kV with a cabinet depth of 1250 mm

0601	0602	0603
Mounting the switchgear on a concrete floor	Mounting the switchgear on a duct	Mounting the switchgear on a steel structure

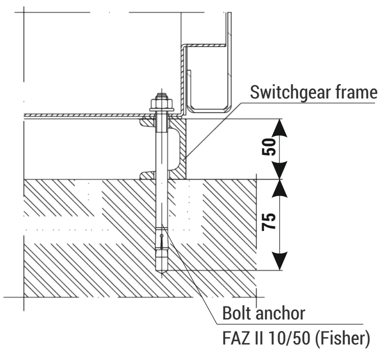


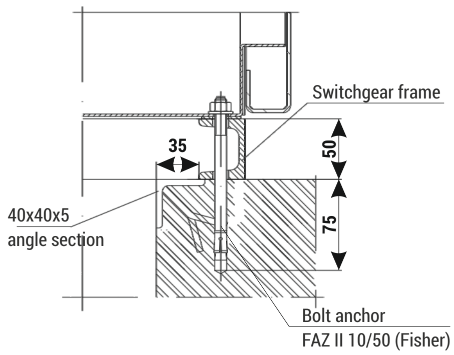


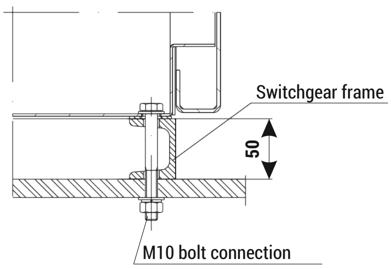


RELF 12 kV i 17,5 kV / RELFex

Mounting on a concrete floor	On a duct	Mounting on a steel structure

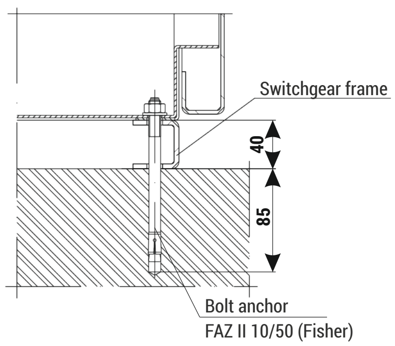


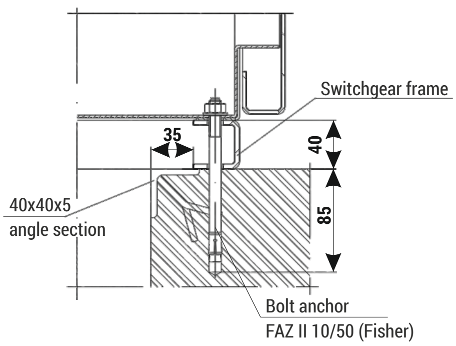


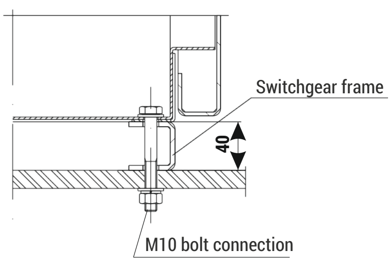


RELF 24 kV

Mounting on a concrete floor	On a duct	Mounting on a steel structure

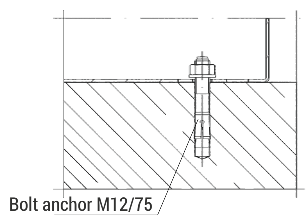


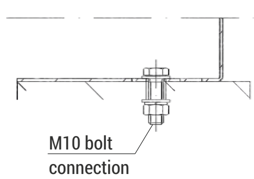




RELF 36 kV

Mounting on a concrete floor	Mounting on a steel structure



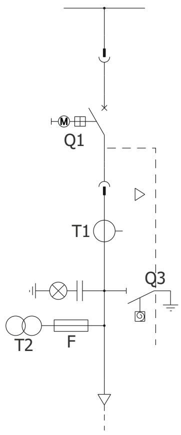


A list of data sheets presented herein*

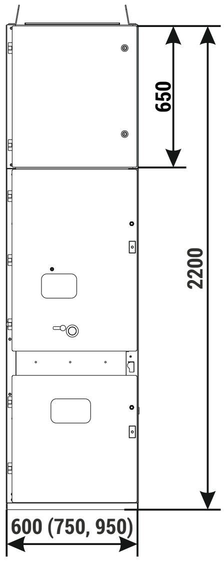
* The presented data sheets are only examples of solutions, which may change. In case of switchgears with technical parameters and bay configurations different than the ones presented, appropriate data sheets are available directly at the manufacturer or on the **www.zpue.com** website.

Figure 1.1 - RELF - Incoming/outgoing

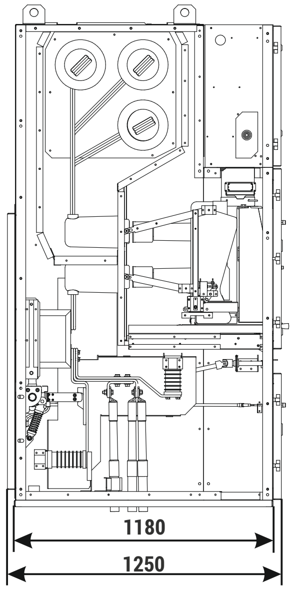
Structural diagram



Front panel



Cross-section



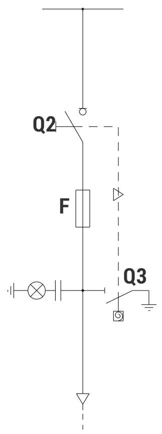
Parameters:		
Rated voltage	[kV]	12/17,5
Rated power-frequency withstand voltage	[kV]	28/38
Rated lightning impulse withstand voltage	[kV]	75/95
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-2500
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 31,5
Rated peak withstand current	[kA]	up to 80
Withstand for internal arcing fault	[kA/1s]	up to 31,5
Protection degree		up to IP4X

Equipment:		
Circuit breaker/contactor	Q1	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric); VSC (ABB)
Current transformer	T1	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)

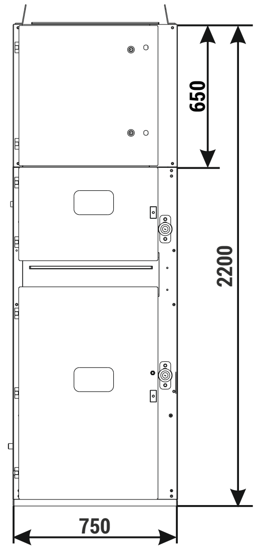
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 1.2 - RELF - Feeder with switch disconnector

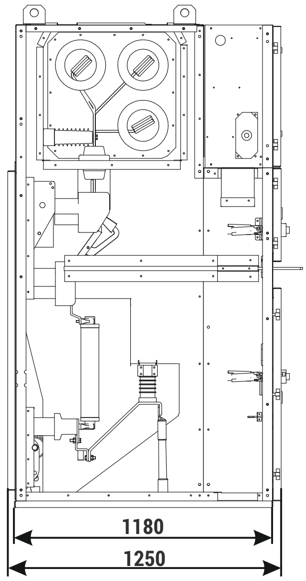
Structural diagram



Front panel



Cross-section



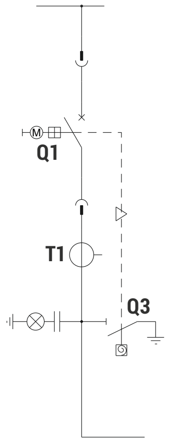
Parameters:		
Rated voltage	[kV]	12/17,5
Rated power-frequency withstand voltage	[kV]	28/38
Rated lightning impulse withstand voltage	[kV]	75/95
Rated frequency	[Hz]	50
Rated continuous current	[A]	400-1250
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 31,5
Rated peak withstand current	[kA]	up to 80
Withstand for internal arcing fault	[kA/1s]	up to 31,5
Protection degree		up to IP4X

Equipment:		
Circuit breaker	Q2	NALF (ABB); OMB (ZWAE)
Earthing switch	Q3	fast, with an impulse drive

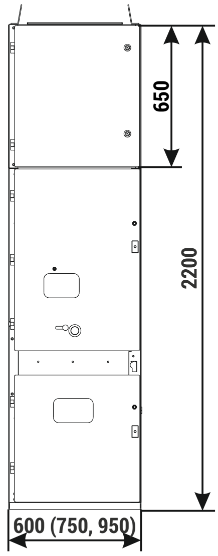
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 1.3 - RELF - Bus coupler bay with circuit breaker

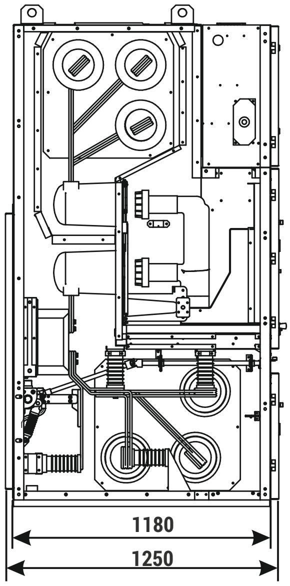
Structural diagram



Front panel



Cross-section

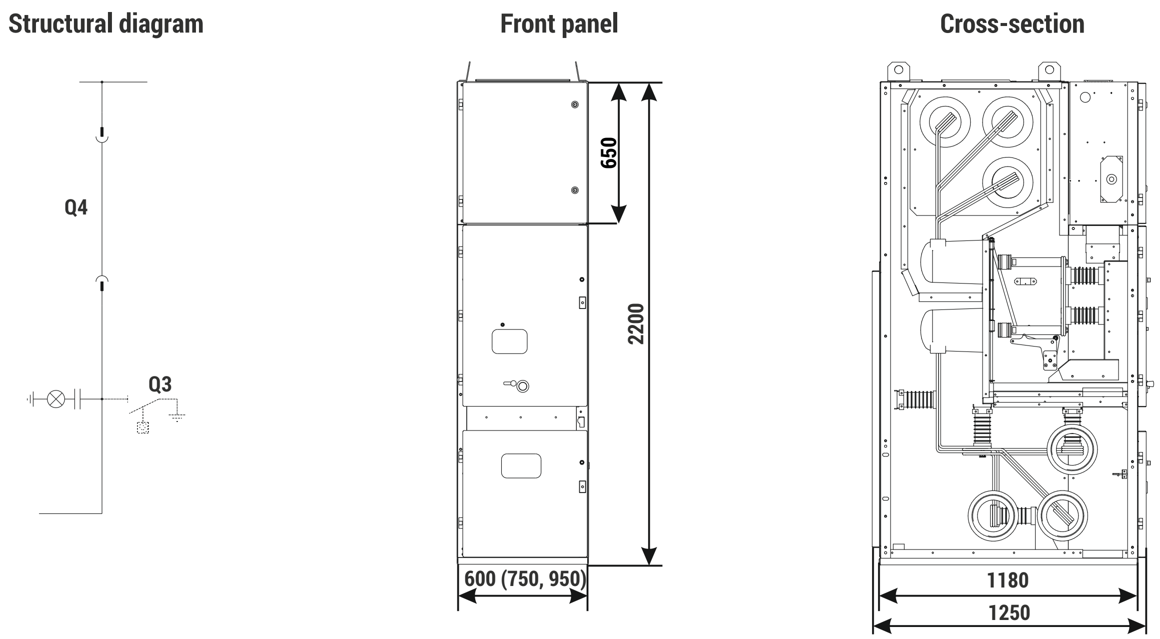


Parameters:		
Rated voltage	**[kV]**	12/17,5
Rated power-frequency withstand voltage	**[kV]**	28/38
Rated lightning impulse withstand voltage	**[kV]**	75/95
Rated frequency	**[Hz]**	50
Rated continuous current	**[A]**	630-2500
Main busbars rated cotinuous current	**[A]**	630-2500
Rated short-time withstand current	**[kA/3s]**	up to 31,5
Rated peak withstand current	**[kA]**	up to 80
Withstand for internal arcing fault	**[kA/1s]**	up to 31,5
Protection degree		up to IP4X

Equipment:		
Circuit breaker	**Q1**	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric)
Current transformer	**T1**	various manufacturers
Earthing switch	**Q3**	Us1 (ZPUE); EK6 (ABB)

Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 1.4 - RELF - Bus coupler bay with sectionalizer



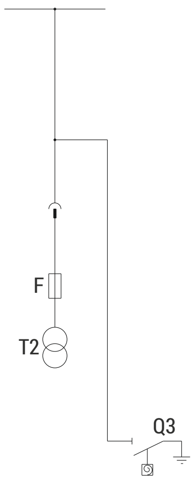
Parameters:		
Rated voltage	[kV]	12/17,5
Rated power-frequency withstand voltage	[kV]	28/38
Rated lightning impulse withstand voltage	[kV]	75/95
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-2500
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 31,5
Rated peak withstand current	[kA]	up to 80
Withstand for internal arcing fault	[kA/1s]	up to 31,5
Protection degree		up to IP4X

Equipment:		
Sectionalizer	Q4	made by ZPUE

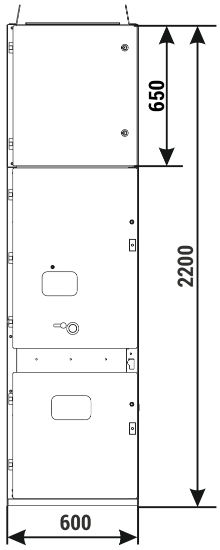
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 1.5 - RELF - Voltage metering bay

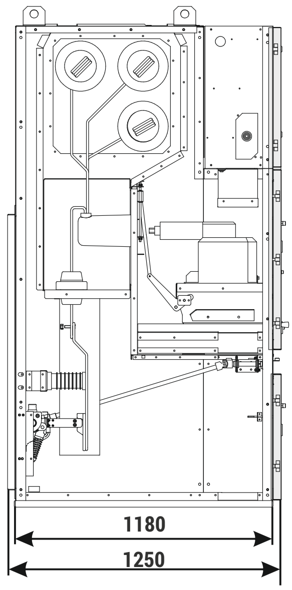
Structural diagram



Front panel



Cross-section



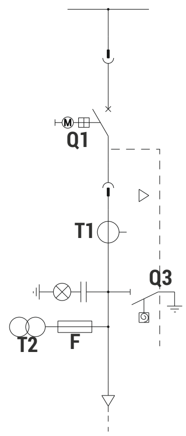
Parameters:		
Rated voltage	**[kV]**	12/17,5
Rated power-frequency withstand voltage	**[kV]**	28/38
Rated lightning impulse withstand voltage	**[kV]**	75/95
Rated frequency	**[Hz]**	50
Main busbars rated cotinuous current	**[A]**	630-2500
Rated short-time withstand current	**[kA/3s]**	up to 31,5
Rated peak withstand current	**[kA]**	up to 80
Withstand for internal arcing fault	**[kA/1s]**	up to 31,5
Protection degree		up to IP4X

Equipment:		
Withdrawable module		Metering bay - withdrawable module with voltage transformers
Voltage transformer	**T2**	various manufacturers
Earthing switch	**Q3**	Us1 (ZPUE); EK6 (ABB)

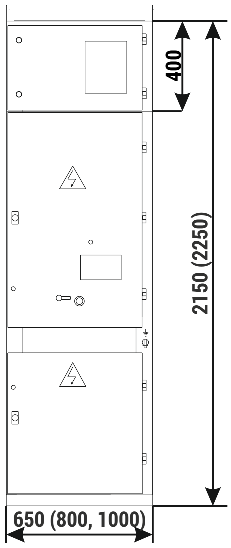
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.1 - RELF - Feeder with circuit breaker

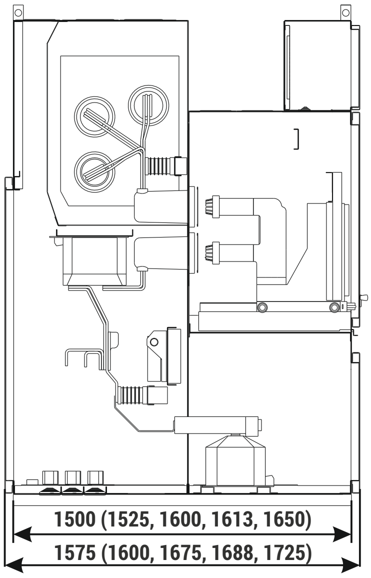
Structural diagram



Front panel



Cross-section



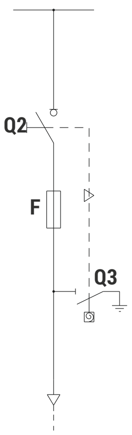
Parameters:		
Rated voltage	[kV]	12/17,5/24
Rated power-frequency withstand voltage	[kV]	28/38/50
Rated lightning impulse withstand voltage	[kV]	75/95/125
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-4000
Main busbars rated cotinuous current	[A]	630-4000
Rated short-time withstand current	[kA/3s]	up to 40
Rated peak withstand current	[kA]	up to 100
Withstand for internal arcing fault	[kA/1s]	up to 31,5 and up to 40/0,5s
Protection degree		up to IP4X

Equipment:		
Circuit breaker	Q1	VB-4(ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric)
Current transformer	T1	various manufacturers
Earthing switch	Q3	US1 (ZPUE); EK6 (ABB)

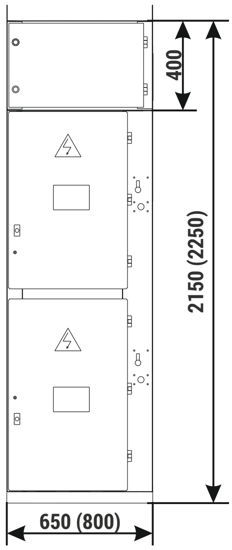
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.2 - RELF - Feeder with switch disconnector

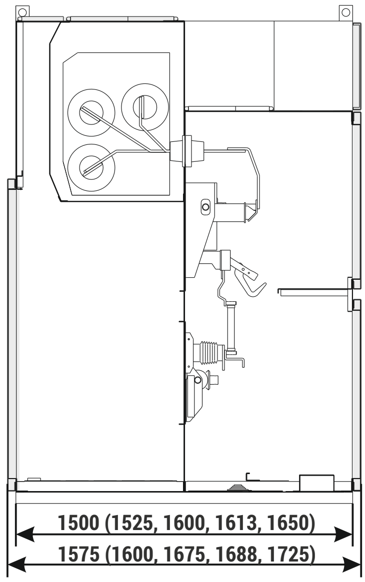
Structural diagram



Front panel



Cross-section



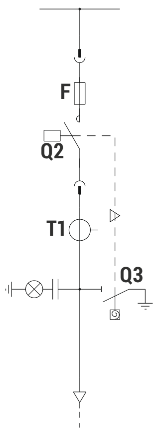
Parameters:		
Rated voltage	**[kV]**	12/17,5/24
Rated power-frequency withstand voltage	**[kV]**	28/38/50
Rated lightning impulse withstand voltage	**[kV]**	75/95/125
Rated frequency	**[Hz]**	50
Rated continuous current	**[A]**	400-1250
Main busbars rated cotinuous current	**[A]**	630-4000
Rated short-time withstand current	**[kA/3s]**	up to 31,5
Rated peak withstand current	**[kA]**	up to 80
Withstand for internal arcing fault	**[kA/1s]**	up to 31,5
Protection degree		up to IP4X

Equipment:		
Circuit breaker	**Q2**	NALF (ABB); OMB (ZWAE)
Earthing switch	**Q3**	fast, with an impulse drive

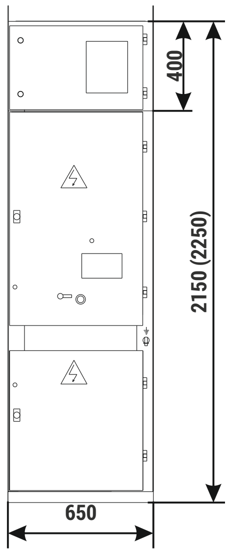
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.3 - RELF - Outgoing feeder with contactor

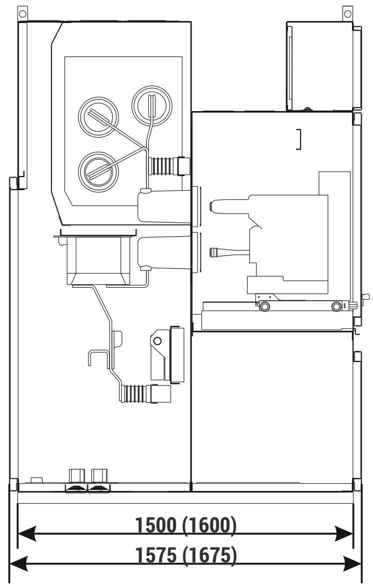
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	400-630
Main busbars rated cotinuous current	[A]	630-4000
Rated short-time withstand current	[kA/3s]	up to 31,5
Rated peak withstand current	[kA]	up to 80
Withstand for internal arcing fault	[kA/1s]	up to 31,5
Protection degree		up to IP4X

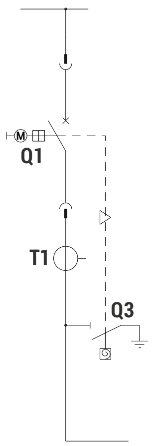
Equipment:

Contactor	Q2	VSC (ABB), Rollarc (Schneider Electric)
Current transformer	T1	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)

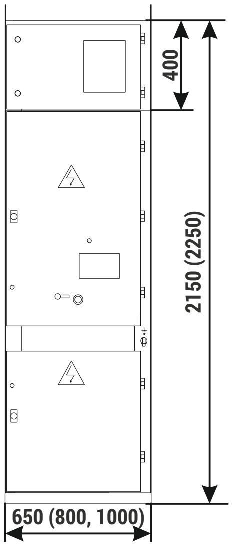
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.4 - RELF - Bus coupler bay with circuit breaker

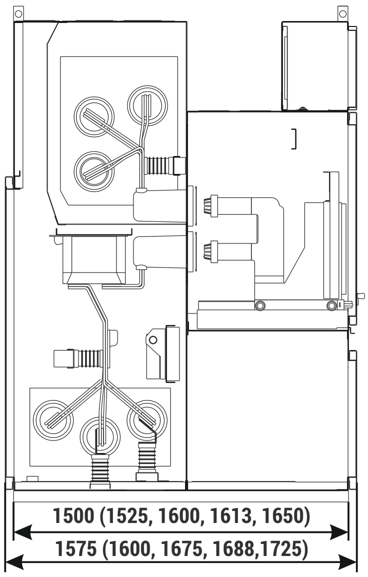
Structural diagram



Front panel



Cross-section



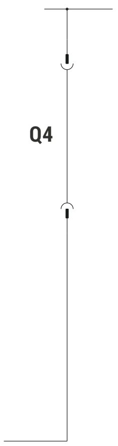
Parameters:		
Rated voltage	**[kV]**	12/17,5/24
Rated power-frequency withstand voltage	**[kV]**	28/38/50
Rated lightning impulse withstand voltage	**[kV]**	75/95/125
Rated frequency	**[Hz]**	50
Rated continuous current	**[A]**	630-4000
Main busbars rated cotinuous current	**[A]**	630-4000
Rated short-time withstand current	**[kA/3s]**	up to 40
Rated peak withstand current	**[kA]**	up to 100
Withstand for internal arcing fault	**[kA/1s]**	up to 31,5 and up to 40/0,5s
Protection degree		up to IP4X

Equipment:		
Circuit breaker	**Q1**	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric)
Current transformer	**T1**	various manufacturers
Earthing switch	**Q3**	Us1 (ZPUE); EK6 (ABB)

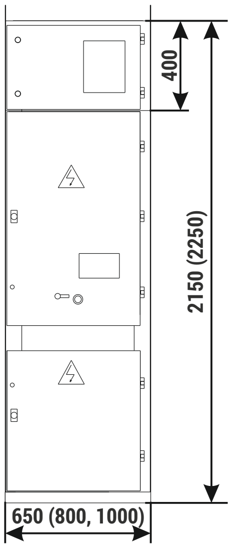
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.5 - Bus coupler bay with sectionalizer

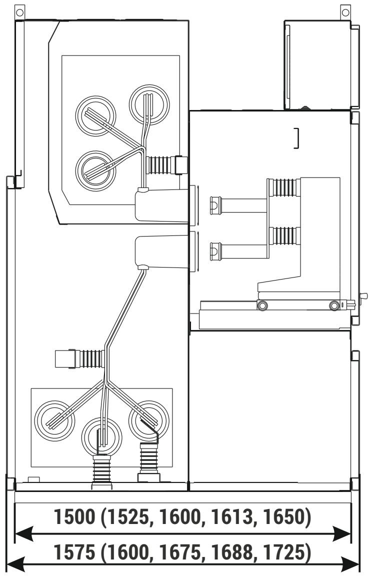
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage	[kV]	12/17,5/24
Rated power-frequency withstand voltage	[kV]	28/38/50
Rated lightning impulse withstand voltage	[kV]	75/95/125
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-4000
Main busbars rated cotinuous current	[A]	630-4000
Rated short-time withstand current	[kA/3s]	up to 40
Rated peak withstand current	[kA]	up to 100
Withstand for internal arcing fault	[kA/1s]	up to 31,5 and up to 40/0,5s
Protection degree		up to IP4X

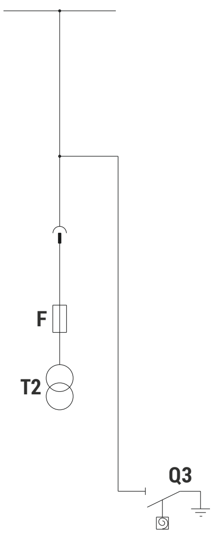
Equipment:

Short-circuiting device	Q4	made by ZPUE

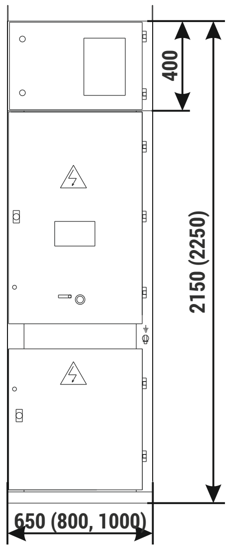
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 2.6 - Metering bay - withdrawable module with voltage transformers

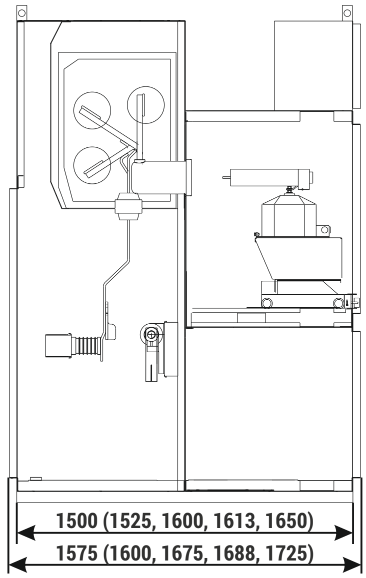
Structural diagram



Front panel



Cross-section



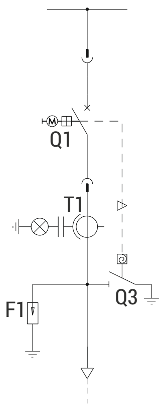
Parameters:		
Rated voltage	[kV]	12/17,5/24
Rated power-frequency withstand voltage	[kV]	28/38/50
Rated lightning impulse withstand voltage	[kV]	75/95/125
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	630-4000
Rated short-time withstand current	[kA/3s]	up to 40
Rated peak withstand current	[kA]	up to 100
Withstand for internal arcing fault	[kA/1s]	up to 31,5 and up to40/0,5s
Protection degree		up to IP4X

Equipment:		
Withdrawable module		Metering bay - withdrawable module with voltage transformers
Voltage transformer	T2	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)

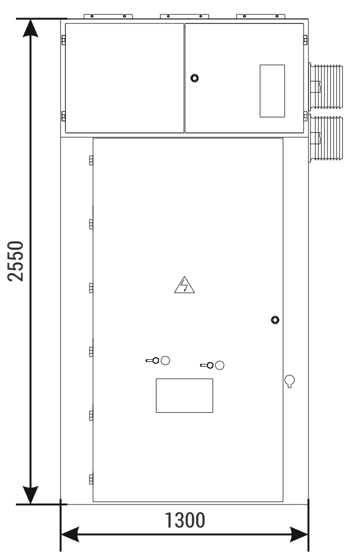
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 3.1 - RELF 36 - Feeder with circuit breaker

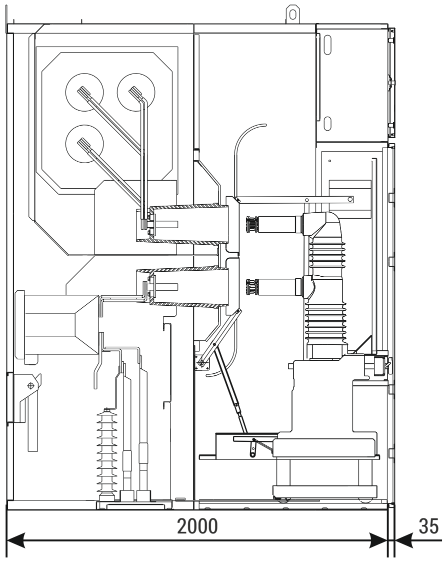
Structural diagram



Front panel



Cross-section



Parameters:		
Rated voltage	[kV]	36/40,5*
Rated power-frequency withstand voltage	[kV]	95/85,5(5min)/95(1min)*
Rated lightning impulse withstand voltage	[kV]	190
Rated frequency	[Hz]	50
Rated continuous current	[A]	up to 1600
Main busbars rated cotinuous current	[A]	up to 1600
Rated short-time withstand current	[kA]	up to 25(3s) and up to 31,5(1s)
Rated peak withstand current	[kA]	63/80
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

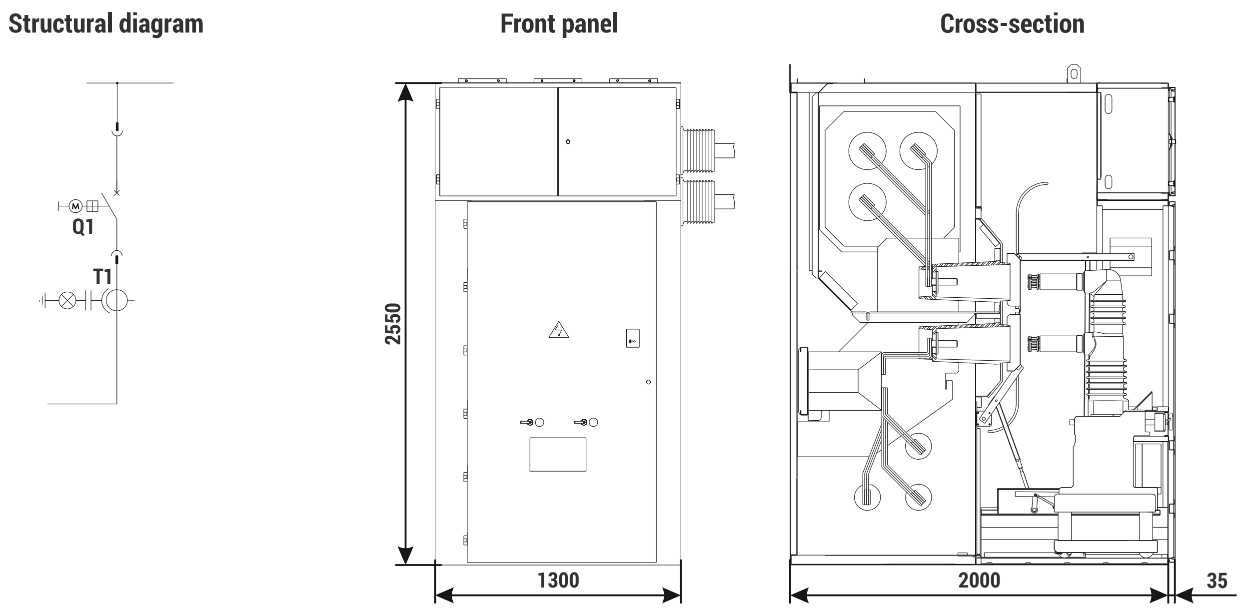
Equipment:		
Circuit breaker	Q1	VD4 (ABB)
Current transformer	T1	TPU (ABB)
Earthing switch	Q3	EK6 (ABB)
Overvoltage limiter	F1	GXE51 (ABB)

* - in accordance with GOST standards

Note:

We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 3.2 - RELF 36 - Bus coupler bay with circuit breaker



Parameters:

Rated voltage	[kV]	36/40,5*
Rated power-frequency withstand voltage	[kV]	95/85,5(5min)/95(1min)*
Rated lightning impulse withstand voltage	[kV]	190
Rated frequency	[Hz]	50
Rated continuous current	[A]	up to 1600
Main busbars rated cotinuous current	[A]	up to 1600
Rated short-time withstand current	[kA]	up to 25(3s) and up to 31,5(1s)
Rated peak withstand current	[kA]	63/80
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:

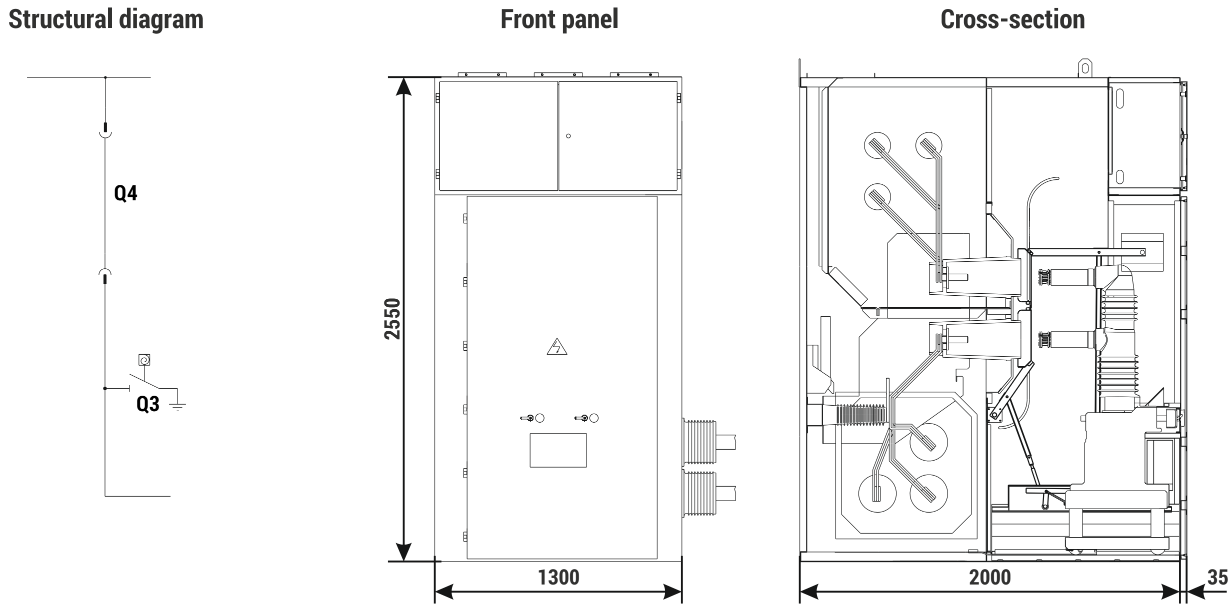
Circuit breaker	Q1	VD4 (ABB)
Current transformer	T1	TPU (ABB)

* - in accordance with GOST standards

Note:

We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 3.3 - RELF 36 - Bus coupler bay with sectionalizer



Parameters:

Rated voltage	[kV]	36/40,5*
Rated power-frequency withstand voltage	[kV]	95/85,5(5min)/95(1min)*
Rated lightning impulse withstand voltage	[kV]	190
Rated frequency	[Hz]	50
Rated continuous current	[A]	up to 1600
Main busbars rated cotinuous current	[A]	up to 1600
Rated short-time withstand current	[kA]	up to 25(3s) and up to 31,5(1s)
Rated peak withstand current	[kA]	63/80
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

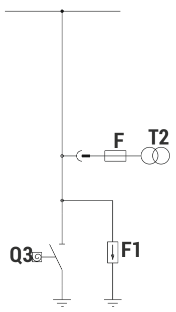
Equipment:

Short-circuiting device	Q4	made by ABB
Earthing switch	Q3	EK6 (ABB)

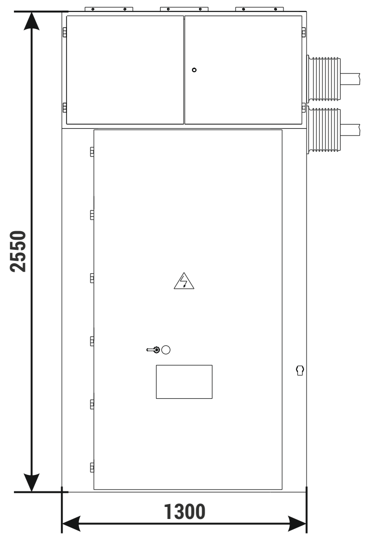
* - in accordance with GOST standards
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 3.4 - RELF 36 - Metering bay - withdrawable module with voltage transformers

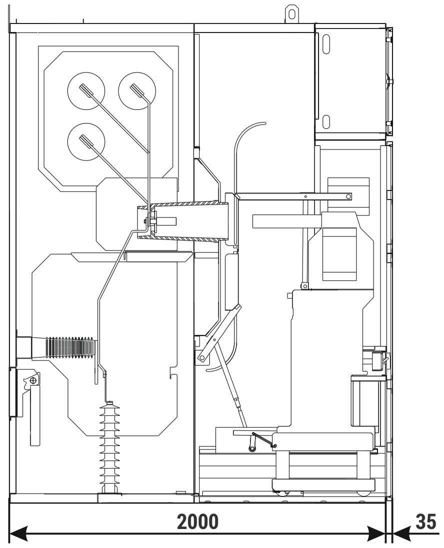
Structural diagram



Front panel



Cross-section



Parameters:		
Rated voltage	[kV]	36/40,5*
Rated power-frequency withstand voltage	[kV]	95/85,5(5min)/95(1min)*
Rated lightning impulse withstand voltage	[kV]	190
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	up to 1600
Rated short-time withstand current	[kA/3s]	up to 25(3s) and up to 31,5(1s)
Rated peak withstand current	[kA]	63/80
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Withdrawable module		Metering bay - withdrawable module with voltage transformers
Voltage transformer	T2	TJP (ABB)
Earthing switch	Q3	EK6 (ABB)
Overvoltage limiter	F1	GXE51 (ABB)

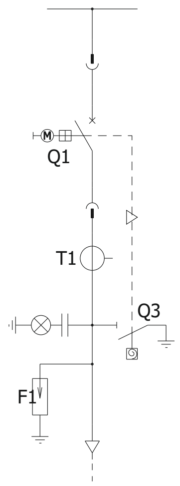
* - in accordance with GOST standards

Note:

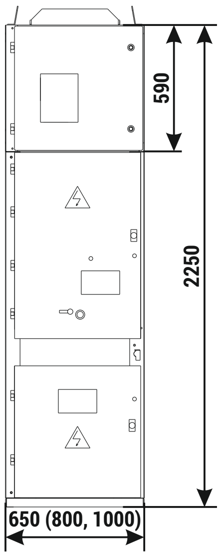
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 4.1 - RELF ex - Feeder with circuit breaker

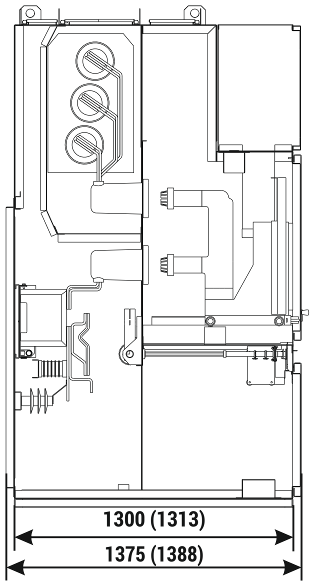
Structural diagram



Front panel



Cross-section



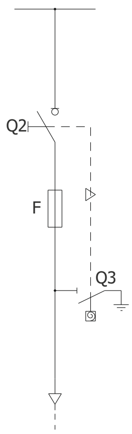
Parameters:		
Rated voltage	[kV]	12; 17,5
Rated power-frequency withstand voltage	[kV]	28/38
Rated lightning impulse withstand voltage	[kV]	75/95
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-2500
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Circuit breaker	Q1	VB-4 (ZPUE); VD4 (ABB); SION (Siemens); HVX (Schneider Electric)
Current transformer	T1	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)

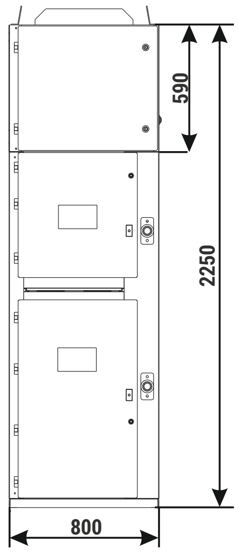
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Figure 4.2 - RELF ex - Feeder with switch disconnector

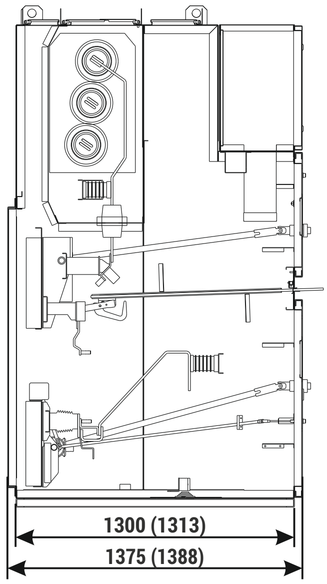
Structural diagram



Front panel



Cross-section

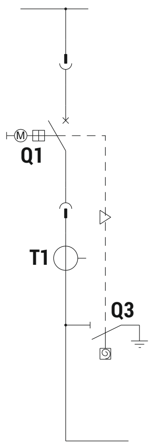


Parameters:		
Rated voltage	[kV]	12; 17,5
Rated power-frequency withstand voltage	[kV]	28; 38
Rated lightning impulse withstand voltage	[kV]	75; 95
Rated frequency	[Hz]	50
Rated continuous current	[A]	400-1250
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

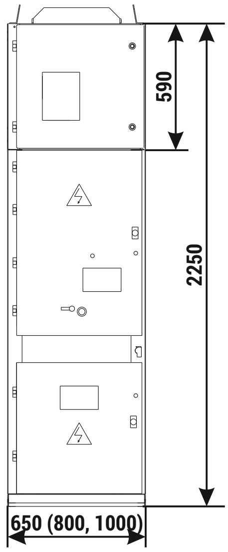
Equipment:		
Circuit breaker	Q2	NALF (ABB); OMB (ZWAE)
Earthing switch	Q3	fast, with an impulse drive

Figure 4.3 - RELF ex - Bus coupler bay with circuit breaker

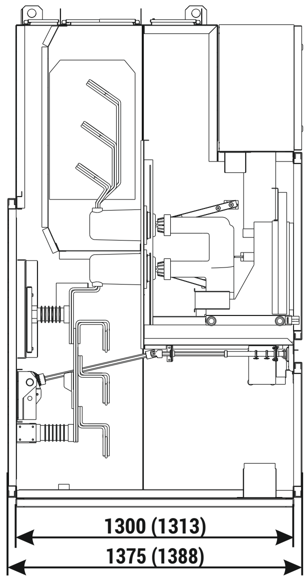
Structural diagram



Front panel



Cross-section

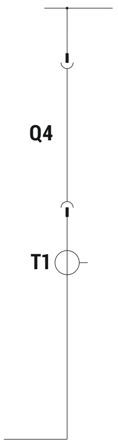


Parameters:		
Rated voltage	[kV]	12; 17,5
Rated power-frequency withstand voltage	[kV]	28; 38
Rated lightning impulse withstand voltage	[kV]	75; 95
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-2500
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

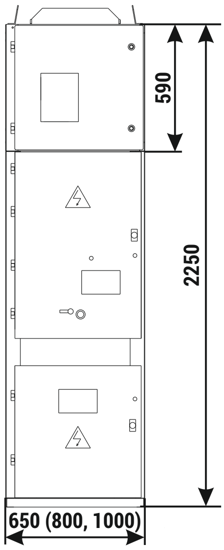
Equipment:		
Circuit breaker	Q1	VB-4 (ZPUE); VD4 (ABB); SION (Siemens); HVX (Schneider Electric)
Current transformer	T1	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)

Figure 4.4 - RELF ex - Bus coupler bay with sectionalizer

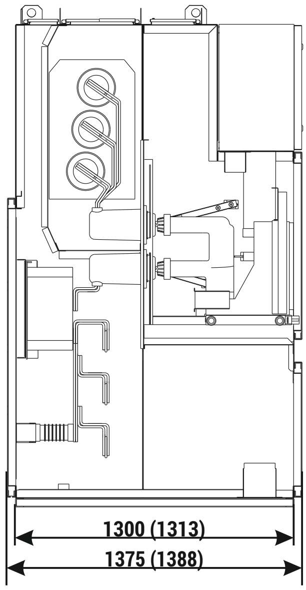
Structural diagram



Front panel



Cross-section

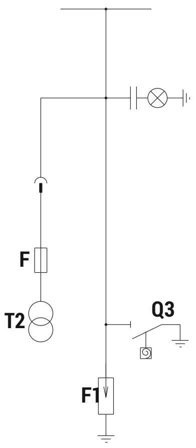


Parameters:		
Rated voltage	[kV]	12; 17,5
Rated power-frequency withstand voltage	[kV]	28; 38
Rated lightning impulse withstand voltage	[kV]	75; 95
Rated frequency	[Hz]	50
Rated continuous current	[A]	630-2500
Main busbars rated cotinuous current	[A]	630-2500
Rated short-time withstand current	[kA/3s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

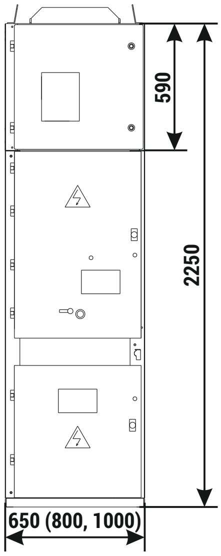
Equipment:		
Short-circuiting device	Q4	Made by ZPUE
Current transformer	T1	various manufacturers

Figure 4.5 - RELF ex - Metering bay - withdrawable module with voltage transformers

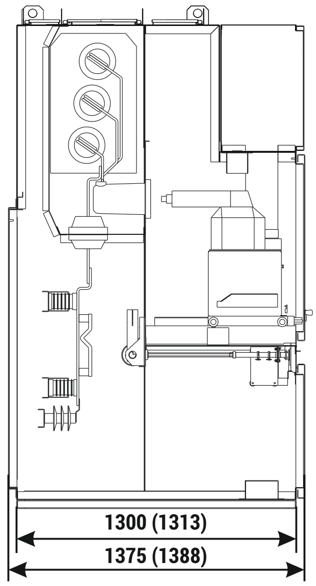
Structural diagram



Front panel



Cross-section



Parameters:		
Rated voltage	[kV]	12; 17,5
Rated power-frequency withstand voltage	[kV]	28; 38
Rated lightning impulse withstand voltage	[kV]	75; 95
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	up to 2400
Rated short-time withstand current	[kA/3s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Withdrawable module		Metering bay - withdrawable module with voltage transformers
Voltage transformer	T2	various manufacturers
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)
Surge arresters	F1	Polim (ABB) od other

Medium voltage switchgear

2 / RELF 2S - Double busbar medium voltage switchgear

INTRODUCTION

The catalogue presents RELF 2S type medium voltage switchgear:

- air insulated
- metal-clad
- withdrawable
- double busbar
- with rated voltage 12 kV
- for indoor use

DESCRIPTION

RELF 2S is a modular, withdrawable, metal-clad, air insulated switchgear for primary distribution. It was equipped with double busbar system, which enable the creation of state of the art, complex supplying systems in distribution stations for industry and for generation and distribution sector. The use of interlocks system and an arc-proof design ensures highest possible operational safety and switchgear maintenance. It is intended for operation in normal conditions, as specified by the (PN-EN) IEC 62271-1 standard.

TYPES OF BAYS

The switchgear may be composed of various functional units:

- feeder bays with a circuit breaker and with optional voltage measurement,
- transverse bus coupler bay,
- longitudinal, double cubicle bus coupler bay with a circuit breaker and sectionalizer,
- metering bay,
- feeder bay with switch disconnector.

The withdrawable module of the switchgear may be equipped with a circuit breaker, contactor, sectionalizer, set of fused voltage transformers. It may be placed in the positions of: service, test/disconnection and separation.

CHARACTERISTICS AND ADVANTAGES

Main advantages

- visual inspection of the state of switches - disconnectors, circuit breaker and earthing switch
- doors in the rear of the switchgear - excellent access to cables and instrument transformers
- removable inspection plates - easy access to disconnectors
- advanced gas blow-out system - specially designed pressure relief duct discharges pressure from inside the bay
- optional gas exhausting duct - discharges gases outside of the switching room
- remote control - optional electrical drives for all switches
- possibility of equipping with current and voltage sensors
- bay with a fused switch disconnector - auxiliary transformer feeder

Characteristic features

- air insulated,
- frame-less, self-supporting design constructed with zinc-coated riveted steel sheets,
- double busbar system,
- IAC AFLR internal arc classification,
- interlocks and protections against performing incorrect switching operations,
- free-standing with access to cable connections from the rear of the cabinet,
- ease of operation,
- versions with manual drives or electrical drives of main switches and withdrawable module are available, depending on requirements and configuration of switchgear bays,
- high operational safety.

The switchgear is designed in a manner that ensures that normal operation, inspections and maintenance operations may be performed in a safe manner. High operational safety is achieved through:

- internal arc resistance of the switchgear enclosure,
- interlocks between switching operations and opening of doors,
- racking the withdrawable module with doors closed,
- controlling the switches remotely or locally,
- the use of internal compartments and partitions,
- the possibility of visual control of switching operations through inspection windows,
- bay voltage indication system.

BASIC TECHNICAL DATA

Compliance with standards:

The RELF 2S type switchgear meets the requirements of the following standards:

- **(PN-EN) IEC 62271-1** - “High-voltage switchgear and controlgear. Common specifications”,
- **(PN-EN) IEC 62271-200** - “High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV”,

The switchgear is certified by appropriate accredited bodies.

Basic technical data

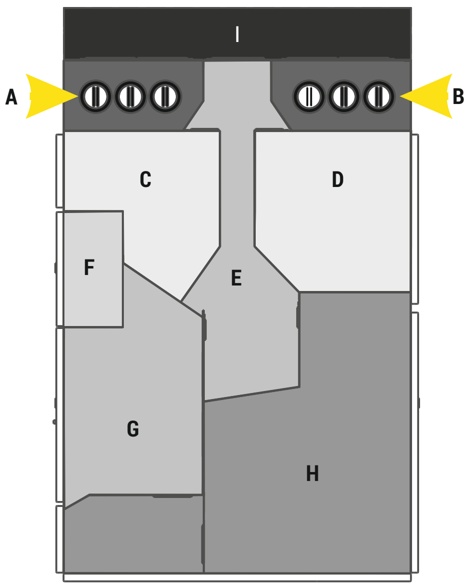
PARAMETERS		TYPE					
		RELF 2S					
Rated voltage	[kV]	12					
Main busbars and incoming feeder rated continuous current	[A]	630		1250	1600	2000	2500
Rated power-frequency withstand voltage	[kV]	28					
Rated lightning impulse withstand voltage	[kV]	75					
Rated frequency	[Hz]	50					
Rated short-time withstand current	[kA/3 s]	31,5					
Rated peak withstand current	[kA]	80					
Withstand for internal arcing fault	[kA/1 s]	31,5					
Degree of protection		up to IP4X					
Cubicle width	[mm]	650	800[1]	800 (650)	800	1100	1100
Cubicle height	[mm]	2700[2]					
Cubicle depth	[mm]	1800					
Compliance with standards		(PN-EN) IEC 62271-200; (PN-EN) IEC 62271-1; (PN-EN) IEC 60529					

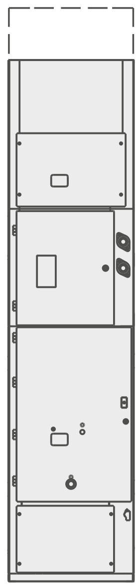
1) Width of bay with a switch disconnector

2) Height of the cubicle without the gas exhausting “I” (gas exhausting duct as optional equipment)

DESIGN

The RELF 2S switchgear bay is designed as a cubicle with separate functional compartments:

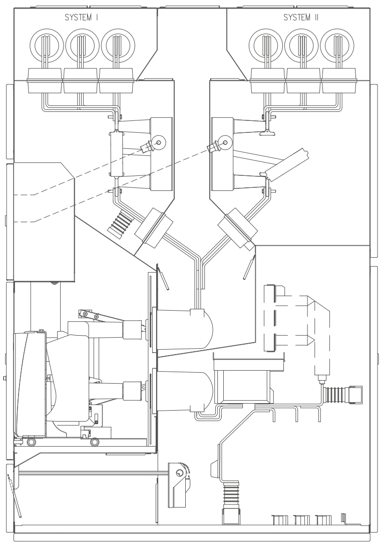


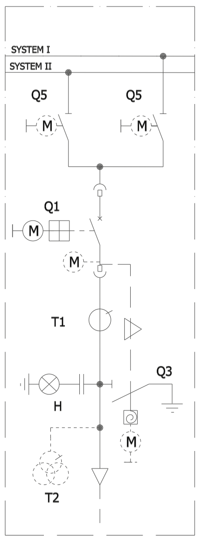


Functional compartments of a feeder bay with circuit breaker:

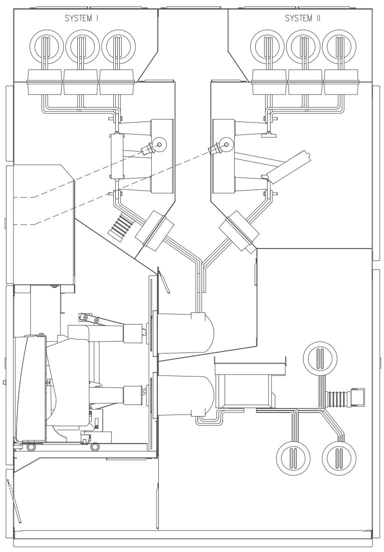
A - busbar compartment of system I
B - busbar compartment of system II
C - disconnector compartment of system I
D - disconnector compartment of system II
E - internal pressure relief and blow-out duct
F - auxiliary circuits LV compartment
G - main device compartment
H - cable compartment
I - gas exhausting duct (optional)

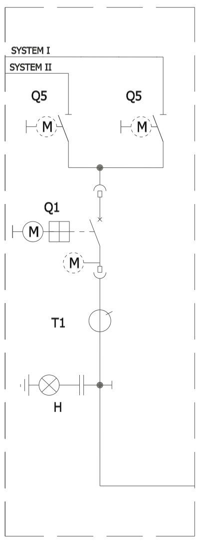
Feeder bay with a circuit breaker (option with voltage measurement)



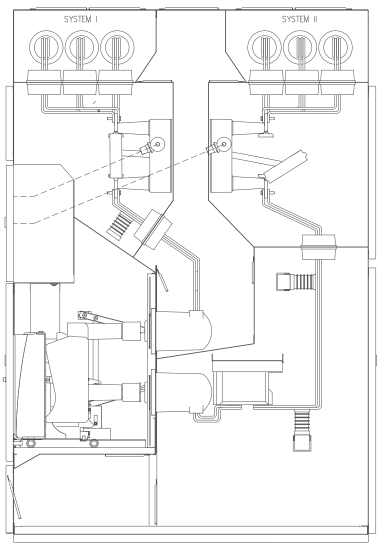


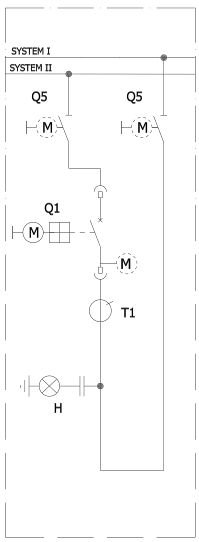
Longitudinal bus coupler bay with circuit breaker



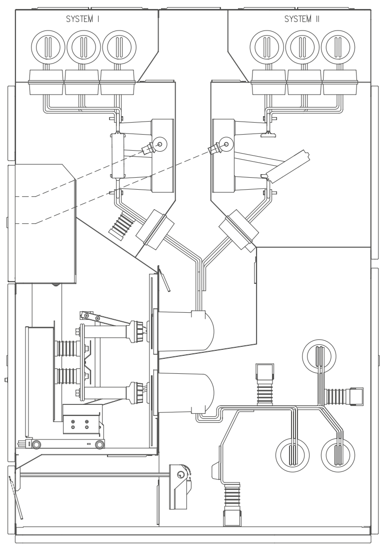


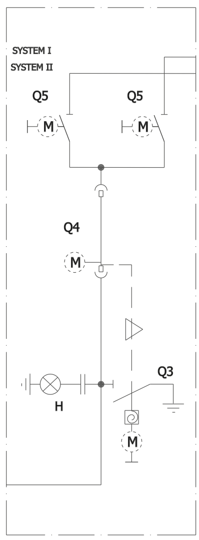
Transverse bus coupler bay



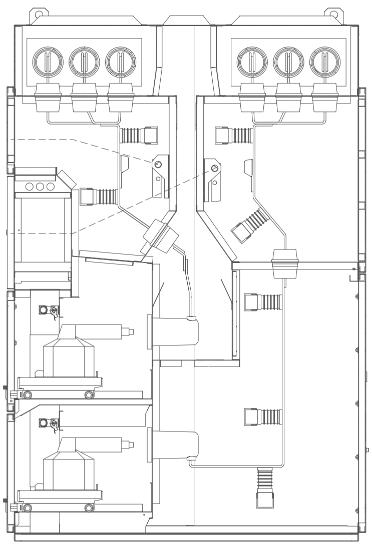


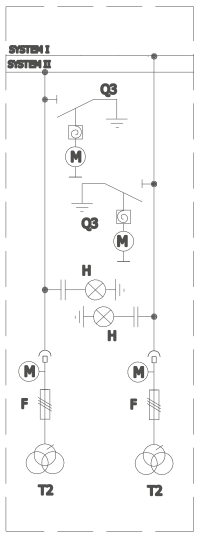
Longitudinal coupler bay with sectionalizer



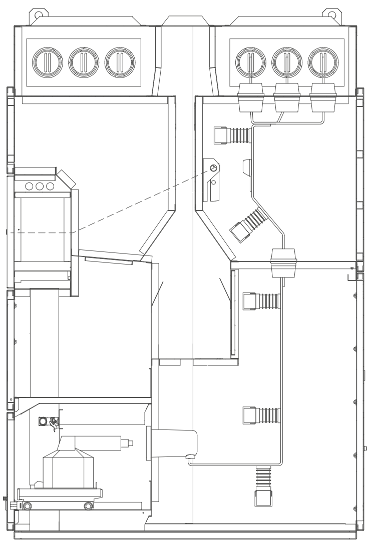


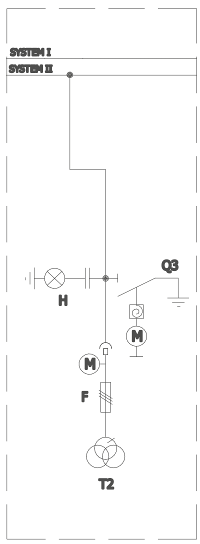
Metering bay – SYSTEM I and II



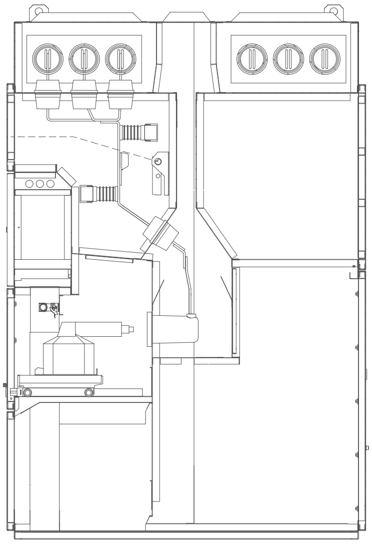


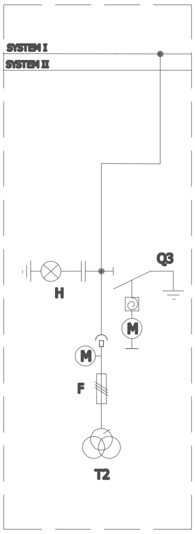
Metering bay – SYSTEM II



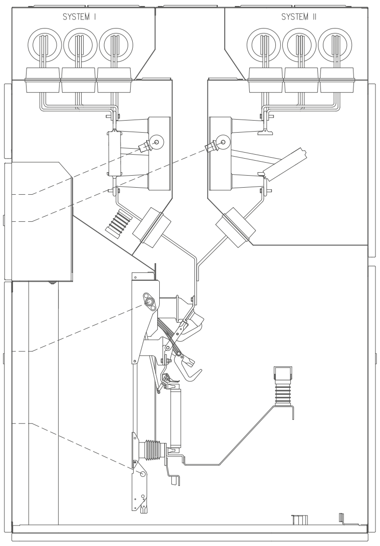


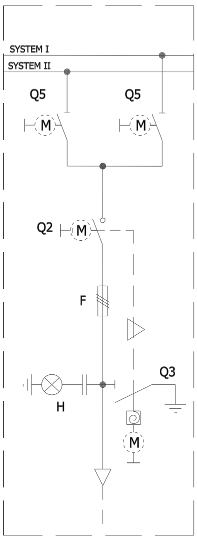
Metering bay – SYSTEM I





Bay with switch disconnector





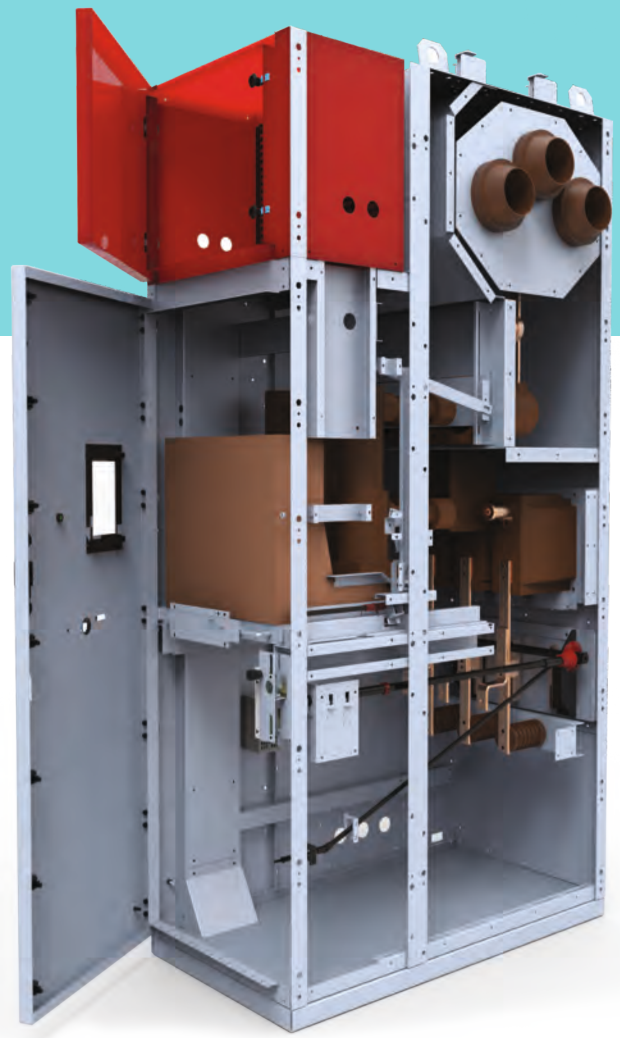
Designations of devices used in the switchgear bays

Q1	circuit breaker	Q4	sectionalizer	T1	current transformer
Q2	switch disconnector	Q5	disconnector	T2	voltage transformer
Q3	earthing switch	F	fuse link	H	voltage indicator

Other types of bays on arrangement with the manufacturer.
Bay equipment may be adapted to special requirements on arrangement with the manufacturer.

Medium voltage switchgear

3 / RXD



INTRODUCTION

The catalogue presents RXD type medium voltage switchgear:

- air insulated,
- metal enclosed,
- withdrawable or fixed module - depending on equipment,
- with a single busbar system,
- for rated voltages of 12 kV or 36 kV,
- for indoor use.

DESCRIPTION

The RXD type switchgear is designed to operate in substations of generation, distribution and industry companies.

It meets the requirements of the (PN-EN) IEC 62271-200 and (PN-EN) IEC 62271-1 standards, provides an IP4X protection degree acc. to (PN-EN) IEC 60529. It is intended for operation in normal conditions, as specified by the (PN-EN) IEC 62271-1 standard.

The switchgear is designed in a manner that ensures that normal operation, inspections and maintenance operations may be performed in a safe manner.

In order to protect against corrosion it uses a frame-less design made of zinc-coated steel sheet, and the doors and side covers of outer bays are powder painted.

TYPES OF BAYS

The switchgear may be composed of various functional units:

- incoming/outgoing bays,
- coupler bays,
- metering bays with the possibility of earthing of the main busbars,
- switch disconnector bay,
- transformer bay,
- reactive power compensation bay.

The withdrawable module of the switchgear may be equipped with a circuit breaker, contactor, sectionalizer or a set of fused voltage transformers.

It may be placed in the positions of: service, test/disconnection and separation.

ADVANTAGES

- air insulated,
- design constructed with zinc-coated, riveted steel sheets, without welding,
- loss of service continuity - LSC2 for 12 kV and LSC1 for 36 kV
- version with main busbars in a separate compartment with PM class partitions - for 12 kV
- high operational safety,
- IAC AFLR internal arc classification,
- interlocks and protections against performing incorrect switching operations,
- wall-standing or free-standing versions, access from the front of the cubicle,
- wide range of devices and bays types,
- possibility of expanding the switchgear with additional bays,
- ease of operation.

The switchgear ensures high operational safety through:

- internal arc resistance of the switchgear enclosure,
- interlocks between switching operations and opening of doors,
- racking in and out the withdrawable module with doors closed,
- the possibility of visual control of switching operations through inspection windows,
- bay voltage indication system.

BASIC TECHNICAL DATA

Compliance with standards:
The RXD type switchgear meets the requirements of the following standards:

- **(PN-EN) IEC 62271-1** - "High-voltage switchgear and controlgear. Common specifications",
- **(PN-EN) IEC 62271-200** - "High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV",

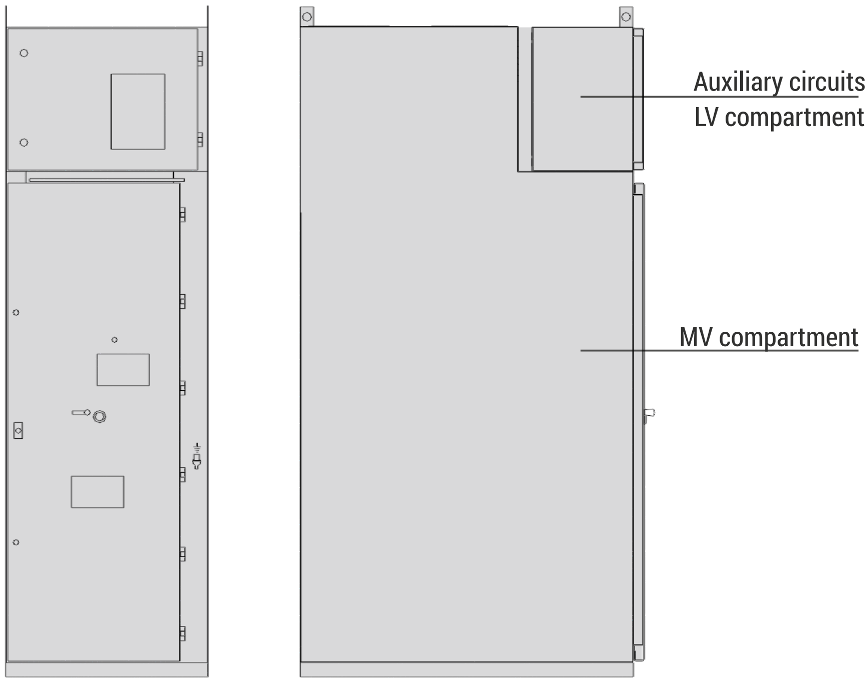
The switchgear is certified by appropriate accredited bodies.

Electrical data:			
Rated voltage	[kV]	12	36
Main busbars and incoming feeder rated continuous current	[A]	630 - 1250	630
Rated power-frequency withstand voltage	[kV]	28	85 (5min) / 95 (1min) / 120 (5min)
Rated lightning impulse withstand voltage	[kV]	75	190/220
Rated frequency	[Hz]	50	
Rated short-time withstand current	[kA]	up to 25/1s	up to 25/1s
Rated peak withstand current	[kA]	up to 63	up to 63
Withstand for internal arcing fault	[kA]	up to 25/1s	up to 25/1s
Protection degree		up to IP4X	
Cubicle height	[mm]	2250	2600
Cubicle width	[mm]	600/700/750/900	1600/2000
Cubicle depth	[mm]	1188	
Compliance with standards		(PN-EN) IEC 62271-200; (PN-EN) IEC 62271-1	

Service conditions:			
Ambient temperature		Relative humidity of air	
- peak short-time	**+ 40°C**	- highest day average	**95%**
- highest day average	**+ 35°C**	- highest month average	**90%**
		- highest day average vapour pressure	**2,2kPa**
- lowest long-term	**- 5°C**	- highest month average vapour pressure	**1,8 kPa**
Atmosphere at the place of installation		no significant soiling with salt, vapour, dust, smoke, flammable or corrosive gasses and lack of icing, frosting and dewing	
Installation altitude		up to 1000 m a.s.l. [1)]	
Vibrations		vibrations caused by external factors or earthquakes negligible	

Note:

[1)] If the switchgear installation height is higher than 1000 m ASL the switchgear insulation level should be corrected in accordance with the standard.



SWITCHGEAR DESIGN

Design

- The switchgear cubicle is constructed of bent steel sheets, riveted together. Walls and partitions create a self-supporting structure. Zinc-coated sheet is used for the construction of cubicles.
- High-strength round-head steel rivets were used as fasteners.
- Additionally, two-part side covers made of painted sheet are bolted to the external walls of the outer bays of the switchgear.
- An auxiliary circuits compartment is placed on top of the cabinet.
- Each cubicle is fully separated from the adjacent cabinets, which prevents damage spreading to adjacent cubicles in case of an electric arc.
- Main busbars are located at the top of the cabinet. The busbars pass between the cabinets through gland plates made of non-magnetic material and equipped with bushings, which are support elements for the main busbars. Outgoing busbars branch off the main busbars.
- The main busbars area can be isolated during servicing by inserting an insulating plate into guide-rails through a slot located above the door (there is also an option of construction of a switchgear with a separate main busbar compartment).
- The cubicle doors may be opened in an interlock-controlled mode.
- The main device may be fixed or as a withdrawable module. The withdrawable module in the operating and test/disconnection positions is located inside the cabinet, behind closed doors. After the doors are opened, it is possible to rack it out to the separation position.
- Mechanical indicators of the circuit breaker position and drive charging state are visible through the inspection window in the switchgear doors.
- In accordance with the LSC (Loss of Service Continuity) classification, the RXD switchgear meets the criteria of LSC2 class (for 12 kV) and LSC1 for 36 kV.
- Connections for cables or busbars are located in the lower zone of the cabinet. It also contains current transformers, fast earthing switch (RXD 12 kV) and depending on operational needs, optionally: voltage transformers, earth fault transformersand surge arresters.
- The earthing switch status is indicated by a position indicator.
- The cubicle bottom is closed by a split floor cover, which also acts as a cable gland plate. Openings in the plate are covered with rubber cable glands.
- Cable clamp supports and earth fault transformer supports are installed on folds of the bottom plate.

The cubicle doors are made of painted sheet. Doors use hinges and bolts which can stand up to explosion-type loads.
The hinges allow opening the doors by approximately 135°.
The doors were reinforced by appropriately shaped and welded reinforcing profiles.
The doors are equipped with an inspection window used for visual control of the position of the withdrawable module and switching operations.
The design of the doors allows the mechanical opening of the circuit breaker in service position with the doors closed.

Safety flaps

The cabinet has in its top part blow-out openings, closed with flaps. Their task is to discharge any pressure created inside the cabinet as a result of an arc fault.
A sudden increase of pressure inside the switchgear cabinet breaks the plastic bolts and opens the flaps, which may activate limit switches installed at the roof of the switchgear. Limit switches activated by the flaps being opened send an impulse which trips the incoming feeder circuit breaker. This allows limiting the effects of an arc fault generated inside the cabinet.

The withdrawable module is a unit composed of a racking system, and depending on the bay function, respectively: circuit breaker, contactor, set of fused voltage transformers, or a sectionalizer. The racking system performs the mechanical connection of the withdrawable module with the switchgear bay. It's stationary part is connected with the bay by interlocking on both sides in guide rail cut-outs. The **moving part** of the racking system is shifted between the service position and the test/disconnection position using a drive screw operated manually with a crank, or with an electric drive, while the doors are closed. The service and test/disconnection position is signalled by position indicators, after the module reaches an appropriate position.

The auxiliary circuits compartment (low voltage compartment is constructed in the form of a control cubicle and is completely separated from the high voltage zone of the switchgear. The cubicle has its own metal enclosure and may be prefabricated independently of the high voltage part of the switchgear.
The cubicle is intended for the installation of: protection relays and IEDs, instrumentation & control devices and automation system elements.
It is installed on the roof of the switchgear. In its bottom, top and side walls a series of openings are made for lead and
cable glands and cable trays.
These openings are covered by plates, in which holes can be made according to design needs. An assembly plate fixed to the rear wall of the LV cubicle was designed for the installation of devices. The devices may be also fixed on the side walls.
On arrangement with the manufacturer, the cubicle design may be adapted to individual needs of the customer and of the design.

Busbars

Main busbars

A single, three-phase current circuit is used as a main busbar in the switchgear, located in the top, back part of the cabinet (see Figure 1a,b. Bay equipment.

Copper flat bars with rounded edges were used, with cross-sections selected in accordance with the rated current of the switchgear.

The main busbars are supported by distribution busbars and on bushings installed in the side partitions.

Distribution busbars

Distribution busbars are made flat bars with rounded edges, with cross-sections selected in accordance with the rated current of the switchgear.

Insulating elements

The switchgear used epoxy resin insulators. These are post insulators used to support busbars and bushings used to pass the main busbars between the switchgear bays, installed in the gland plates of the bay side walls.

Protective earthing

A earthing conductor is placed in every cabinet, in the form of a copper busbar with a cross-section of 40x5 mm, placed at the bottom, in the rear of the cabinet. These busbars are bridged between the cabinets, creating an earthing conduit. This conduit is terminated with terminals on the left and right side of the switchgear, used to connect it to the facility's earthing system.

Cable connections

The cabinet connection is adapted for entry of single- or multi-core MV cables.

SYSTEM OF INTERLOCKS AND PROTECTIONS

The switchgear may be equipped with a series of standard and, on arrangement with the manufacturer, other additional mechanical and electrical interlocks which improve operational safety:

Mechanical interlocks:

1) prevent racking the withdrawable module in or out of the service position when the circuit breaker is closed,
2) allow the closing of the circuit breaker only in the service and test/disconnection positions,
3) allow the closing of the earthing switch only in the test/disconnection or separation position of the withdrawable module,
4) prevent racking the withdrawable module from the test/disconnection position to the service position if the earthing switch is closed,
5) allow changing the position of withdrawable module only when it is locked in a bay,
6) prevent opening the bay door if the earthing switch is open (does not apply to RXD36),
7) prevent racking the withdrawable module from the test/disconnection position to the separation position until the circuit breaker control circuits supply plug is set to the separation position (optional),
8) a servicing truck for the transporting of withdrawable modules may be equipped with a secure bay coupling mechanism, which prevents changing the position of the racking truck even when its wheels are unlocked (optional),
9) a servicing truck for the transporting of withdrawable modules may be constructed in a way that allows moving the withdrawable module from the truck to the bay only after mechanical coupling of the truck with the bay (optional),
10) a servicing truck for the transporting of withdrawable modules may be constructed in a way that allows uncoupling the truck from the bay only after the withdrawable module is locked in the bay or in the truck (optional),
11) allow locking the drive of moving partitions which cover the fixed contacts.

On arrangement with the manufacturer it is possible to use additional key and padlock interlocks.

Electrical interlocks:

1) prevent closing the circuit breaker if its auxiliary circuits are not powered; only mechanical opening of the circuit breaker is possible (optional),
2) prevent racking the withdrawable module to the service position without power supply to the control circuits (optional),
3) prevent access to the earthing switch drive when closing of the earthing switch requires additional conditions (for example, main busbar earthing switch can be closed only when the withdrawable modules in the particular section are in the test/disconnection position),
4) prevent access to the withdrawable module drive when racking the module requires additional conditions (optional).

Interlocks, with the exception of standard interlocks, are always designed to fit to a particular project.

On arrangement with the switchgear's manufacturer, it is possible to install additional interlocks, which operate based on limit switches and electromagnetic locks.

The door design allows them to be unlocked and the withdrawable module drive to be accessed when needed (this special activity may be unsafe).

SWITCHGEAR EQUIPMENT

Switching devices

The switchgear may be equipped as with VB-4 (ZPUE), SION (Siemens), VD4 (ABB), HVX (Schneider) vacuum circuit breakers; HD4 (ABB) gas insulated circuit breakers; VSC (ABB) contactors, and also Rollarc (Schneider Electric) and 3TM i 3TL (Siemens) on arrangement.
Other devices may be used on arrangement with the switchgear manufacturer.
A fast earthing switch with an impulse drive is used (with the exception of RXD 36).

Metering instrumentation

Instrument transformers by different manufacturers are used for metering purposes.

Bay voltage indication utilizes capacitive insulators or voltage transformers with voltage dividers and voltage indicator type SN (ZPUE).

Protection devices

The switchgear can be equipped with low voltage devices by any manufacturer, according to the individual needs of the customer.
It is also possible to install any digital protection relay or IED.

An internal arc protection system can be installed in the switchgear.
The systems sense the internal arc by detecting the flash and an addtional voltage or current criteria inside the protected switchgear.

When these two events occur simultaneously, the system is activated and a circuit breaker tripping impulse is sent.

DIAGRAMS OF PRIMARY AND AUXILIARY CIRCUITS, SWITCHGEAR AUTOMATION

Primary circuits

Structural diagrams of examples of primary circuits are shown on Figure 2 and in data sheets provided herein and on the www.zpue.com website. Alternative solutions to the ones presented can be implemented on arrangement with the manufacturer.

Auxiliary circuits

LV auxiliary circuits consist of: protection relays, metering, control, automation and signalling systems. An auxiliary circuits compartment is intended for the devices of these circuits. Dimensions and example arrangement of devices are presented on figures 3 and 4.

Diagrams of example internal and assembly connections for primary and auxiliary devices for a typical switchgear equipment can be obtained by contacting the switchgear manufacturer.

Switchgear automation

The switchgear is designed to operate in SCADA systems. With this goal in mind it is equipped with digital protection relays (with possible digital communication) and automation systems. The switchgear can then operate in master control systems and automated control systems.

SWITCHGEAR PACKAGING, TRANSPORT AND INSTALLATION

Packaging

Three packaging methods are used for RXD type switchgears:

a) standard packaging - the switchgear cubicles is placed on a pallet and wrapped with bubble wrap followed by shrink wrap,

b) in boxes - switchgear cubicles are packaged as described above and put into boxes,

c) maritime transport packaging - switchgear cubicles with inserted moisture absorbing material are placed in barrier plastic sheet bags, which are evacuated. The switchgears protected in this manner are transported respectively on pallets or in boxes.

Transport

Switchgears are transported as single cubicles or as cubicles assembled into transport assemblies. Transport of the switchgear in the room and to the room in which it is to be installed can be done with a crane, forklift, or on rollers.

For crane transport, the cubicles is equipped with transport lugs. The angle of lifting ropes should not exceed 120°. Attaching the lifting ropes directly to the cubicles structure is prohibited.
The placement of the cubicles on a transport pallet enables lifting the switchgear with a forklift.

During the transport and installation of the switchgear cubicles, great care should be taken to not to damage the paintwork and steel sheet enclosures.

Main devices, such as circuit breakers, contactors, and withdrawable modules, and LV devices sensitive to vibrations, are transported separately in the manufacturers' original packages.

Switchgear installation

The manner of switchgear placement and external cable and busbar connections depend on the design of the facility where it will be placed. These connections should be performed according to the instructions established during arrangements with the switchgear manufacturer.
The switchgears can be placed directly on concrete floor, on foundation frame attached to the floor, or on a steel or concrete structure of the facility.
Regardless of the type of foundation, switchgears must be placed horizontally, well levelled and attached to the foundation.
Figures 5 and 6 present the principles of switchgear placement: location of the switchgear in the room, example locations of floor holes for cable entries, switchgear support frame with holes for attaching the switchgear to the foundation.
They should be treated as demonstrations, and their exact location agreed upon when ordering the switchgear. Figure 7 demonstrates methods for attaching the switchgears to the foundation.
Due to the switchgear installation technology it is recommended that the Y dimension of the room be at least 1000 mm higher than the total length of the switchgear.
Recommended minimum distance from closed safety flaps on the switchgear roof to the room ceiling: 600 mm.

STANDARD EQUIPMENT DELIVERED WITH THE SWITCHGEAR

Each switchgear is equipped with:

- fasteners for connecting all the units together,
- withdrawable module racking crank,
- earthing switch drive crank,
- withdrawable module transport cart,
- cabinet key doors.

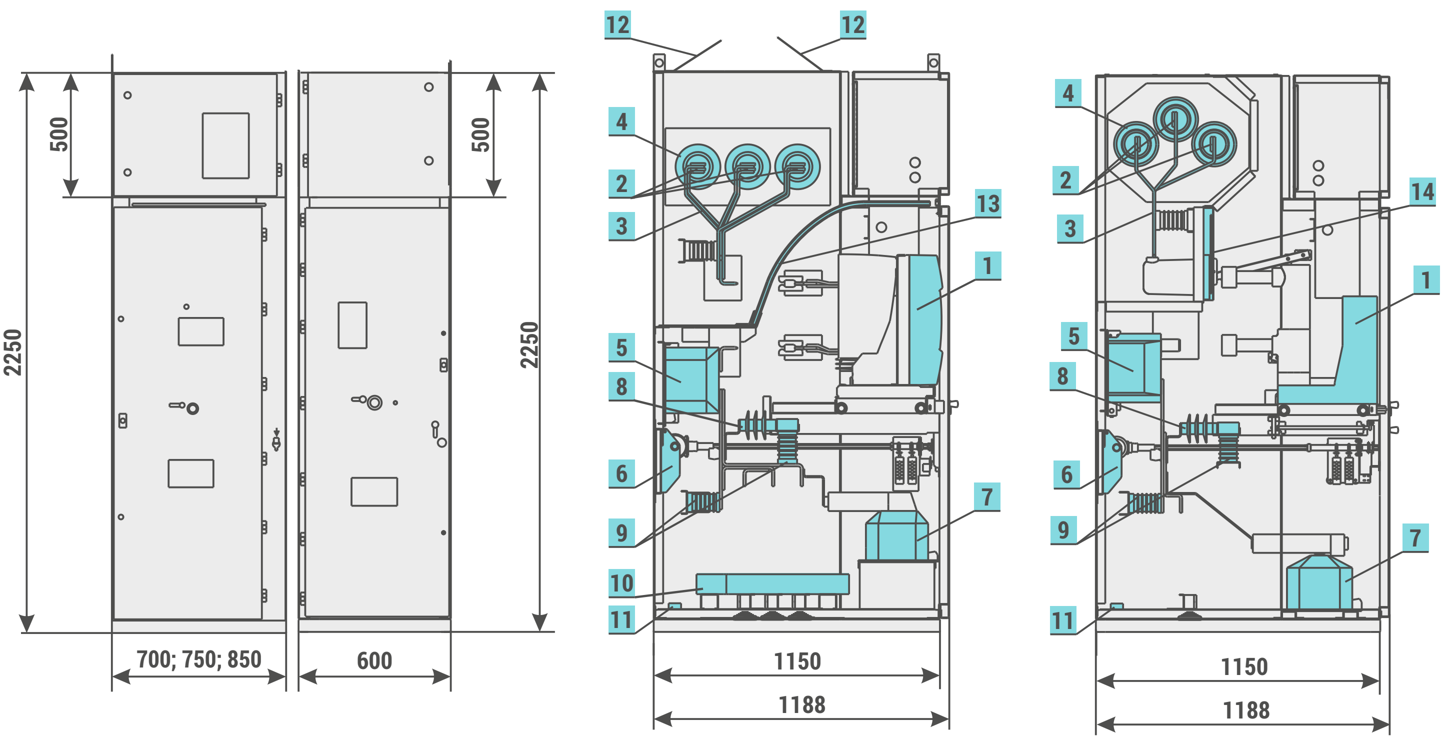
Documents delivered with the switchgear:

- declaration of conformity,
- switchgear manual,
- operation and maintenance manuals and warranty cards for the used devices,
- as-built documentation for the switchgear,
- warranty card.

DRAWINGS

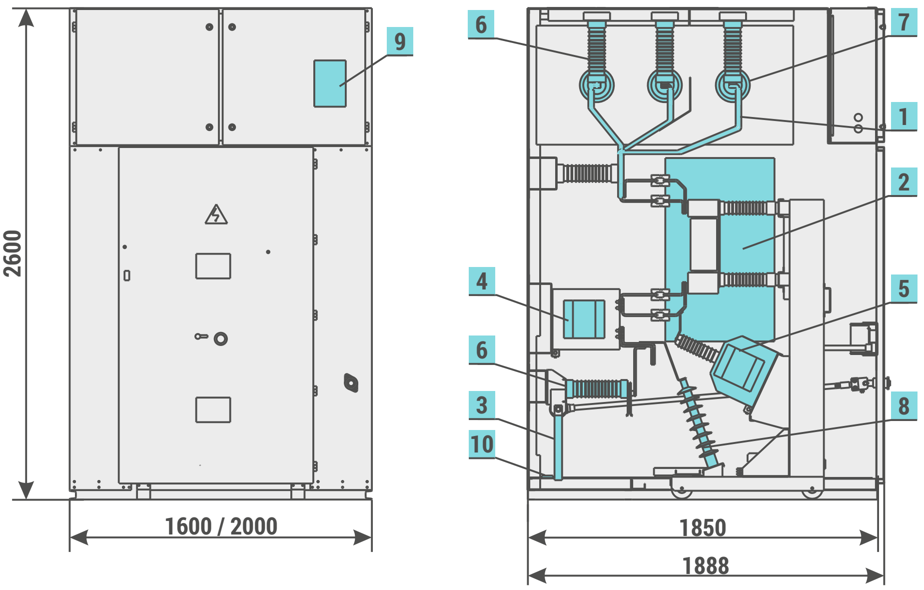
A list of figures presented herein:

Figure 1a Example equipment of the RXD 12 bay



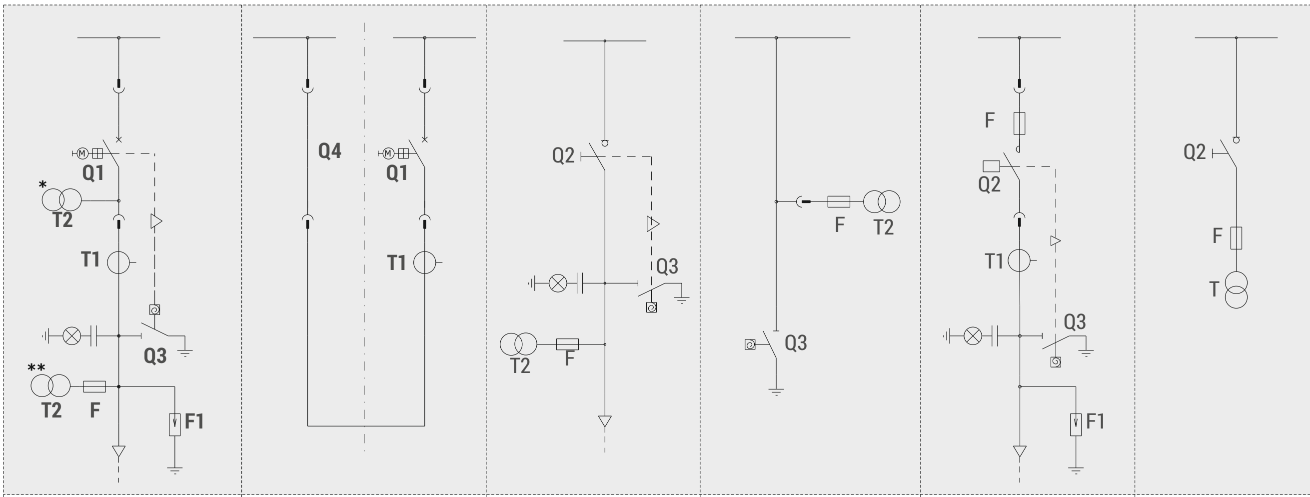
1 - main device: circuit breaker contactor
2 - main busbars
3 - outgoing busbars
4 - bushings
5 - current transformers
6 - earthing switch
7 - voltage transformers
8 - surge arresters
9 - capacitive post insulators
10 - earth fault transformer
11 - earthing busbar
12 - safety flaps
13 - insulating plate
14 - partition with insulator

Figure 1b Example equipment of the RXD 36 bay



1 - outgoing busbars
2 - primary device: circuit breaker
3 - earthing switch
4 - current transformers
5 - voltage transformers
6 - capacitive post insulators
7 - bushings
8 - surge arresters
9 - protection relay
10 - earthing busbar

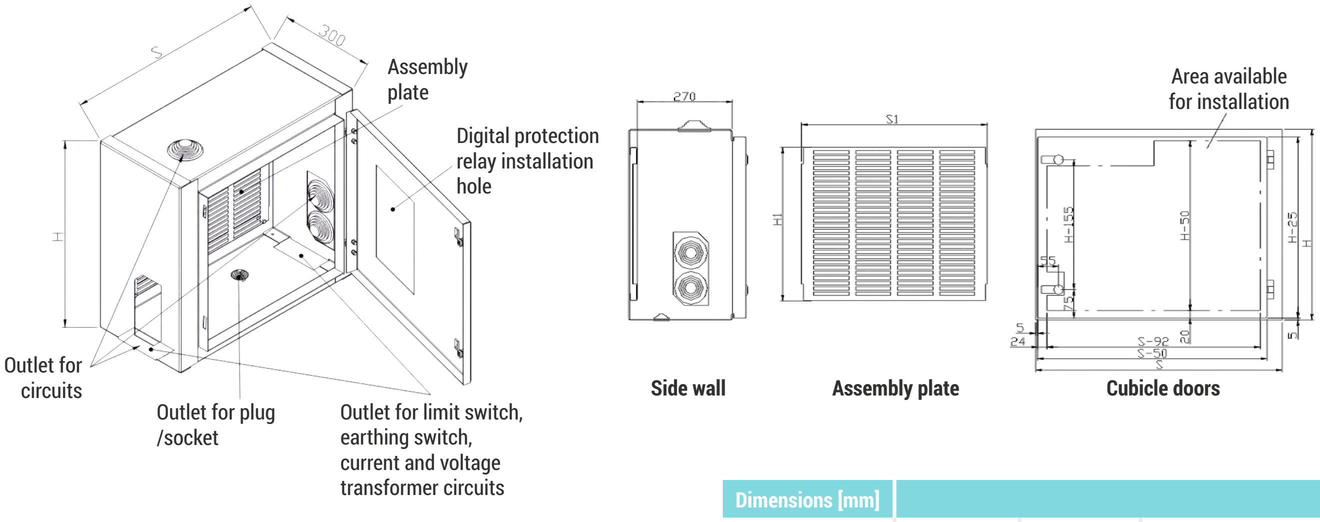
Figure 2 Structural diagrams of primary circuits



Feeder bay with cable connection	Bus coupler bay, double cubicle	Feeder bay with switch disconnector	Metering bay with earthing of main busbars	Outgoing feeder bay with contactor**	Auxiliary transformer bay

Notes:
*) only for RXD36; **) not for RXD36

Figure 3a RXD 12 bay auxiliary circuits compartment



Dimensions [mm]				
H	500	500	500	500
S	900	750	700	600
H1	450	450	450	450
S1	820	670	630	520

Figure 3b RXD 36 bay auxiliary circuits compartment

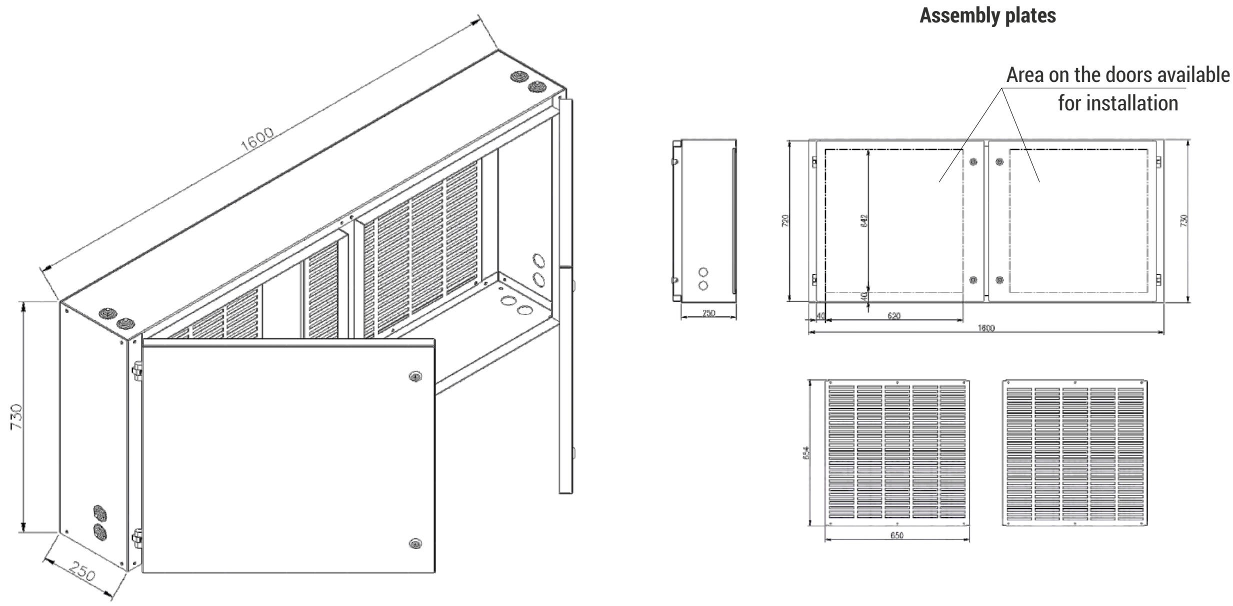
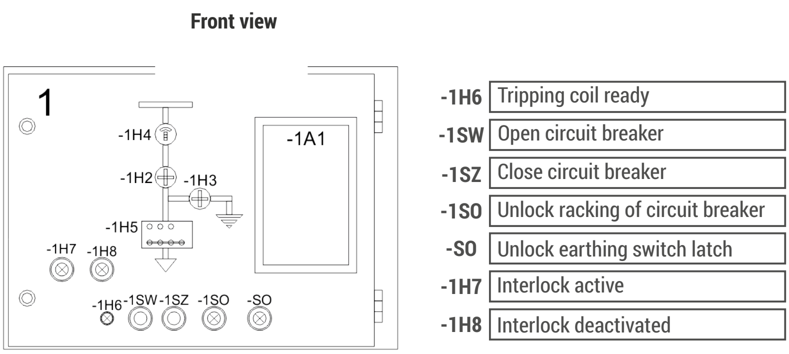


Figure 4 Example device layout in the RXD 12 bay auxiliary circuits compartment



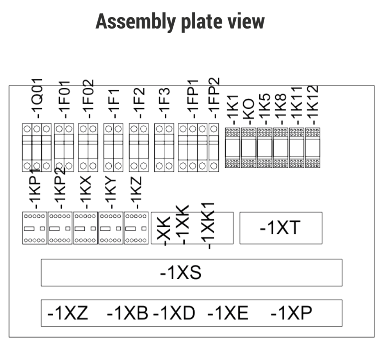
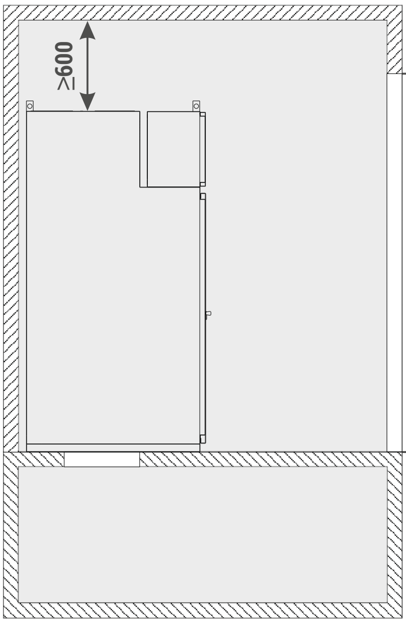


Figure 5a Placement of the RXD 12 switchgear

side view



top view

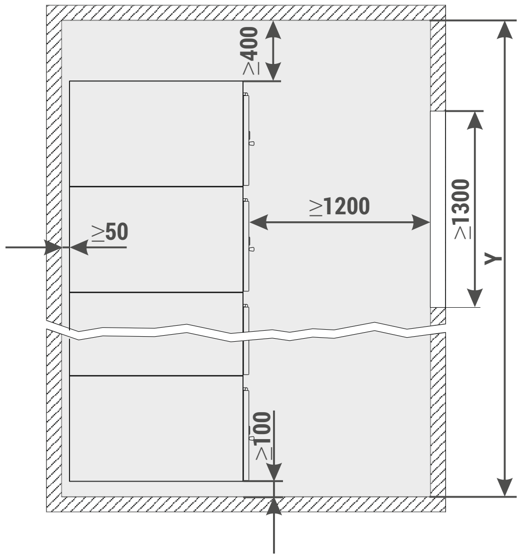
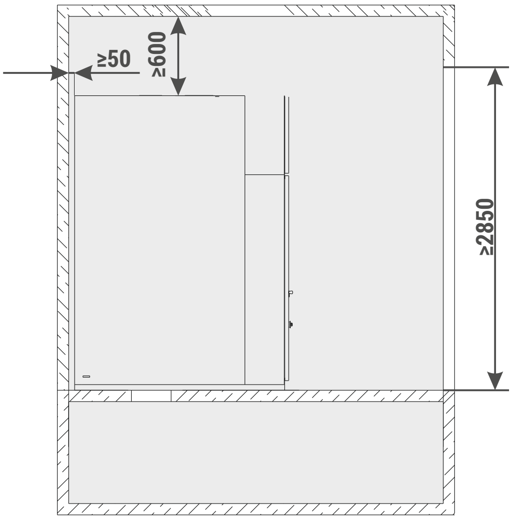
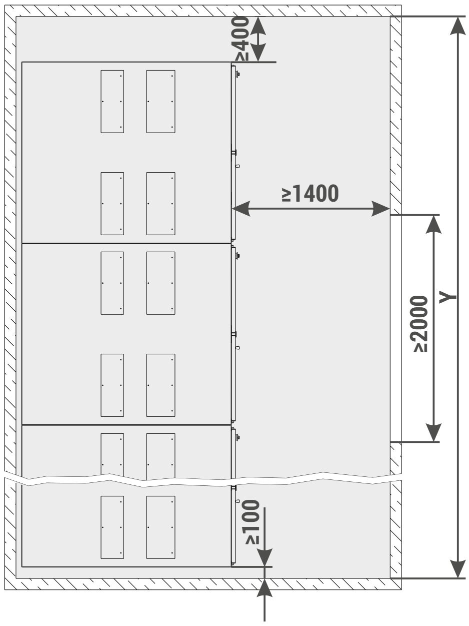


Figure 5b Placement of the RXD 36 switchgear

side view

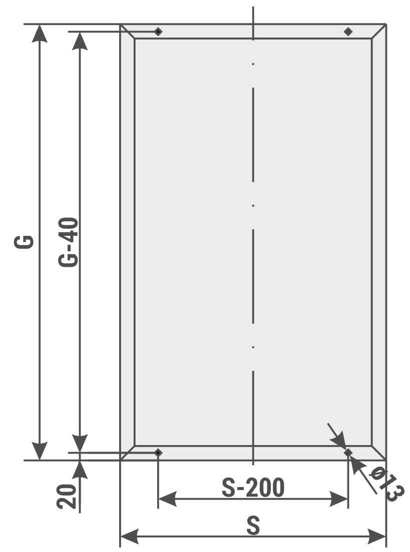


top view



Note:
In case of specific requirements which impact the presented dimensions, please contact the switchgear manufacturer.

Figure 6a RXD 12 switchgear support frame



Dimensions [mm]				
G	1150			
S	600	700	750	900

Figure 6b RXD 36 switchgear support frame

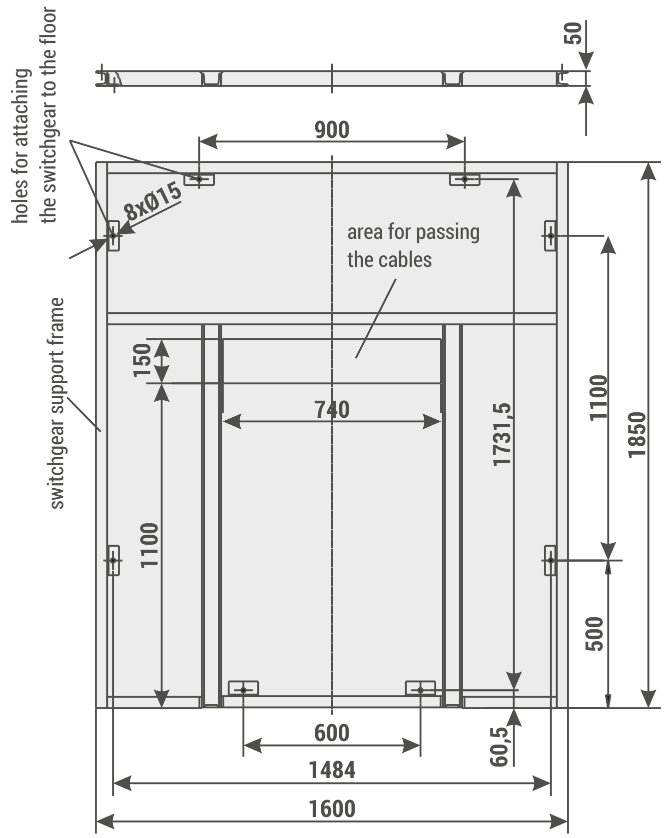
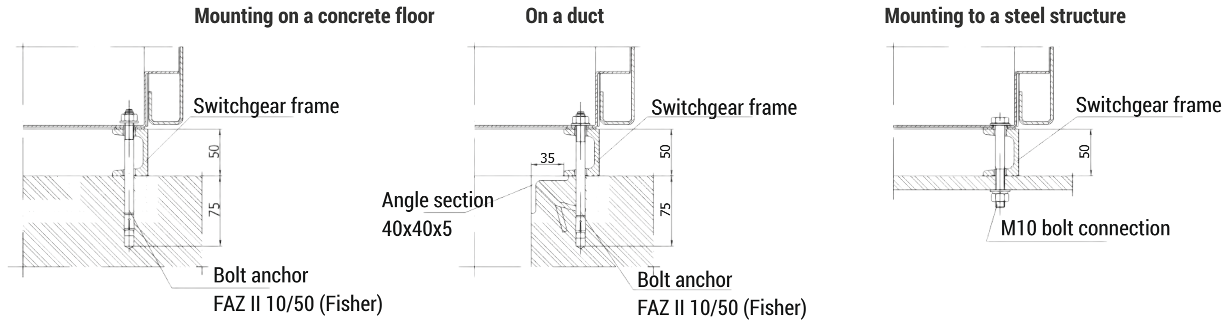
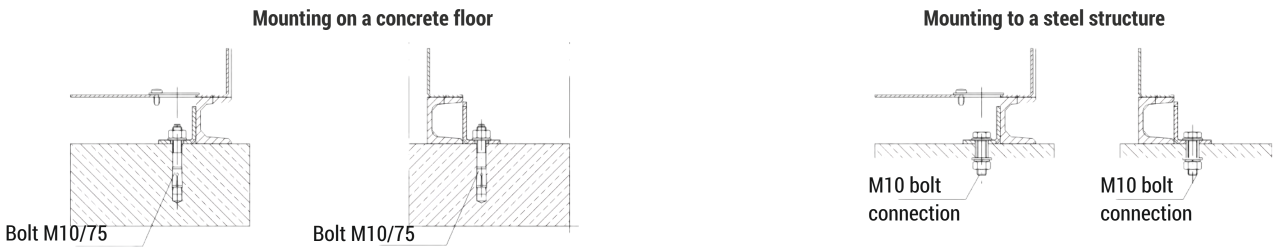


Figure 7 Mounting the RDX switchgear on the floor

RXD 12



RXD 36



DATA SHEET EXAMPLES

A list of data sheets presented herein*

RXD 12 kV

Sheet 1.1	Feeder bay with circuit breaker, 12 kV
Sheet 1.2	Feeder bay with circuit breaker and a separate compartment of main busbars, 12 kV
Sheet 1.4	Feeder bay with switch disconnector, 12 kV
Sheet 1.6	Bus coupler bay - cubicle with circuit breaker, 12 kV
Sheet 1.8	Bus coupler bay - cubicle with sectionalizer, 12 kV
Sheet 1.10	Metering bay, 12 kV
Sheet 1.11	Metering bay with a separate compartment of main busbars, 12 kV
Sheet 1.13	Auxiliary transformer bay - with a transformer up to 40 kVA, 6/0.4 kV
Sheet 1.14	Reactive power compensation set - with a capacitor bank up to 700 kvar; 6.6 kV

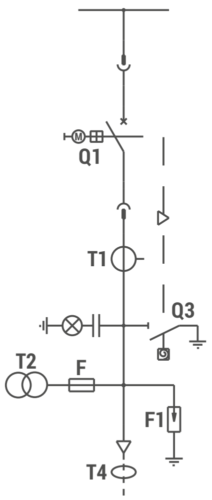
RXD 36 kV

Sheet 2.1	Feeder bay with circuit breaker
Sheet 2.2	Feeder bay with switch disconnector
Sheet 2.3	Bus coupler bay - cubicle with circuit breaker
Sheet 2.4	Bus coupler bay - cubicle with sectionalizer
Sheet 2.5	Metering bay
Sheet 2.6	Auxiliary transformer bay

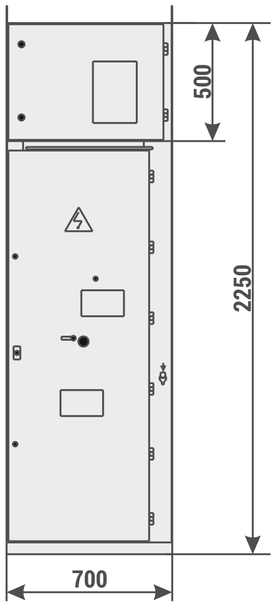
Note:
* The presented data sheets are only examples of solutions, which may change. In case of switchgears with technical parameters and bay configurations different than the ones presented, appropriate data sheets are available directly from the manufacturer or on the www.zpue.com website.

Sheet 1.1 Feeder bay with circuit breaker, 12 kV

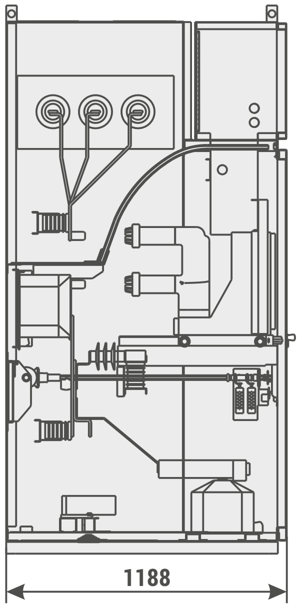
Structural diagram



Front panel



Cross-section



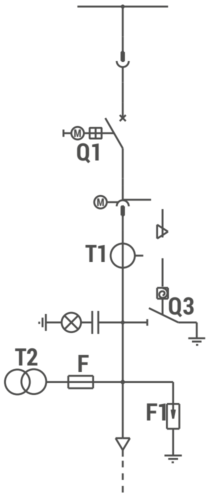
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	630 ÷ 1250
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	do 25
Rated peak withstand current	[kA]	do 65
Withstand for internal arcing fault	[kA/1s]	do 25
Protection degree		do IP4X

Equipment:		
Circuit breaker	Q1	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric)
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)
Current transformer	T1	various manufacturers
Voltage transformer	T2	various manufacturers
Earth fault transformer	T4	various manufacturers
Surge arrester	F1	various manufacturers
Weight	[kg]	560 ÷ 700

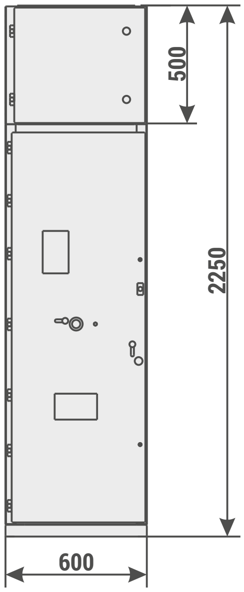
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.2 Feeder bay with circuit breaker and a separate compartment of main busbars, 12 kV

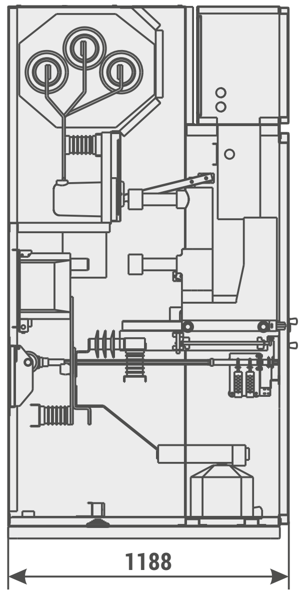
Structural diagram



Front panel



Cross-section



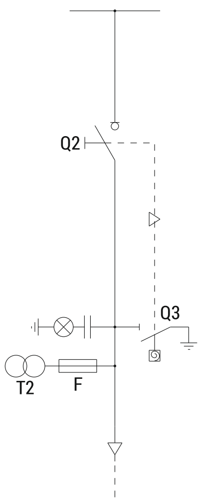
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	630 ÷ 1250
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Circuit breaker	Q1	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider)
Earthing switch	Q3	Us1 (ZPUE); EK6 (ABB)
Current transformer	T1	various manufacturers
Voltage transformer	T2	various manufacturers
Surge arrester	F1	various manufacturers
Weight	[kg]	650

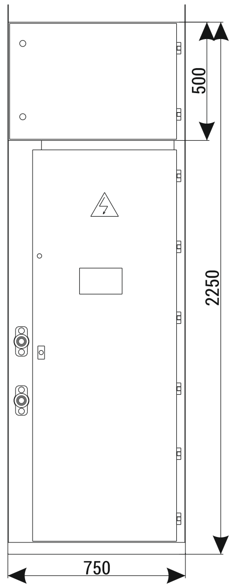
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.4 Feeder bay with switch disconnector, 12 kV

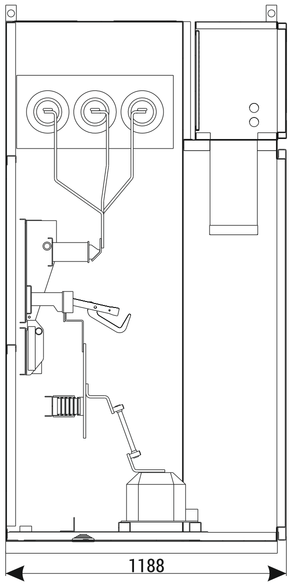
Structural diagram



Front panel



Cross-section



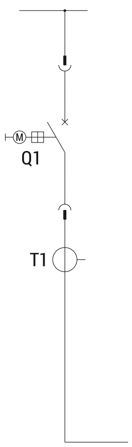
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	630 ÷ 1250
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Switch disconnector	Q2	NAL (ABB); OM (ZWAE)
Earthing switch	Q3	fast, with an impulse drive
Voltage transformer	T2	various manufacturers
Weight	[kg]	520 ÷ 620

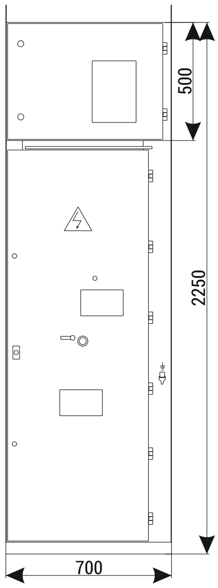
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.6 Bus coupler bay - cubicle with circuit breaker, 12 kV

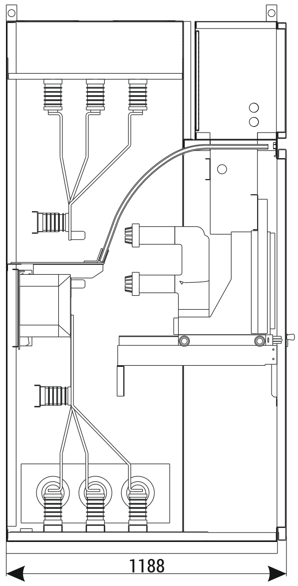
Structural diagram



Front panel



Cross-section



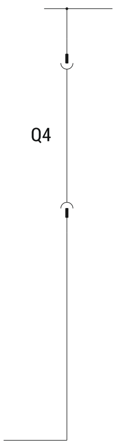
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	630 ÷ 1250
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Circuit breaker	Q1	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric)
Current transformer	T1	various manufacturers
Weight	[kg]	530 ÷ 630

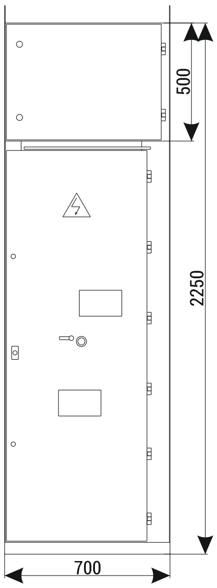
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.8 Bus coupler bay - cubicle with sectionalizer, 12 kV

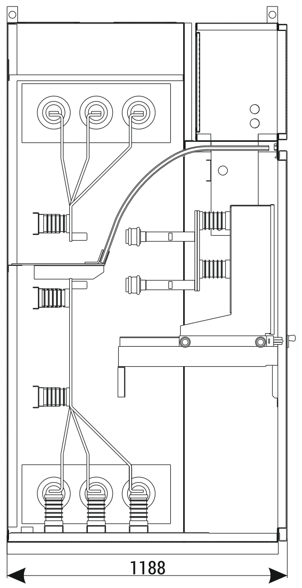
Structural diagram



Front panel



Cross-section



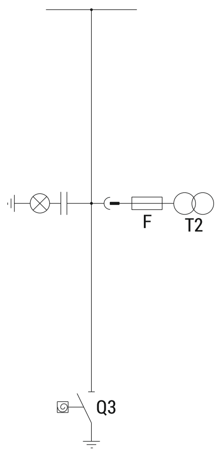
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Rated continuous current	[A]	630 ÷ 1250
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Sectionalizer	Q4	made by ZPUE
Weight	[kg]	405 ÷ 510

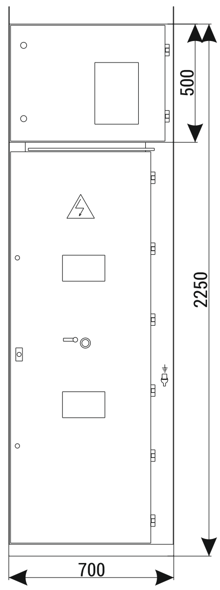
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.10 Metering bay, 12 kV

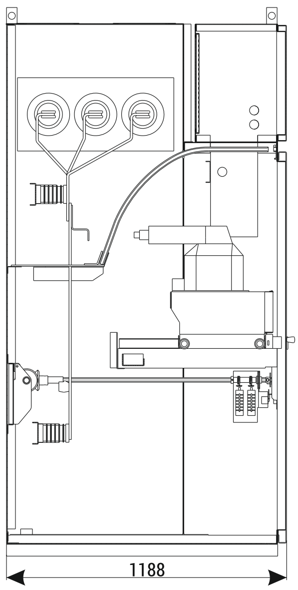
Structural diagram



Front panel



Cross-section



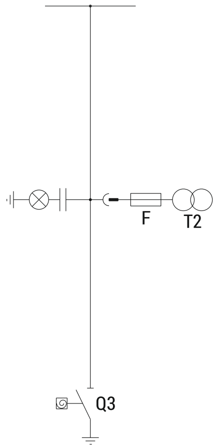
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Withdrawal module		withdrawable module with voltage transformers
Earthing switch	Q3	US1 (ZPUE); EK6 (ABB)
Voltage transformer	T2	various manufacturers
Weight	[kg]	440 ÷ 540

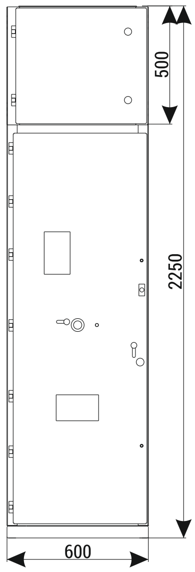
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.11 Metering bay with a separate compartment of main busbars, 12 kV

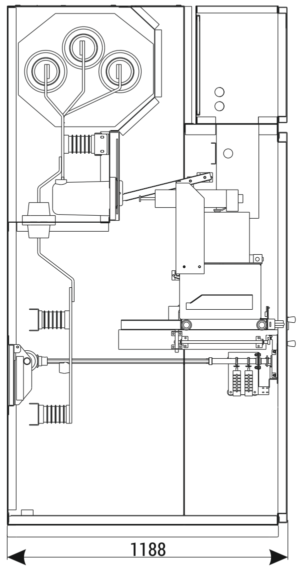
Structural diagram



Front panel



Cross-section



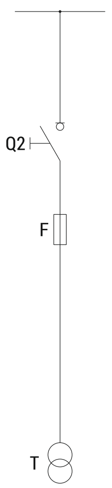
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Withdrawal module		withdrawable module with voltage transformers
Earthing switch	Q3	US1 (ZPUE); EK6 (ABB)
Voltage transformer	T2	various manufacturers
Weight	[kg]	470

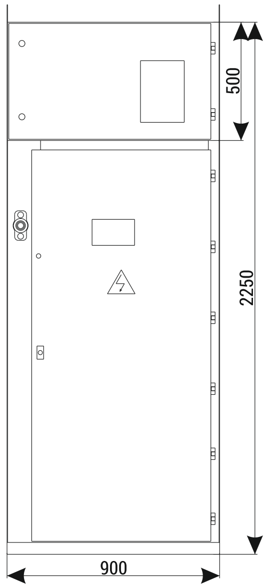
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.13 Auxiliary transformer bay - with a transformer up to 40 kVA, 6/0.4 kV

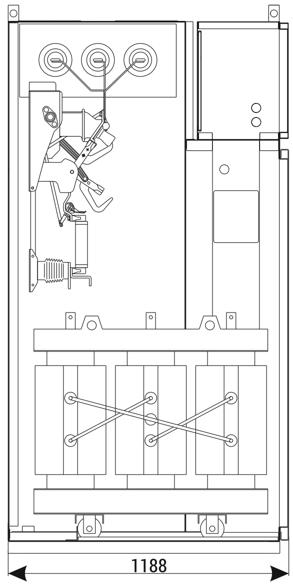
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

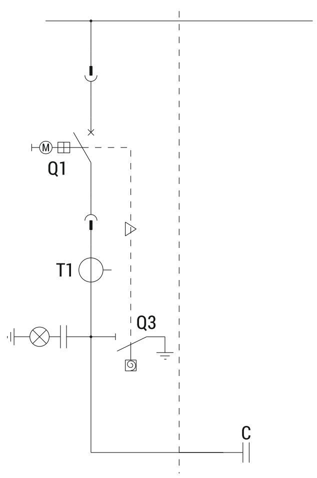
Equipment:

Switch disconnector	Q2	NALF (ABB); OMB (ZWAE)
Transformer	T	do 40 kVA; 6/0,4 kV
Weight	[kg]	890

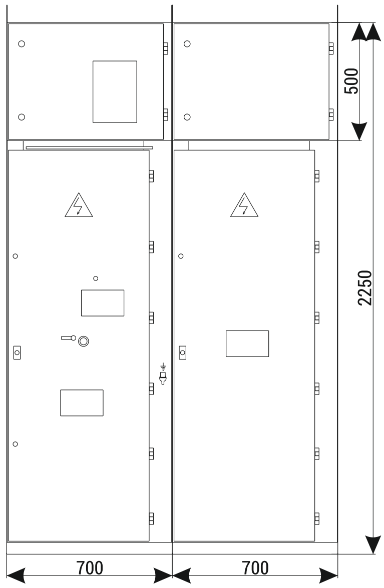
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 1.14 Reactive power compensation set - with a capacitor bank up to 700 kvar; 6.6 kV

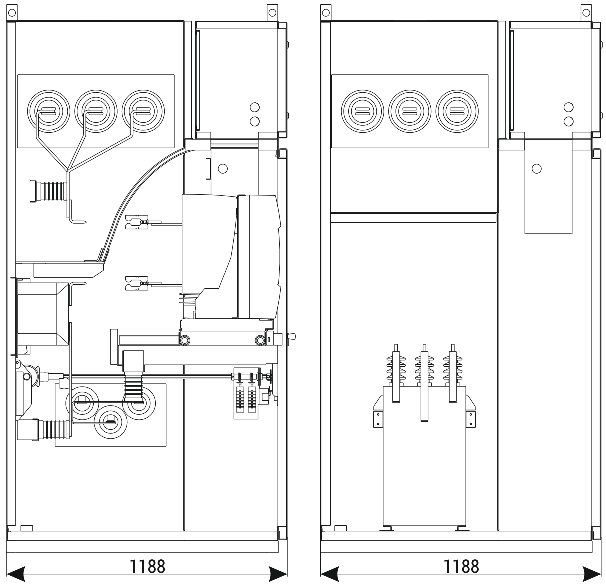
Structural diagram



Front panel



Cross-section



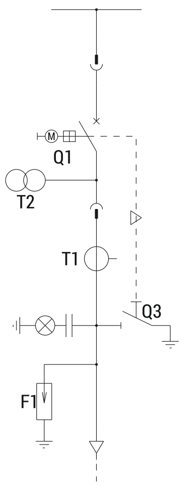
Parameters:		
Rated voltage	[kV]	12
Rated power-frequency withstand voltage	[kV]	28
Rated lightning impulse withstand voltage	[kV]	75
Rated frequency	[Hz]	50
Main busbars rated cotinuous current	[A]	630 ÷ 1250
Rated short-time withstand current	[kA/1s]	up to 25
Rated peak withstand current	[kA]	up to 63
Withstand for internal arcing fault	[kA/1s]	up to 25
Protection degree		up to IP4X

Equipment:		
Circuit breaker/contactor	Q1	VB-4 (ZPUE); SION (Siemens); VD4/HD4 (ABB); HVX (Schneider Electric); VSC (ABB)
Earthing switch	Q3	US1 (ZPUE); EK6 (ABB)
Current transformer	T1	various manufacturers
Capacitor bank	C	up to 700 kvar; 6,6 kV
Weight	[kg]	960

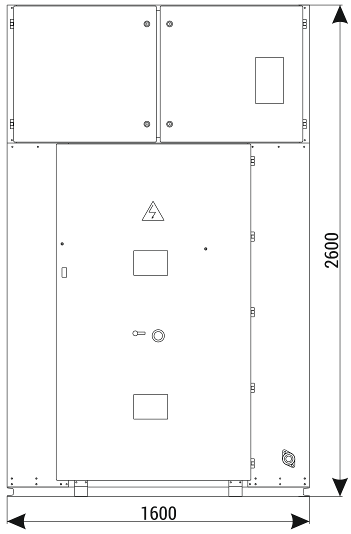
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.1 Feeder bay with circuit breaker

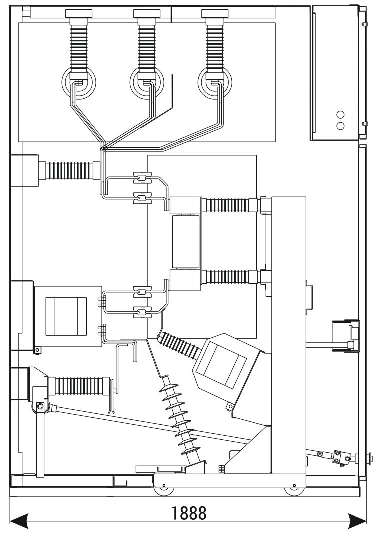
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage		[kV]	36
Rated power-frequency withstand voltage	to earth and between phases	[kV]	85 (5min)/95 (1min)
	across the isolating distance	[kV]	120 (5min)
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	190 (1,2/50μs)
	across the isolating distance	[kV]	220 (1,2/50μs)
Rated frequency		[Hz]	50
Rated continuous current		[A]	630
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

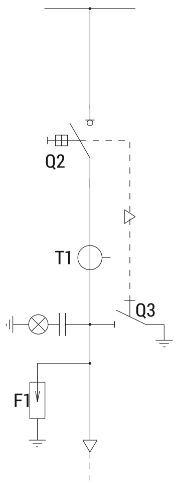
Equipment:

Circuit breaker	Q1	3AH (SIEMENS); VD4/HD4 (ABB)
Earthing switch	Q3	UW36
Current transformer	T1	various manufacturers
Voltage transformer	T2	various manufacturers
Overvoltage limiter	F1	various manufacturers
Weight	[kg]	1380

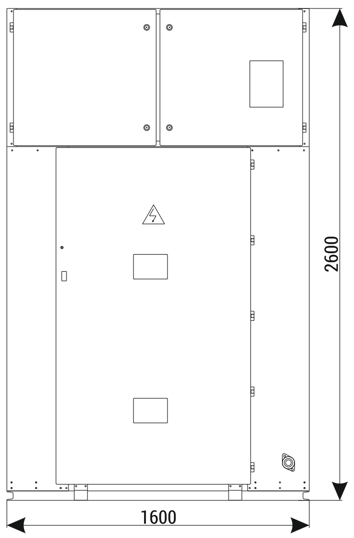
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.2 Feeder bay with switch disconnector

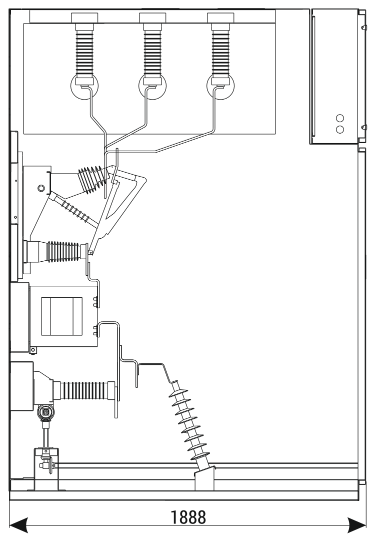
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage		[kV]	36
Rated power-frequency withstand voltage	to earth and between phases	[kV]	85 (5min) / 95 (1min)
	across the isolating distance	[kV]	120 (5min)
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	190 (1,2/50μs)
	across the isolating distance	[kV]	220 (1,2/50μs)
Rated frequency		[Hz]	50
Rated continuous current		[A]	630
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

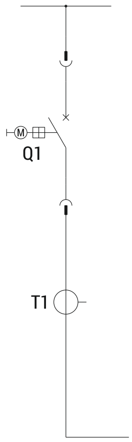
Equipment:

Switch disconnector	Q2	NAL 36 (ABB)
Earthing switch	Q3	UW36
Current transformer	T1	various manufacturers
Overvoltage limiter	F1	various manufacturers
Weight	[kg]	1150

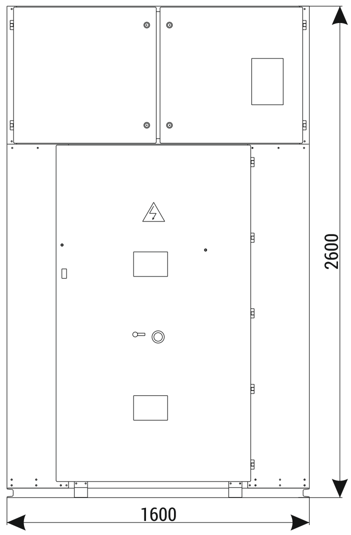
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.3 Bus coupler bay - cubicle with circuit breaker

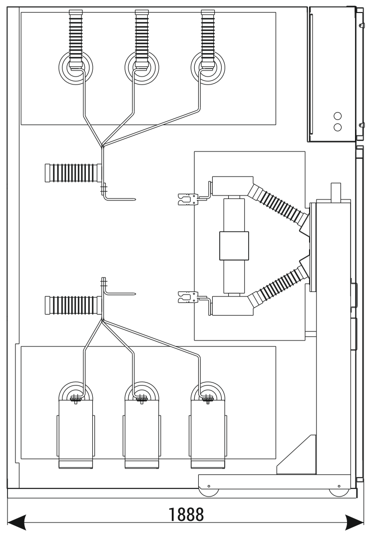
Structural diagram



Front panel



Cross-section



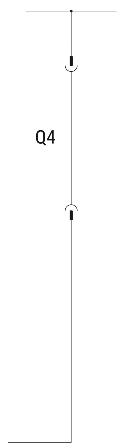
Parameters:			
Rated voltage		[kV]	36
Rated power-frequency withstand voltage	to earth and between phases	[kV]	85 (5min)/95 (1min)
	across the isolating distance	[kV]	120 (5min)
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	190 (1,2/50µs)
	across the isolating distance	[kV]	220 (1,2/50µs)
Rated frequency		[Hz]	50
Rated continuous current		[A]	630
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

Equipment:		
Circuit breaker	Q1	3AH (SIEMENS); VD4/HD4 (ABB)
Current transformer	T1	various manufacturers
Weight	[kg]	1300

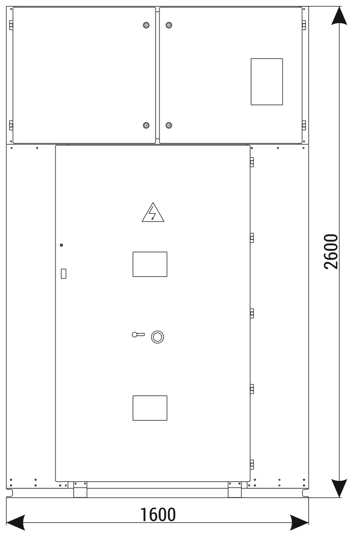
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.4 Bus coupler bay - cubicle with sectionalizer

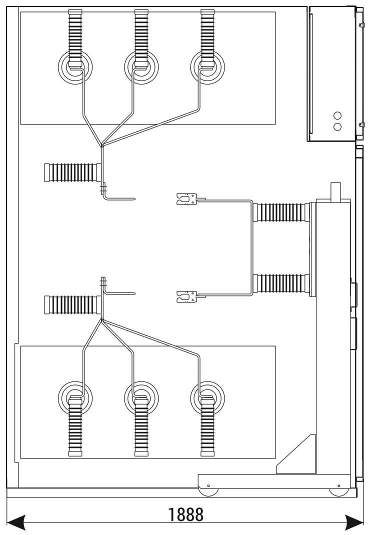
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage		[kV]	36
Rated power-frequency withstand voltage	to earth and between phases	[kV]	85 $_{(5min)}$/95 $_{(1min)}$
	across the isolating distance	[kV]	120 $_{(5min)}$
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	190 $_{(1,2/50\mu s)}$
	across the isolating distance	[kV]	220 $_{(1,2/50\mu s)}$
Rated frequency		[Hz]	50
Rated continuous current		[A]	630
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

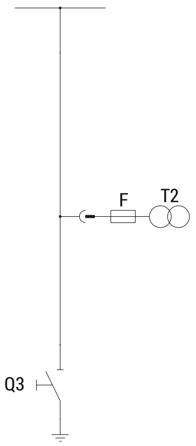
Equipment:

Sectionalizer	Q4	made by ZPUE
Weight	[kg]	1150

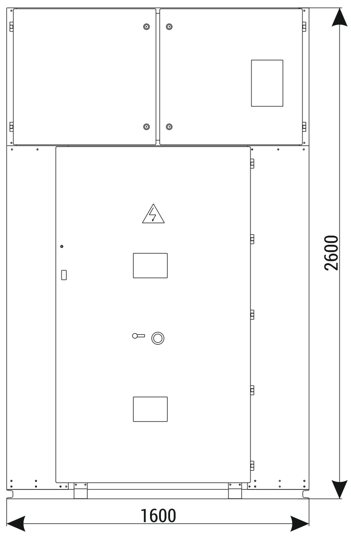
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.5 Metering bay

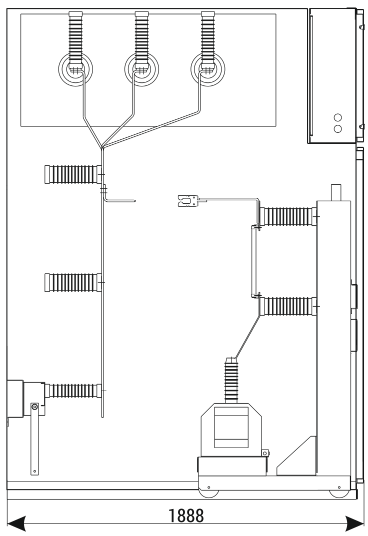
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage		[kV]	36
Rated power-frequency withstand voltage	to earth and between phases	[kV]	85 (5min)/95 (1min)
	across the isolating distance	[kV]	120 (5min)
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	190 (1,2/50μs)
	across the isolating distance	[kV]	220 (1,2/50μs)
Rated frequency		[Hz]	50
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

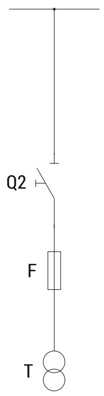
Equipment:

Withdrawable module		withdrawable module with voltage transformers
Earthing switch	Q3	UW36
Voltage transformer	T2	various manufacturers
Weight	[kg]	1100

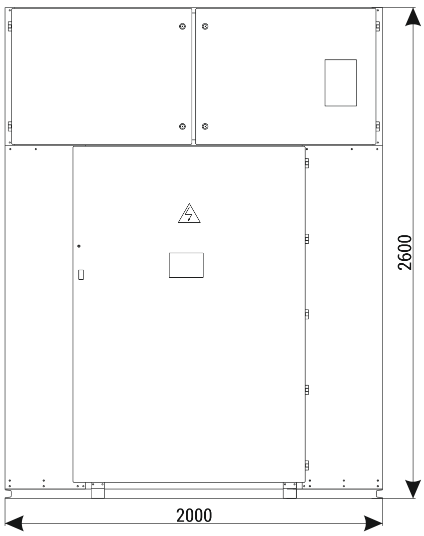
Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Sheet 2.6 Auxiliary transformer bay

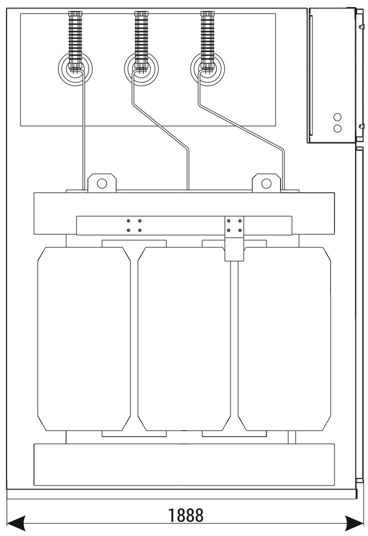
Structural diagram



Front panel



Cross-section



Parameters:

Rated voltage		[kV]	36
Rated power-frequency withstand voltag	to earth and between phases	[kV]	$85_{(5min)}/95_{(1min)}$
	across the isolating distance	[kV]	$120_{(5min)}$
Rated lightning impulse withstand voltage	to earth and between phases	[kV]	$190_{(1,2/50\mu s)}$
	across the isolating distance	[kV]	$220_{(1,2/50\mu s)}$
Rated frequency		[Hz]	50
Main busbars rated cotinuous current		[A]	630
Rated short-time withstand current		[kA/1s]	up to 25
Rated peak withstand current		[kA]	up to 63
Withstand for internal arcing fault		[kA/1s]	up to 20
Protection degree			up to IP4X

Equipment:

Disconnector/Switch disconnector	Q2	ON/NAL (ABB)
Transformer	T	do 100 kVA; 35/0,4 kV
Weight	[kg]	2070

Note:
We allow the possibility of arranging the bay configuration concerning its function and equipment (type/manufacturer)

Medium Voltage switchgear

4 / TPM

INTRODUCTION

TPM series switchgear are a group of medium voltage ring type switchgear (RMU - Ring Main Unit), in SF_6 gas insulation for use indoors. They are designed for supply and secondary distribution of electricity in radial and ring urban grids, in industry and in all facilities where compact switchgears with high technical parameters are very desirable. The switchgears are manufactured and tested based on the following standards. Type testing performed by independent accredited certification bodies. The test results are confirmed by appropriate certifications and test reports.

CHARACTERISTICS

- miniature switchgear dimensions while maintaining high technical parameters
- very high safety level, including arc protection - confirmed by appropriate certificates
- the possibility of configuring the switchgear with the use of a wide range of bays: feeder, transformer, circuit-breaker, bus coupler, metering
- possibility of easily expanding the switchgear with additional assemblies (which should be taken into account when placing the order) each assembly may be manufactured as expandable
- the possibility of adapting the switchgear to work with remote control and metering systems, e.g. to work in Smart Grid networks
- fast earthing switch, which earths the fuse link on both sides in the transformer bay
- the main SF_6 gas tank is made of stainless, acid-resistant steel, with welded connections, which ensure environmental and personal safety, and remain sealed over the entire period of switchgear operation
- the manufacturer is able to recycle the waste switchgear and safely remove the SF_6 gas from their tanks

POSSIBLE MARKINGS/NAMING SCHEME

TPM | TPM- Kompakt | ☐ ☐ ☐ ☐

(l) - version expandable to the left

(p.) - version expandable to the right

+ - expandable version

Bay type/configuration

- **L** - Switch disconnector bay - feeder/outgoing
- **W** - Circuit breaker bay - feeder/outgoing/transformer
- **T** - Switch disconnector bay with fuses - transformer
- **S** - Switch disconnector - bus coupler
- **M** - Metering bay

TPM Kompakt - TPM type ring switchgear in SF_6 gas insulation, with a transformer bay connection from the top

TPM - TPM type ring switchgear in SF_6 gas insulation, with a transformer bay connection from the bottom

BASIC TECHNICAL DATA

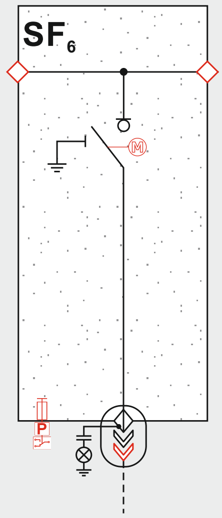
Compliance with standards:
The TPM type switchgear meets the requirements of the following standards:

- **PN-EN 62271-1** - „High-voltage switchgear and controlgear - Part 1: Common specifications”,
- **PN-EN 62271-200** - „High-voltage switchgear and controlgear - Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV”,
- **PN-EN 62271-100** - „High-voltage switchgear and controlgear - Part 100: High-voltage alternating-current circuit-breakers”,
- **PN-EN 62271-102** - „High-voltage switchgear and controlgear - Part 102: High-voltage alternating current disconnectors and earthing switches”,
- **PN-EN 62271-103** - „High-voltage switchgear and controlgear - Part 103: Switches for rated voltages above 1 kV up to and including 52 kV”,
- **PN-EN 62271-105** - „High-voltage switchgear and controlgear - Part 105: Alternating current switch-fuse combinations”.

The switchgear is certified by the Electrotechnical Institute.

L - LINE FEEDER EQUIPMENT

Parameters	
U_r	= 25 Kv
F_r	= 50/60 Hz
U_d	= 50/60 kV
U_p	= 125/145 kV
I_r	= 630 A
I_k	= 20 kA
I_p	= 50 kA
I_A	= up to 22 kA
	switch disconnector class M2, E3
	earthing switch class M0, E2



STANDARD

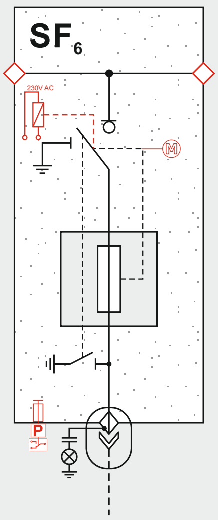
- meets the requirements of the PN-EN 62271-103 Switches for rated voltages above 1 kV up to and including 52 kV standard
- the L unit as a single module with option of expanding, in almost any configuration up to four units in a common tank,
- disconnector-earthing switch unit, the construction of which is based on common moving contacts and separated fixed contacts of the earthing switch and switch disconnector,
- switch disconnector with a switching operations arc quenching system,
- manual double spring drive which ensures intuitive and easy operation and snap-action closing and opening of the switching devices,
- system display representing the state of devices and entire primary circuits,
- type C insulating bushings with M16 thread, equipped with capacitive voltage dividers intended for operation with voltage indicators in the LRM system and to operate with electromagnetic interlocks,
- cable voltage indicator in the LRM system,
- pressure meter - gas pressure indicator with a scale with two zones, indicating the rated absolute pressure of the SF_6 gas - 125 kPa (0.125 MPa) at a temperature of 20°C (one per one tank),
- a system of mechanical interlocks between the devices and front panels of the cable compartment preventing incorrect switching operations - removing the front panel only after closing the earthing switch,
- safety valve (one per one tank), which is opened by pressure increase caused by arcing inside the tank, directing the gases downwards, to the cable duct, eliminating the hazard to personnel,
- cable clamps.

OPTION

- 24 V DC motor drive (other supply voltage on request), possibility of easy expansion at the facility,
- pressure control - for operating with motor drive, telemetry,
- SEM SC 11 field controller plus local control panel, Modbus communication or binary communication
- auxiliary contacts as representation of state of devices for telemetry systems,
- voltage sensors - low power transformers,
- current transformers, Rogowski coils,
- earth fault transformers,
- short-circuit current indicators,
- auxiliary circuits cubicle/operation with telemetry,
- “ON”, “OFF” signalling in the form of signalling lamps,
- anti-condensation heaters,
- possibility of expanding on the left and right side,
- key interlock of the switch disconnector or earthing switch socket,
- electromagnetic interlock of the earthing switch socket,
- overvoltage limiters.

T - TANSFORMER FEEDER EQUIPMENT

Parameters	
U_r	= 25 kV
F_r	= 50/60 Hz
U_d	= 50/60 kV
U_p	= 125/145 kV
I_r	= 250 A (125 A fuse link)
I_k	= up to 20 kA (1s)
I_p	= up to 50 kA
I_A	= up to 22 kA
I_{transf}	= 720 A
	switch disconnector class M2, E3



STANDARD

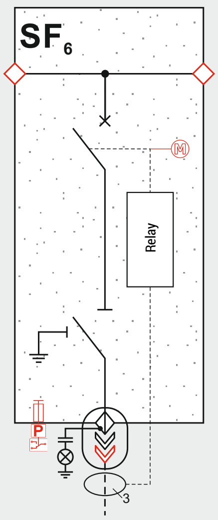
- meets the requirements of the PN-EN 62271-105 Alternating current switch-fuse combinations standard
- the T unit as a single module with option of expanding, in almost any configuration up to four units in a common tank,
- disconnector-earthing switch unit, the construction of which is based on common moving contacts and separated fixed contacts of the earthing switch and switch disconnector,
- lower earthing switch, ensuring earthing on both sides of the fuse links,
- switch disconnector with a switching operations arc quenching system,
- manual double spring drive which ensures intuitive and easy operation and snap-action closing and opening of the switching devices,
- system display representing the state of devices and entire primary circuits,
- stored energy release mechanism function, which allows the switch disconnector contacts to be opened when MV fuse links with thermal protection (striker) or a tripping coil is used,
- blown fuse link indicator,
- type A insulating bushings with plug-in socket, equipped with capacitive voltage dividers intended for operation with voltage indicators in the LRM system and to operate with electromagnetic interlocks,
- cable voltage indicator in the LRM system,
- a system of mechanical interlocks between the devices and front panels of the cable connection compartment preventing incorrect switching operations - removing the front panel only after the earthing switch is closed,
- safety valve (one per one tank), which is opened by pressure increase caused by arcing inside the tank, directing the gases downwards, to the cable duct,
- cable clamps.

OPTION

- 24 V DC motor drive (other supply voltage on request), possibility of easy expansion at the site
- pressure control - for operating with motor drive, telemetry
- SEM SC 11 field controller plus local control panel, binary or Modbus communication
- auxiliary contacts as representation of state of devices for telemetry systems
- fuse links with integrated temperature limiter (thermal trip), acc. to the IEC 60282-1, DIN 43625 standard, e.g. by SIBA
- voltage sensors - low power transformers
- current transformers, Rogowski coils
- “ON”, “OFF” signalling in the form of signalling lamps
- anti-condensation heaters
- possibility of expanding on both sides
- key interlock of the disconnector or earthing switch socket
- electromagnetic interlock of the earthing switch socket, option dedicated for renewable energy system
- shunt trip - DWN 24 V DC coil, 230V AC/DC (other voltages on request)

W - CIRCUIT BREAKER FEEDER

Parameters	
U_r	= 25 kV
F_r	= 50/60 Hz
U_d	= 50/60 kV
U_p	= 125/145 kV
I_r	= 630 A
I_k	= up to 20 kA (1s)
I_{sc}	= up to 50 kA
I_{cc1}	= 10 A
I_{cc2}	= 31,5 A
	circuit braker class M2, E2
	Operating sequence duty cycle (O-0, 3s-CO-3min-CO)



STANDARD

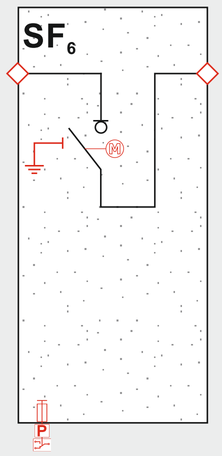
- meets the requirements of the PN-EN 62271-100 Alternating current circuit-breakers standard,
- meets the requirements of the PN-EN 62271-102 Alternating current disconnectors and earthing switches standard,
- the W bay as a single module with option of expanding, in almost any configuration up to four bays in a common tank,
- circuit breaker unit, the construction of which is based on the use of vacuum chambers with a breaking current of 16 kA or 20 kA, enclosed in an SF_6 gas filled tank,
- disconnector-earthing switch unit, the construction of which is based on common moving contacts and separated fixed contacts of the earthing switch and disconnector. The function of the disconnector is to ensure a safe gap in the circuit,
- manual spring drive of the circuit breaker, which ensures intuitive and easy operation and snap-action closing and opening of the switching devices, the drive has a charging system which allows a rapid breaker on-off cycle,
- manual spring-less drive of the disconnector and earthing switch, which ensures intuitive and easy operation of the switching devices,
- system display representing the state of devices and entire primary circuits,
- circuit breaker charging indication,
- independent protection, preferably AZZ-4 (by ITR) or WIC 1 (by Woodward) with dedicated current transformers,
- type C insulating bushings with M16 thread, equipped with capacitive voltage dividers intended for operation with voltage indicators in the LRM system and to operate with electromagnetic interlocks,
- cable voltage indicator in the LRM system,
- pressure meter - gas density indicator with a scale with two zones, indicating the rated absolute pressure of the SF_6 gas - 125 kPa (0.125 MPa) at a temperature of 20°C (one per one tank),
- a system of mechanical interlocks between the devices and front panels of the cable compartment preventing incorrect switching operations - removing the front panel only after closing the earthing switch,
- safety valve (one per one tank), which is opened by pressure increase caused by arcing inside the tank, directing the gases downwards, to the cable duct, eliminating the hazard to personnel,
- cable voltage indicator,
- cable clamps.

OPTION

- 24V DC motor drive for the circuit breaker and for the disconnector and earthing switch (other supply voltage on request),
- pressure control - for operating with motor drive, telemetry,
- auxiliary contacts as representation of state of devices for telemetry systems,
- protections other than preferred independent, unit controllers, ATS automation
- voltage sensors - low power transformers,
- current transformers, Rogowski coils,
- earth fault transformers,
- auxiliary circuits cubicle/operation with telemetry,
- "ON", "OFF" signalling in the form of signalling lamps,
- anti-condensation heaters,
- possibility of expanding on both sides,
- overvoltage limiters.

S - BUS SECTIONALIZER PANEL

Parameters	
U_r	= 25 kV
F_r	= 50/60 Hz
U_d	= 50/60 kV
U_p	= 125/145 kV
I_r	= 630 A
I_k	= 20 kA
I_p	= 50 kA
I_A	= up to 22 kA
	switch disconnector class M2, E3
	earthing switch class M0, E2



STANDARD

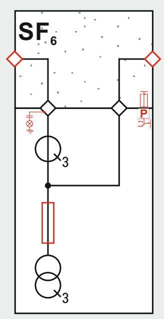
- meets the requirements of the PN-EN 62271-103 Switches for rated voltages above 1 kV up to and including 52 kV standard
- the S unit as a single module expandable both to the right and to the left,
- disconnector, the construction of which is based on common moving contacts and on fixed contacts,
- switching operations arc quenching system,
- manual single or double spring drive (depending on the use of an earthing switch), which ensures intuitive and easy operation and snap-action closing and opening of the switching device,
- system display representing the state of devices and entire primary circuits,
- pressure meter - gas density indicator with a scale with two zones, indicating the rated absolute pressure of the SF_6 gas - 125 kPa (0.125 MPa) at a temperature of 20°C (one per one tank),
- safety valve (one per one tank), which is opened by pressure increase caused by arcing inside the tank, directing the gases downwards, to the cable duct, eliminating the hazard to personnel.

OPTION

- 24 V DC motor drive (other supply voltage on request), possibility of easy expansion at the facility,
- earthing switch of the primary circuit of the right section,
- primary circuits (before and after the disconnector) voltage indicator,
- pressure control - for operating with motor drive, telemetry,
- SEM SC 11 field controller plus local control panel, binary or Modbus communication,
- auxiliary contacts as representation of state of devices for telemetry systems,
- anti-condensation heaters,
- possibility of expanding on both sides,
- key interlock of the disconnector or earthing switch socket.

M - METERING PANEL EQUIPMENT

Parameters	
U_r	= 25 kV
F_r	= 50/60 Hz
U_d	= 50/60 kV
U_p	= 125/145 kV
I_r	= 630 A
I_k	= up to 20 kA (1s)
I_p	= up to 50 kA



STANDARD

- meets the requirements of the PN-EN 62271-200 AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV standard,
- the M unit as a single module expandable both to the right and to the left,
- a system of primary busbars enclosed in a stainless steel tank,
- a set of current transformers and voltage transformers,
- primary circuits voltage indicator,
- system display representing the state primary circuits,
- pressure meter - gas density indicator with a scale with two zones, indicating the rated absolute pressure of the SF_6 gas - 125 kPa (0.125 MPa) at a temperature of 20°C (one per one tank),
- safety valve (one per one tank), which is opened by pressure increase caused by arcing inside the tank, directing the gases downwards, to the cable duct, eliminating the hazard to personnel.

OPTION

- pressure control - for operating with motor drive, telemetry,
- anti-condensation heaters,
- option of connecting with side connectors or cable terminations.

SAFETY

- robust construction of TPM type switchgear ensures high reliability,
- the tank is constructed of stainless, acid-resistant steel, ensuring resistance to environmental conditions,
- use of shielded terminations guarantees safety, e.g. during servicing operations with the front panel removed and live supply cables,
- gas pressure indicator - pressure meter which shows the correct pressure of insulating gas inside the tank,
- resistance to internal arc of 20 kA as a standard and 22 kA in custom design,
- pressure increase caused by internal arcing is eliminated by opening the safety valve installed in the lower part of the switchgear's tank. The gases are discharged to the cable duct, eliminating the hazard to personnel,
- drives which enable snap-action switching of devices, which combined with the electric arc quenching system prevents an arc occurring between opening contacts,
- each switchgear unit is equipped with voltage indicators, which enable the personnel to make sure that the insulating bushing terminals are not live,
- legible system display which improves intuitiveness of operation and facilitates reading the state of devices,
- a set of mechanical interlocks enables opening the front panels of the cable compartment only after the earthing switch is closed,
- a set of mechanical interlocks between the devices, which prevents performing incorrect switching operations,
- optional use of electromagnetic interlocks, which prevent the closing of the earthing switch with live supply cables,
- a set of auxiliary contacts with device state output, guaranteeing safety of remote operation,
- the use of pressure control at all times for the motor drive option guarantees safety of remote operation.

TPM TYPE MV SWITCHGEAR COMPARTMENT

Switching device compartment

The switching device compartment is placed in a tank made from stainless steel sheet, with SF_6 gas is used as insulation, with very high dielectric strength and very good arc quenching ability. The following components were installed in the tank: primary busbars, switches and bushings. The switching device is an integrated disconnector and earthing switch, which is also opened and closed by snap-action. Each tank has a safety valve which can be opened to relieve the pressure increase caused by internal arcing. In TPM and TPM Kompact switchgear system, the valve is installed at the bottom of the tank in the cable connection compartment of one of the feeder units. Isolator bushings are equipped with capacitive voltage dividers, connected to voltage indicators located on the front panel of the switchgear cabinet. The switch disconnector itself and its drive mechanisms are exceptionally durable and reliable devices. Their design allows for 5000 operating cycles without any adjustment, maintenance, or component replacement.

Fuses compartment

Fuse links with integrated temperature limiter are installed in the switchgear fuses compartment (in special insulating tubes), in accordance with the DIN 43625 standard.
The design of the fuses compartment prevents its opening before the earthing switch has been closed. Closing the switch disconnector in the transformer feeder is possible only after the fuse compartment door is closed.
In the event the fuse link is blown, the striker mounted on the link trips the circuit breaker in the transformer feeder.
The switch disconnector can be re-closed after replacement of the fuse links.

Drive mechanism compartment

The drive mechanism compartment contains the integrated, direct manual (motor driven) operating mechanism for switch disconnector and earthing switch or vacuum circuit breaker and disconnector with an earthing switch. The transformer feeder is moreover equipped with a stored energy release mechanism, which allows the switch disconnector to be opened after the activation of the fuse link striker, or in case a tripping coil is used. A blown fuse link is indicated on the front panel of the drive. In the switchgear cabinet operating mechanism compartment, there is a pressure gauge (calibrated to take into account state depending on temperature), which indicates the correct SF_6 gas pressure inside the tank. Cable voltage indicators are installed In the front side of the switchgear cabinet.

Cable compartment

In the cable compartment, cable terminations are used to connect cables from the power grid to the switchgear. Individual feeders of the cable compartments have metal partitions which separate one feeder from another.

Each cable compartment is equipped with:
- type C insulating bushings for incoming, outgoing and transformer feeders equipped with a power circuit breaker,
- type A insulating bushings for transformer feeders equipped with MV fuses,
- cable clamps,
- earthing terminals for return cables.

Moreover each bay allows the installation of the following equipment:
- current transformers, Rogowski coils,
- voltage sensors,
- overvoltage limiters,
- combined systems with the use of deep front panels, e.g.: two terminations per phase, termination + voltage sensor, termination + overvoltage limiter, two terminations per phase + voltage sensor, two terminations per phase + overvoltage limiter, termination + overvoltage limiter + voltage sensor.

The TPM type switchgear is designed for the installation of cables with a cross-section up to 630 m^2, such as:
- in plastic insulation, e.g.: YHAKXS, YHKX, XUHAKXS, XRUHKS.

Environmental service conditions:	
Ambient temperature	
- peak short-time	+40°C
- highest day average	+35°C
- minimum	
- without secondary circuits	-25°C
- with secondary circuits	-5°C / -15°C/-25°C[1)]
Relative humidity of air	
- Highest day average	95%
- Highest month average	90%
Vibrations	vibrations caused by external factors or earthquakes negligible
Internal Protection	
- device compartment, stainless steel SF_6 tank	IP 67
- drive mechanism and connections compartment	IP 4X
Soiling conditions	
- Significant soiling with salt, vapour, dust, smoke, flammable gases	NONE
- Corrosive	NONE
- Icing, frosting and dewing	NONE

1) Unless the manufacturer of instrumentation & control and protection devices has specified otherwise.

RATED PARAMETERS

TPM switchgear rated parameters			
MV rated voltage	U_r	25 kV	
Rated frequency - number of phases	F_r	50 / 60 Hz / 3	
Rated network frequency withstand voltage	U_d	50 kV / 60 kV	
Withstand lightning surge voltage (1.2/50 µs)	U_p	125 kV / 145 kV	
Primary busbars continuous rated current	I_r	630 A	
Rated short-time withstand primary circuits current	I_k	16 kA (3s) / 20 kA (3s) / 25 kA (3s) *1)	
Rated peak withstand primary circuits current	I_p	40 kA / 50 kA / 63 kA*1)	
Resistance to internal arc effects	I_A	20 kA (1s) / 22 kA (1s)*1)	
IAC class		AFLR	
IP protection rating		IP4X (IP54 option)	
Mechanical impact resistance		IK10	
Electrical data of line functional unit (L)			
Continuous rated current	I_r	630 A	
Rated short-circuit making current	I_{ma}	50 kA	
Rated low inductance circuit breaking current	I_{load}	630 A	
Rated ring network circuit breaking current	I_{loop}	630 A	
Rated buried cable charging breaking current	I_{icc2}	60 A	
Rated overhead line charging breaking current	I_{icc1}	20 A	
Rated earth fault breaking current	I_{ef1}	180 A	
Rated buried cable and overhead line charging breaking current in earth fault conditions	I_{ef2}	104 A	
Switch disconnector class		M2, E3	
Earthing switch class		M0, E2	
Electrical data of the fused transformer functional unit (T)			
Continuous rated current	I_r	250 A	
Maximum thermally protected fuse link current		125 A	
Through-current	$I_{transfer}$	720 A	
Switch disconnector electrical class		M2, E3	
Maximum transformer power		6 kV	800 kVA
		10 kV	1000 kVA
		15 kV	1600 kVA
		20 kV	2000 kVA
Electrical data of circuit breaker feeder (W)			
Continuous rated current	I_r	630 A	
Short-circuit making current	I_{ma}	40 kA / 50 kA / 52,5 kA *2)	
Short-circuit breaking current	I_{sc}	16 kA / 20 kA / 21 kA *2)	
Rated low inductance circuit breaking current		630 A	
Cable line current with no load - Icc1 / Icc2	I_{cc1} / I_{cc2}	10 A / 31,5 A	
Circuit breaker class		M2, E2	
Operating sequence duty cycle		0-0, 3s-CO-3min-CO	

1) Custom design.
2) For 12 kV voltage.

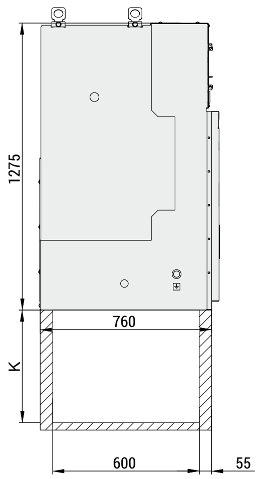
Rated currents of fuse links recommended by leading manufacturers for the protection of primary circuits of transformers with a rated voltage of 6 kV, 10 kV, 15 kV and 20 kV should be selected acc. to the IEC 60282-1, DIN 43625 standard, with integrated temperature limiter (thermal trip).

CONSTRUCTION METHOD FOR A CABLE DUCT UNDER THE TPM TYPE MV SWITCHGEARS

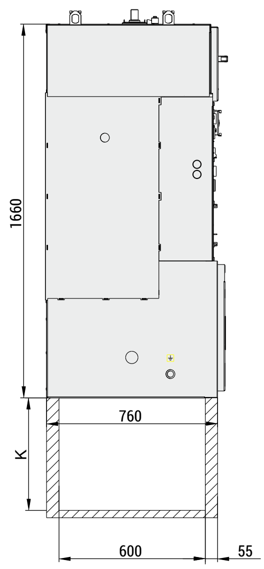
Figures 1–3 present a cable duct construction proposal. The cable bending radius (which depends on its outside diameter, according to PBUE) should be taken into account when establishing the dry cables duct depth. Figure 1 shows the suggested cable duct depth. It is possible to avoid or reduce the depth of the cable duct by using a raised base or a raised floor.

Figure 1 - Proposed depth of the cable duct under the TPM switchgear

Side view (TPM)

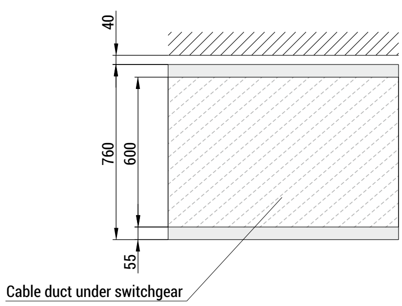


Side view (TPM Kompakt)



Dry single-core cable		
Cable cross-section (mm^2)	Bending radius (mm)	Duct depth **K** (mm)
50	370	400
70	400	430
95	440	470
120	470	500
150	500	550
185	540	600
240	590	700

Figure 2 - Cable duct proposal, to be constructed under an TPM switchgear and TPM Kompakt



CABLE FITTINGS - GPH EUROMOLD TERMINATIONS - INTERFACE A

Cable type	Cable cross-section depending on termination type	Termination type	Cable terminal type for a given termination/cable	Overvoltage limiter type depending on termination type
Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires, for a voltage of 20 kV	25-120	K152SR (straight)[1]	crimped	156S A (possibility of connecting only with K200T)
	25-150	K200SR (straight)[1]	bolted	
	25-150	K158LR (angle)	crimped	
	25-150	K200LR (angle)	bolted	

CABLE FITTINGS - GPH EUROMOLD TERMINATIONS - INTERFACE C

Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires, for a voltage of 20 kV	10-300	K430TB	bolted	300PB -10SA
	10-300	K480TB	bolted	800PB -10SA
	240-630	K484TB	bolted	800PB -10SA
	10-300	K400TB	bolted	400PB -10SA
	185-630	K440TB	bolted	400PB -10SA
	10-240	K400LB	crimped and bolted	400PB -10SA (only before the termination)

CABLE FITTINGS - CELLPACK TERMINATIONS - INTERFACE A

Cable type	Cable cross-section	Cable termination depending on cable cross-section	Cable terminal type for a given termination/cable	Overvoltage limiter type depending on termination type
Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires, for a voltage of 20 kV	16-95	CWS 250A 24kV 16-95 M/EGA - straight[1]	(CWS C16-95)-set	**NONE**
	70-150	CWS 250A 24kV 70-150 M/EGA - straight[1]	(CWS C70-150)-set	
	25-95	CGS 250A 24kV 25-95 M/EGA - angle	(CGS C25-95)-set	
	70-150	CGS 250A 24kV 70-150 M/EGA - angle	(CGS C70-150)-set	

CABLE FITTINGS - CELLPACK TERMINATIONS - INTERFACE C

				depending on network voltage
Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires, for a voltage of 20 kV	25-70	CTS 630A 24kV 25-70 EGA - angle	(CTS C25-95)-set	CTKSA 18kV
	95-240	CTS 630A 24kV 95-240 EGA - angle	(CTS C95-240)-set	CTKSA 24kV

[1] Possibility of using in TPM Compact swiftchgear.

CABLE FITTINGS - GPH EUROMOLD TERMINATIONS - INTERFACE A

Type and manufacturer of voltage sensor (with which the terminations were tested)	Coupling termination type, option of two cables per phase.	Coupling termination type, option of two cables per phase + limiter	Coupling termination type, option of two cables per phase + sensor.	Type of insulating plug
KAA-VS4 (Nexans)	none	none	none	K150DR-B/G
KAA-VS4 (Nexans)	none	none	none	K150DR-B/G
KAA-VS4 (Nexans)	none	none	none	K150DR-B/G
KAA-VS4 (Nexans)	none	none	none	K150DR-B/G

CABLE FITTINGS - GPH EUROMOLD TERMINATIONS - INTERFACE C

UR-65 (**ITR**), SMVS UW1002-1 (Zelisko), KEVA24C24(c) (ABB)	K300PB	K300PB	K300PB	K400DR-B/G
SMVS UW1002-3 (Zelisko), KEVA24C24(c) (ABB)	K800PB and K804PB	K800PB and K804PB	K800PB and K804PB	K400DR-B/G
SMVS UW1002-3 (Zelisko)	K800PB and K804PB	K800PB and K804PB	K800PB and K804PB	K400DR-B/G
SMVS UW1001 (Zelisko), PLUGSENS (Arteche), KEVA24C10(c) (ABB)	K400TB+K400CP or K440PB	K400TB+K400CP or K440PB	K400TB+K400CP or K440PB	K400DR-B/G
SMVS UW1001 (Zelisko), PLUGSENS (Arteche), KEVA24C10(c) (ABB)	K400TB+K400CP or K440PB	K400TB+K400CP or K440PB	K400TB+K400CP or K440PB	K400DR-B/G
None	K440PB (only before the termination)	K440PB (only before the termination)	K440PB (only before the termination)	K400DR-B/G

CABLE FITTINGS - CELLPACK TERMINATIONS - INTERFACE A

Type and manufacturer of voltage sensor (operating with the terminations)	Coupling termination type, option of two cables per phase.	Coupling termination type, option of two cables per phase + limiter	Coupling termination type, option of two cables per phase + sensor.	Type of insulating plug
NONE	**NONE**	**NONE**	**NONE**	**CIK 250A 24kV**

CABLE FITTINGS - CELLPACK TERMINATIONS - INTERFACE C

UR-65 (**ITR**), KEVA24C25(c) (ABB)	CTKS 630A 24kV 25-70 EGA	on request	on request	**CIK 630A 36kV**
	CTKS 630A 24kV 95-240 EGA	on request	on request	

CABLE FITTINGS - TYCO ELECTRONICS TERMINATIONS - INTERFACE A

Cable type	Rated voltage Uo/U (kV)	Cable cross-section depending on termination type	Termination type straight / angle	Cable terminal type for a given termination/cable	Overvoltage limiter type depending on termination type
Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires	6/10	16-70	RSSS 525A / RSES 525A	Bolted included	None
	6/10	95	RSSS 525B / RSES 525B		
	6/10	95-100	RSSS 525C / RSES 525C		
	8,7/15	16-50	RSSS 525A / RSES 525A		
	8,7/15	50-95	RSSS 525B / RSES 525B		
	8,7/15	70-120	RSSS 525C / RSES 525C		
	8,7/15	120-150	RSSS 525D / RSES 525D		
	12/20	16	RSSS 525A / RSES 525A		
	12/20	25-95	RSSS 525B / RSES 525B		
	12/20	70-95	RSSS 525C / RSES 525C		
	12/20	70-150	RSSS 525D / RSES 525D		

CABLE FITTINGS - TYCO ELECTRONICS TERMINATIONS - INTERFACE C

Cable type	Rated voltage Uo/U (kV)	Cable cross-section depending on termination type	Termination type straight / angle	Cable terminal type for a given termination/cable	Overvoltage limiter type depending on termination type
Single-core cables in plastic insulation with an Al and Cu phase core, with a return core of copper wires	6/10	35-95	RSTI-5851	Bolted included	RSTI-CC-68SA**10 - LIMITERS SELECTED INDIVIDUALLY
	6/10	95-240	RSTI-5853		
	6/10	185-300	RSTI-5855		
	6/10	400	RSTI-3951		
	6/10	500	RSTI-3952		
	6/10	600	RSTI-3953		
	8,7/15 i 12/20	35-70	RSTI-5851		
	8,7/15 i 12/20	95-240	RSTI-5852		
	8,7/15 i 12/20	185-300	RSTI-5855		
	8,7/15 i 12/20	400	RSTI-5951		
	8,7/15 i 12/20	500	RSTI-5952		
	8,7/15 i 12/20	600	RSTI-5953		
	8,7/15 i 12/20	800	RSTI-5954		

CABLE FITTINGS - TYCO ELECTRONICS TERMINATIONS - INTERFACE

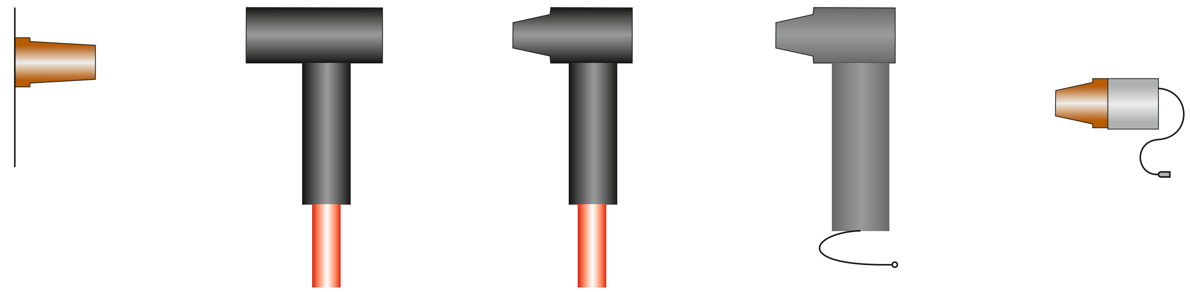
Type and manufacturer of voltage sensor (with which the terminations were tested)	Type of coupling termination, option of two cables per phase	Type of coupling termination, option of two cables per phase + limiter	Type of coupling termination, option of two cables per phase + sensor	Type of insulating plug
None	None	None	None	None

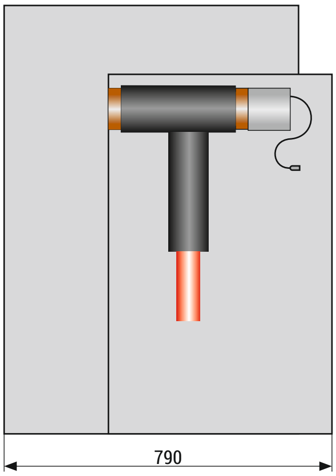
CABLE FITTINGS - TYCO ELECTRONICS TERMINATIONS - INTERFACE

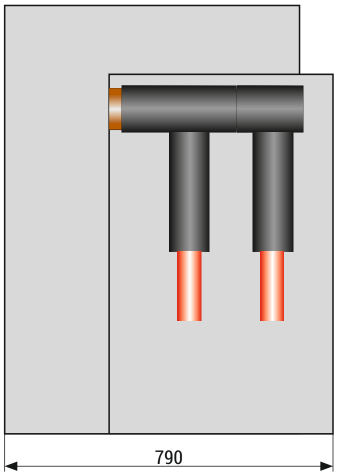
Type and manufacturer of voltage sensor (with which the terminations were tested)	Type of coupling termination, option of two cables per phase	Type of coupling termination, option of two cables per phase + limiter	Type of coupling termination, option of two cables per phase + sensor	Type of insulating plug
RSTI-VS-24-BP Tyco Electronics SMVS-UW1002-0 Zelisko		RSTI-CC-5851		None
		RSTI-CC-5853		
		RSTI-CC-5855		
		RSTI-CC-3951*		
		RSTI-CC-3952*		
		RSTI-CC-3953*		
		RSTI-CC-5851		
		RSTI-CC-5854		
		RSTI-CC-5855		
		RSTI-CC-3951*		
		RSTI-CC-3952*		
		RSTI-CC-3953*		
		RSTI-CC-3954*		

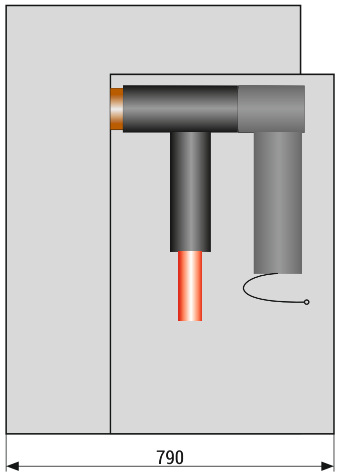
APPROXIMATE DIMENSIONS / TPM SWITCHGEAR CONNECTION OPTIONS

Insulating bushing type C	Main termination	Coupling termination	Overvoltage limiter	Voltage sensor (low power transformer)

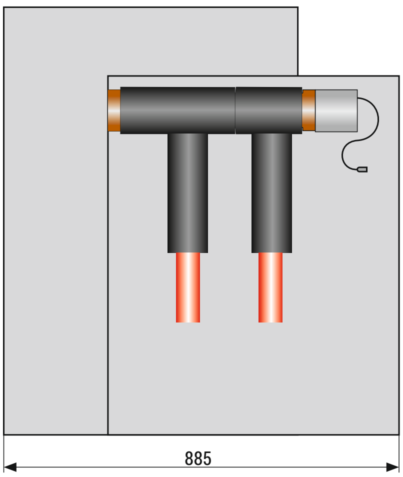


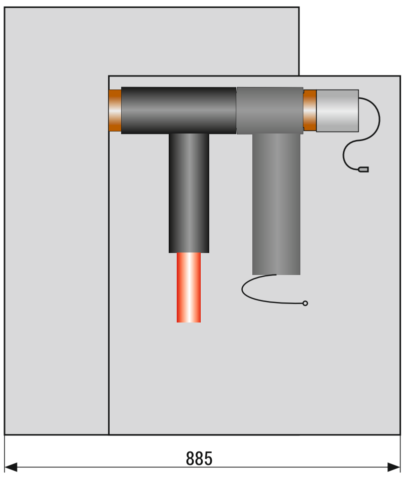


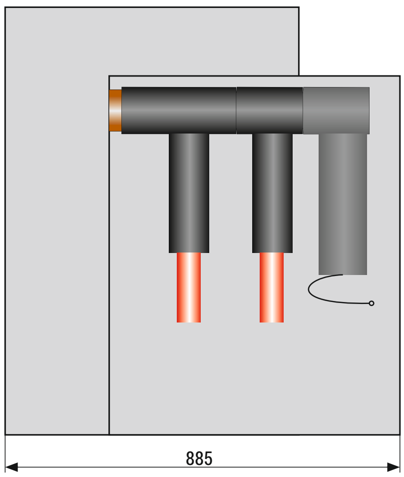




APPROXIMATE DIMENSIONS / TPM SWITCHGEAR CONNECTION OPTIONS





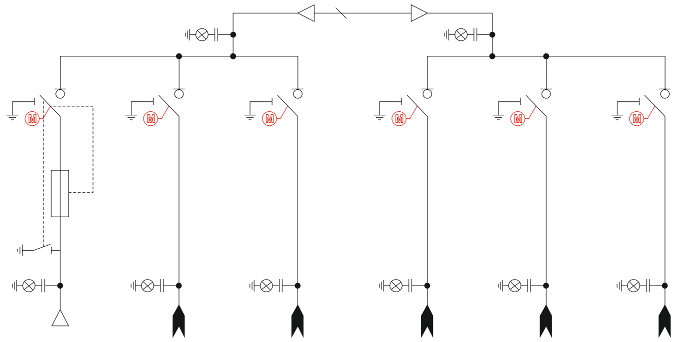


EXPANDABLE UNITS CONNECTION METHOD

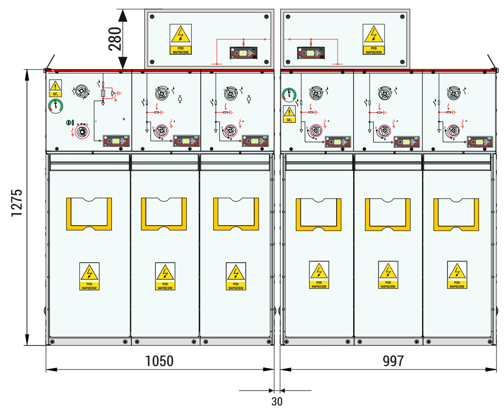
The TPM switchgear can be expanded with additional assemblies (on the condition that this was discussed at the pricing and ordering stage). The examples of connection methods were presented on figures below. Detailed information is provided in the Switchgear Operation & Maintenance Manual.

Example 1. TLL^{+} + LLL^{+} switchgear top connection

Electrical diagram

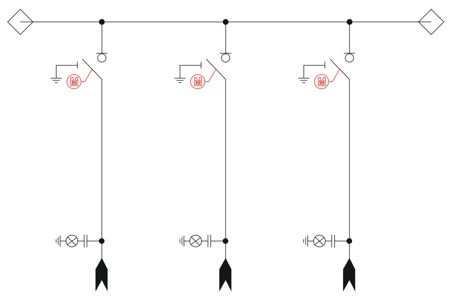


Front view

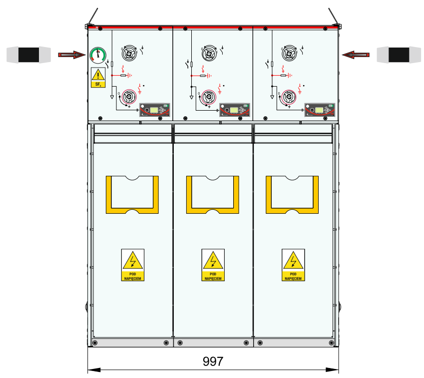


Example 2. LLL^{+} (l, p) system

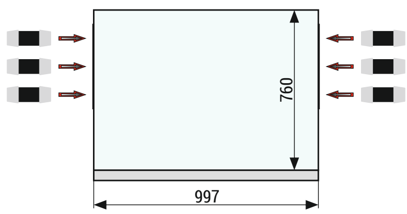
Electrical diagram



Front view

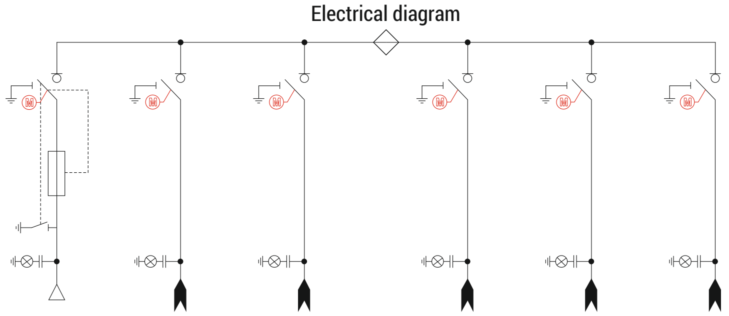


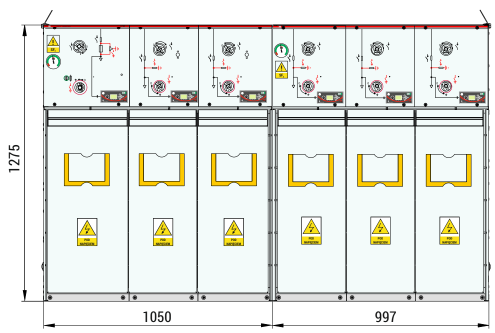
Top view



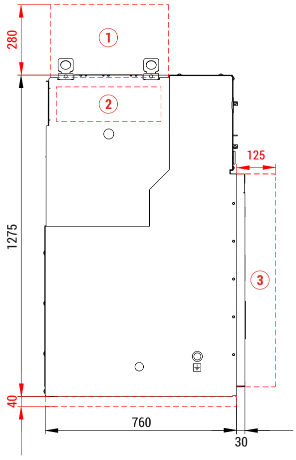
Example 3. TLL^{+} (p)+LLL^{+} (l) switchgears side connection

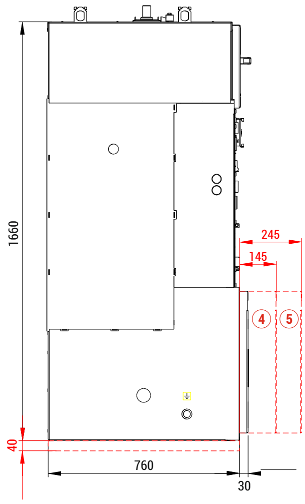
Electrical diagram





TPM SWITCHGEAR SIDE VIEWS AND DIMENSIONS

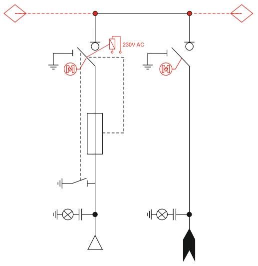


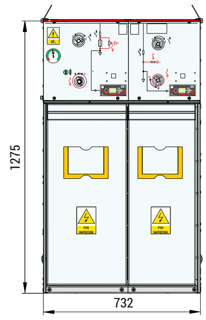


1) - cover for TPM switchgear in expandable version - top connection,
2) - cover for TPM switchgear in expandable version - side connection,
3) - front panel depth of 125 mm used only in case of:
   Double termination with a voltage sensor;
   Termination with overvoltage limiter and voltage sensor;
   K400LB termination with a 400PB overvoltage limiter.
4) - front panel depth in case of use termination with with overvoltage limiter,
5) - front panel depth in case of use termination with with overvoltage limiter and voltage sensor.

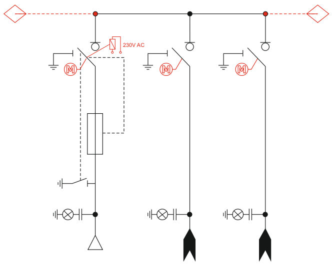
TPM - TYPICAL CONFIGURATIONS

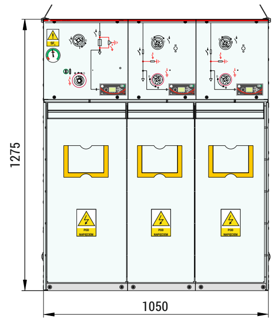
TL / LT configuration (transformer feeder, line feeder)



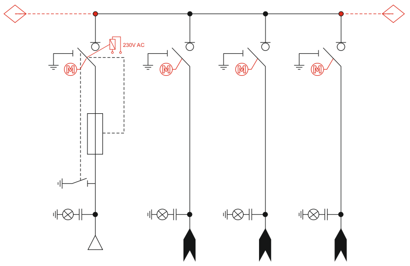


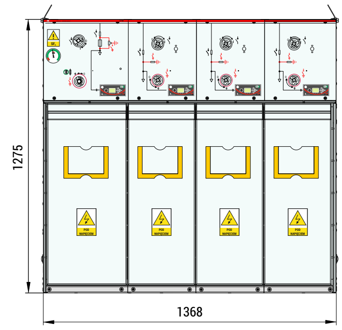
TLL / LLT configuration (transformer feeder, 2 line feeders)



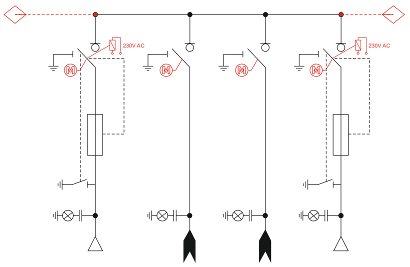


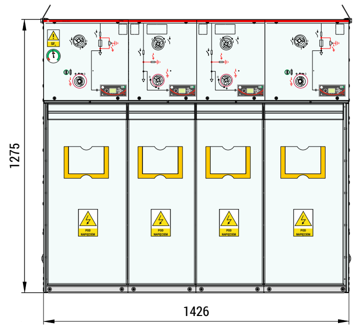
TLLL / LLLT configuration (transformer feeder, 3 line feeders)





TLLT configuration (2 transformer feeders, 2 line feeders)

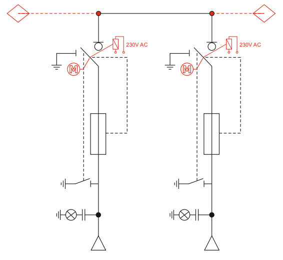


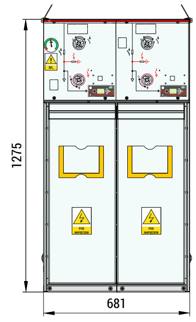


NOTE!

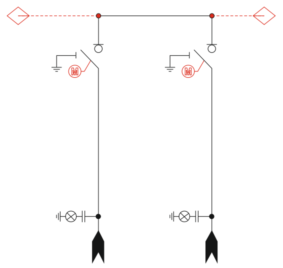
Optional equipment was marked with red on the electrical diagram.
The catalogue only presents preferred solutions of TPM switchgear.

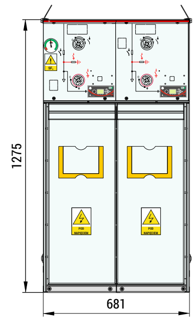
TT configuration (2 transformer feeders)



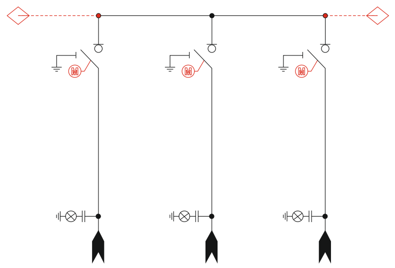


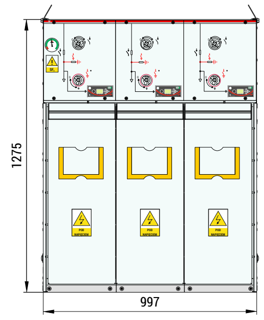
LL configuration (2 line feeders)



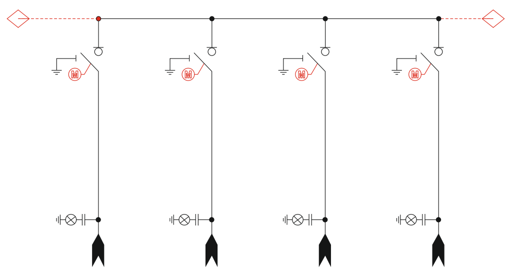


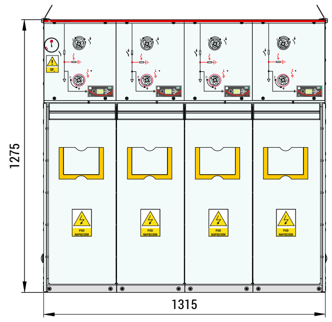
LLL configuration (3 line feeders)





LLLL configuration (4 line feeders)





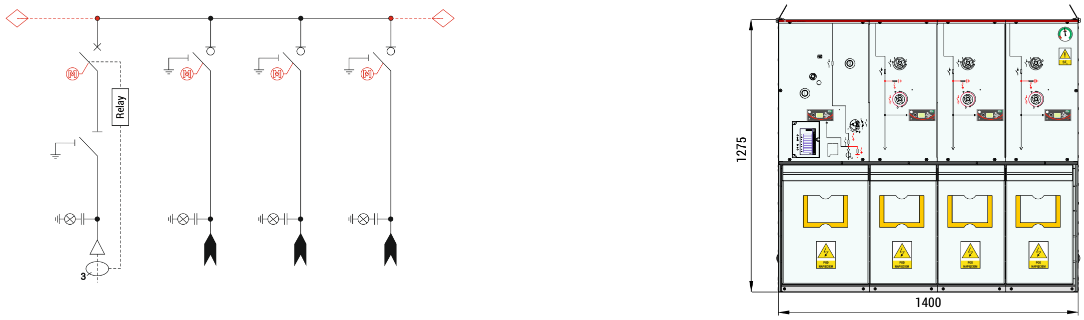
NOTE!

Optional equipment was marked with red on the electrical diagram.
The catalogue only presents preferred solutions of TPM switchgear.

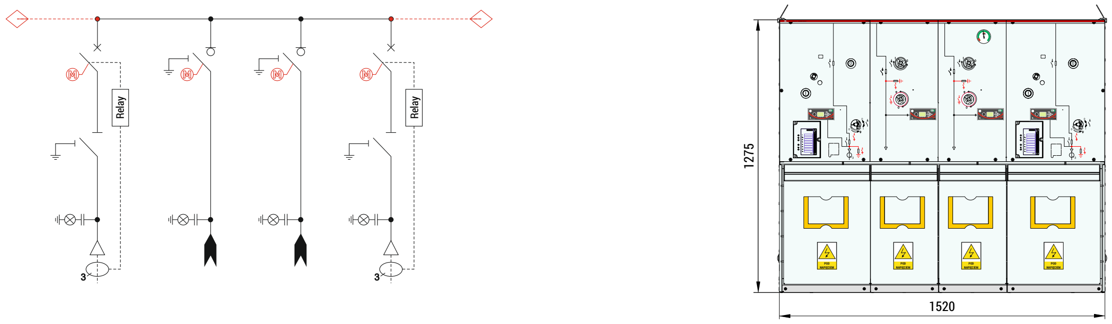
WL / LW configuration (circuit breaker feeder, line feeder)

WLL / LLW configuration (circuit breaker feeder, 2 line feeders)

WLLL / LLLW configuration (circuit breaker feeder, 3 line feeders)



WLLW configuration (2 circuit breaker feeders, 2 line feeders)



NOTE!

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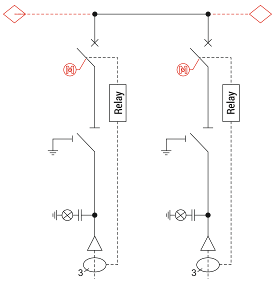
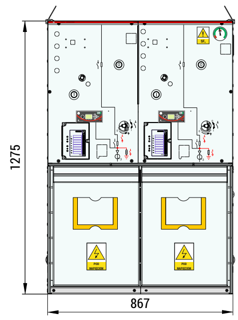
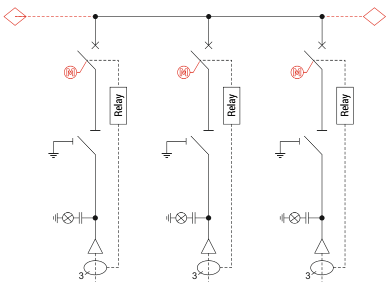
The catalogue only presents preferred solutions of TPM switchgear.

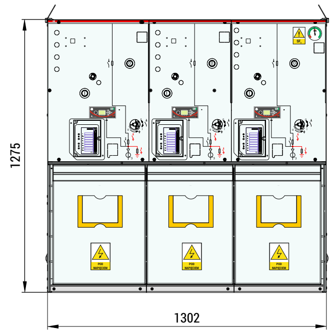
WW configuration (2 circuit breaker feeders)



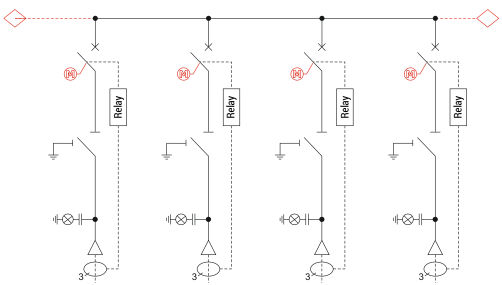


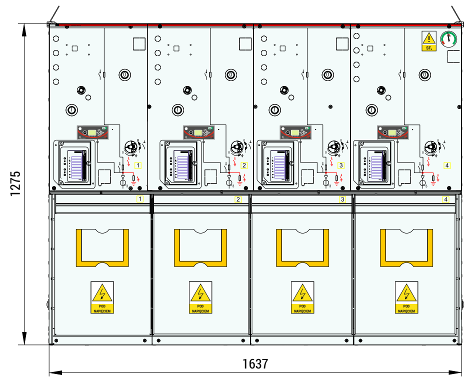
WWW configuration (3 circuit breaker feeders)



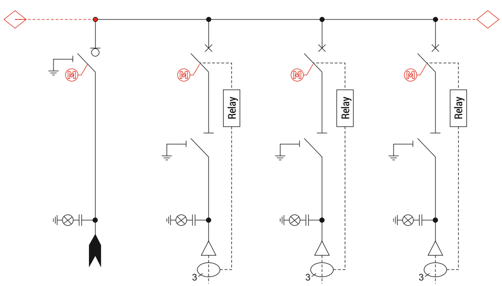


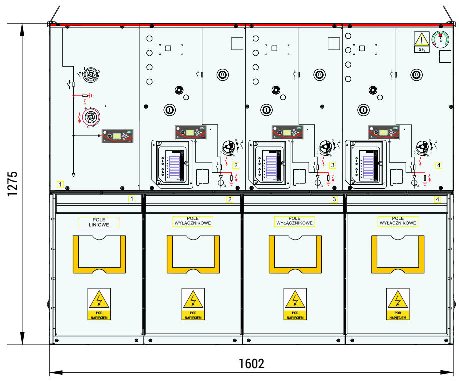
WWWW configuration (4 circuit breaker feeders)





LWWW configuration (line feeder, 3 circuit breaker feeders)



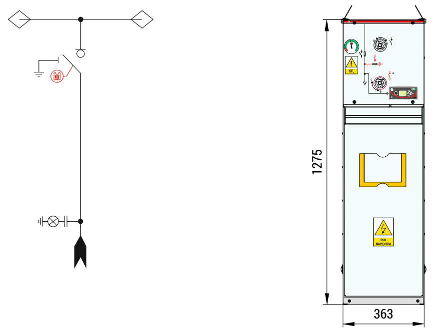


NOTE!

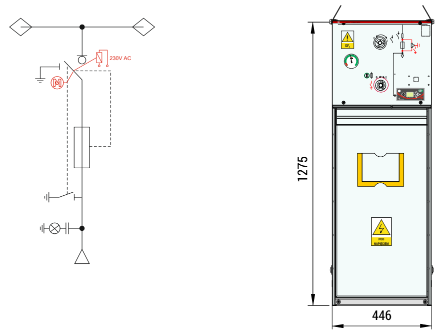
Optional equipment was marked with red on the electrical diagram.
The catalogue only presents preferred solutions of TPM switchgear.

TPM - TYPICAL CONFIGURATIONS - SINGLE UNITS

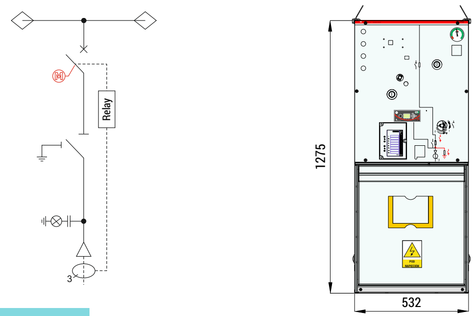
L+ (p,l) configuration (line feeder)



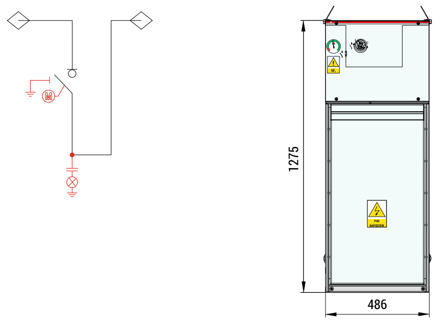
T+ (p,l) configuration (transformer feeder)



W+ (p,l) configuration (circuit breaker feeder)



S configuration (bus coupler unit)



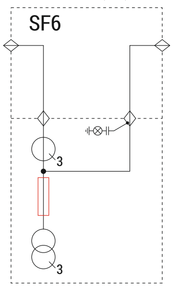
NOTE!

Optional equipment was marked with red on the electrical diagram.
The TPM switchgear is subject to an optimisation process, external dimensions specified in the directory may differ slightly from the physical dimensions.

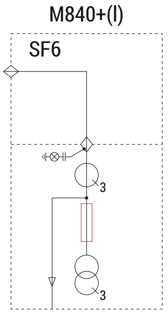
M840 METERING UNIT

Electrical diagrams

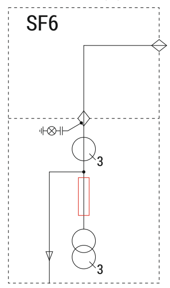
M840+(l,p)



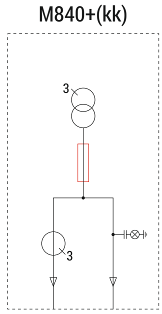
M840+(l)



M840+(p)

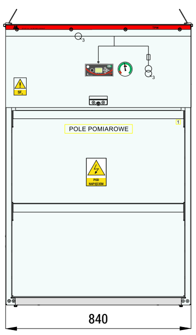


M840+(kk)

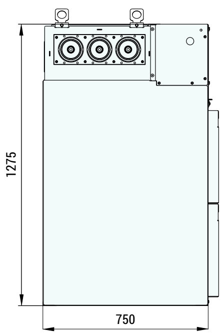


Dimensions

Front view

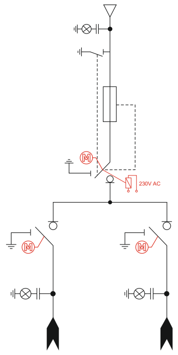


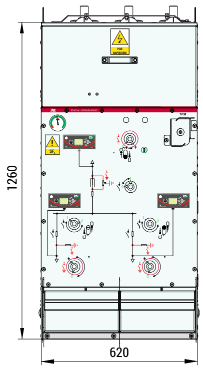
Side view

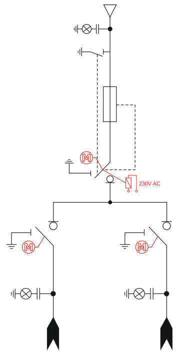


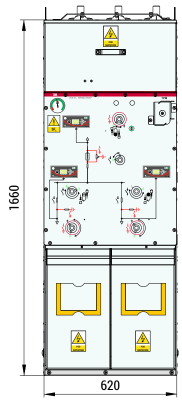
TPM - TYPICAL CONFIGURATIONS - KOMPAKT SYSTEM

LTL configuration (transformer feeder and 2 line feeders)

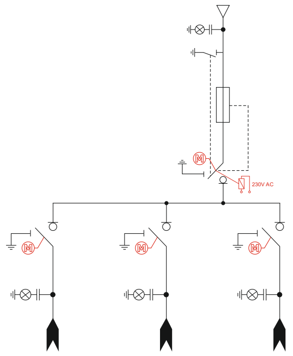


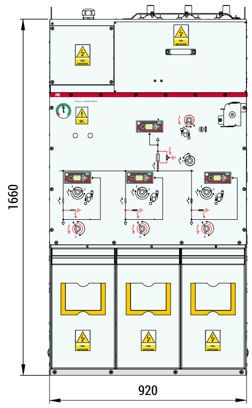






LLTL configuration (transformer feeder and 3 line feeders)



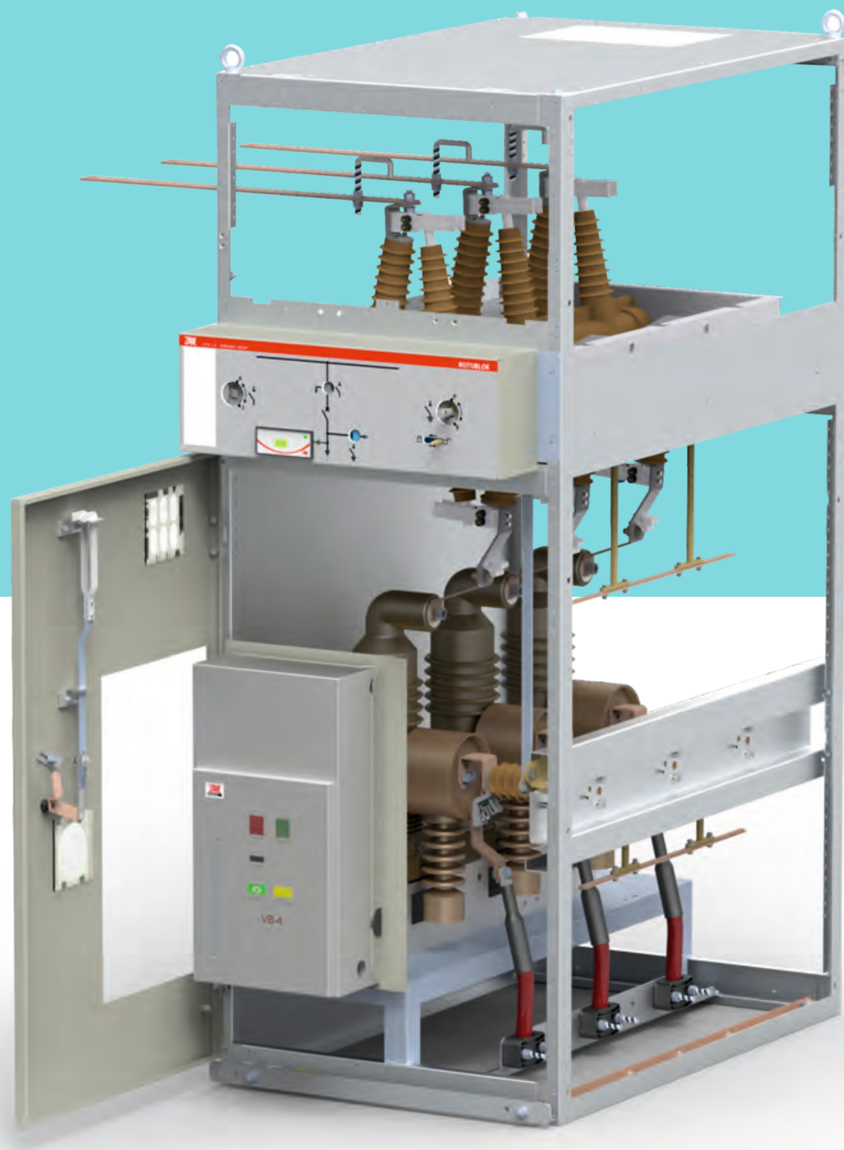


NOTE!

Optional equipment was marked with red on the electrical diagram.
The catalogue only presents preferred solutions of TPM switchgear.

Medium Voltage switchgear

5 / Rotoblok



INTRODUCTION

The subject of this document is a ROTOBLOK type state-of-the-art, indoor medium voltage switchgear intended for distribution of three-phase alternating current with a frequency of 50 Hz, at a rated voltage up to 24 kV, in industrial and commercial power sector distribution grids. The switchgears are configured from standard single bays with varied equipment.
The information and technical data specified herein enable the designer to assemble a switchgear from typical modules.
In case bays with equipment not specified herein or with changed dimensions are needed, the scope of equipment should be arranged with the manufacturer.

CHARACTERISTICS

The Rotoblok type switchgear is a two compartment, indoors switchgear in metal enclosure made of zinc-coated metal sheet (which ensures equipotential bonding), with a single primary busbars system. The switchgear is equipped with state-of-the-art, air insulated switching devices. It has separate primary busbars and cable compartments, and the arc-proof design ensures high level of operational safety.

The distribution bays have the following properties:

- small external dimensions compared to rated voltage, defined insulation levels, primary busbar rated currents and short-circuit currents,
- two-compartment bay ensuring the separation of the primary busbar circuit from the section used to connect power supply cables,
- high reliability of operation,

- long operating period without the need for troublesome maintenance operations,
- high corrosion resistance, the switchgear design uses metal sheet which has been zinc-coated for corrosion protection,
- universality in designing different switchgear configurations with any number of bays,
- use of state of the art, reliable switching devices, such as GTR type disconnectors and switch disconnectors (ZPUE), or circuit breakers by other manufacturers,
- adapted for the installation of state of the art protection and control devices,
- the possibility of wall-mounting of the switchgear, saving space in the switching room, which is particularly important during retrofits and expansions of existing switching stations,
- easy and quick access to switchgear devices for supervision and maintenance,
- simple operation.

SYSTEM OF INTERLOCKS AND PROTECTIONS

A system of interlocks prevents incorrect switching operations and opening of the distribution bay doors before voltage is disconnected and the earthing switch is closed. Opening of the earthing switch is possible only when the bay doors are closed (or after the interlock is purposefully released with a special key provided with the switchgear - for example in order to perform a voltage test of a cable). Each feeder bay and circuit breaker bay is equipped as standard with capacitive voltage dividers on each phase and a voltage indicator. Such a solution facilitates checking the cable for lack of voltage and safe phase testing with a phase comparator.

At the customer's request it is possible to provide capacitive voltage dividers in bays which do not have them as standard.

High safety of operation, achieved by:

- arc-proof design - resistance to internal arcing effects
- specially reinforced bay design (enclosures, locks, hinges)
- mechanical interlocks, which prevent incorrect switching operations and touching live devices
- access to controlgear and control circuits is possible while the primary circuits parts cannot be touched by the operator
- the use of monitoring and signalling systems, and mechanical and electrical position indicators, and inspection windows
- visual indicator of disconnector contacts, switch-disconnector and earthing switch state, and installing of inspection windows to control them,
- possibility of disconnecting the switch disconnector without an operating lever (optional - GTR 2, GTR 2V)
- the use of visible double gap disconnectors and switch disconnectors
- forcing the sequence of switching operations

BASIC TECHNICAL DATA

Compliance with standards:
The Rotoblok type switchgear meets the requirements of the following standards:

- **PN-EN62271-1** - “High-voltage switchgear and controlgear. Common specifications”,
- **PN-EN 62271-200** - “High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV”,
- **PN-EN 62271-100** - “High-voltage switchgear and controlgear. Alternating-current circuit-breakers”,
- **PN-EN 62271-102** - “High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches”.
- **PN-EN 62271-103** - “High-voltage switchgear and controlgear. Switches for rated voltages above 1 kV up to and including 52 kV”,
- **PN-EN 62271-105** - “High-voltage switchgear and controlgear. Alternating current switch-fuse combinations”.

The switchgear is certified by the Electrotechnical Institute.

Electrical data:		
	Rotoblok 17,5kV	Rotoblok 24
Rated network voltage	15 kV	20 kV
Highest device voltage	17,5 kV	24 kV
Rated frequency / number of phases	50 Hz / 3	
Rated short-time network frequency withstand voltage	55 kV / 63 kV	50 kV / 60 kV
Rated withstand lightning surge voltage 1,2/50 µs	95 kV /110 kV	125 kV / 145 kV
Continuous rated current	630 A / 1250 A	630 A / 1250 A
Rated short-time withstand current	up to 16 kA (1 s)	up to 16 kA (1 s)
Rated peak withstand current	up to 40 kA	up to 40 kA
IAC internal arc resistance classification	AF up to 16 kA (1 s)	
IP protection rating	IP 3X	

Service conditions:	
Ambient temperature	
- peak short-time	+ 40°C
- highest day average	+ 35°C
- highest annual average	+ 20°C
- lowest long-term	- 25°C*1)
Relative humidity of air	
- highest day average 95%	95 %
- highest month average 90%	90 %
- highest day average vapour pressure 2.2 kPa	2,2 kPa
- highest month average vapour pressure 1.8 kPa	1,8 kPa
Atmosphere at the place of installation	no significant contamination with salt, vapour, dust, smoke, flammable or corrosive gasses and lack of icing, frosting and dewing
Installation altitude	up to 1000 m asl*2)
Vibrations	vibrations caused by external factors or earthquakes negligible

Note:
*1) Unless the manufacturer of instrumentation & control and protection devices has specified otherwise.
*2) If the switchgear installation altitude is higher than 1000 m ASL should corrected by an indicator in accordance with the guidelines of item 2.2.1 of the PN-EN 62271-1 standard.

Rated power of transformers that can be connected and disconnected using GTR 2V disconnectors, depending on voltages on the MV side:

Rated network voltage	Rated current	Max. transformer power
6 kV	60,6 A	630 kVA
10 kV	57,7 A	1000 kVA
15 kV	48,1 A	1250 kVA
20 kV	46,2 A	1600 kVA

In case of transformers with higher powers please contact the switchgear manufacturer.
In Rotoblok type switchgear typical fuse links are used acc. to the IEC 282-1, DIN 43625 standard, with thermal protection.

CONSTRUCTION OF SWITCHGEAR TYPE ROTOBLOK

The design of each bay includes elements constructed with zinc-coated metal sheet, and bolted or riveted together. The construction of each bay ensures the possibility of easy assembly in any switchgear unit, and also rapid disassembly (e.g. in order to carry single bays into the station) and custom reconfiguration. Each bay may be constructed wider than its standard dimension. This solution is used when replacing older large size switchgears (e.g. Rue, M20) with a Rotoblok switchgear, when problems may occur with shifting the old cables to a new attachment point.

Each bay has two compartments, that is, the frame and the main disconnector shaft form a mechanical and electrical partition between the lower part of the switchgear and the primary busbar circuit. After opening the bay doors touching the primary busbar circuit is impossible. Each bay is equipped with a lower earthing switch (in a transformer bay it is installed under the fuse bases).

Each bay has a system of mechanical interlocks, which fulfils two primary tasks:

- prevents opening the door of any compartment before its power supply is switched off and the earthing switch is closed; therefore it prevents electric shock,
- forces the proper sequence of the switching operations.

Capacitive voltage dividers used in the bays allow checking for lack of voltage, and safe phase testing from the front side of the bay, in a safe manner, using a LV bipolar indicator without needing to open the bay doors. Additionally, inspection windows installed in the doors allow the observation of each element in the bay, for example: open circuits, condition of transformers, chambers, connections, etc.

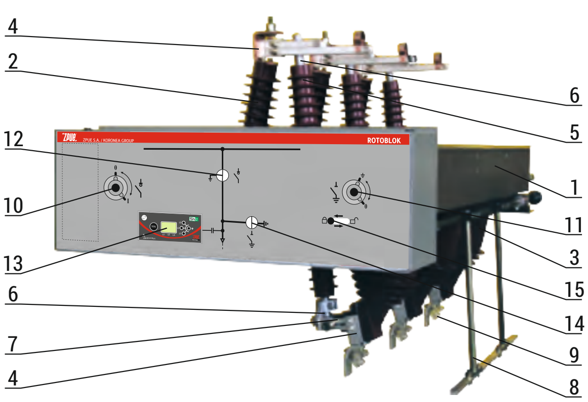
An auxiliary circuits compartment is located at the top of the circuit breaker bay, used to install such elements as: terminal strips, relays, batteries, additional (or primary) protection modules, etc.

SWITCHING DEVICES

The main devices used in the aforementioned bays include:

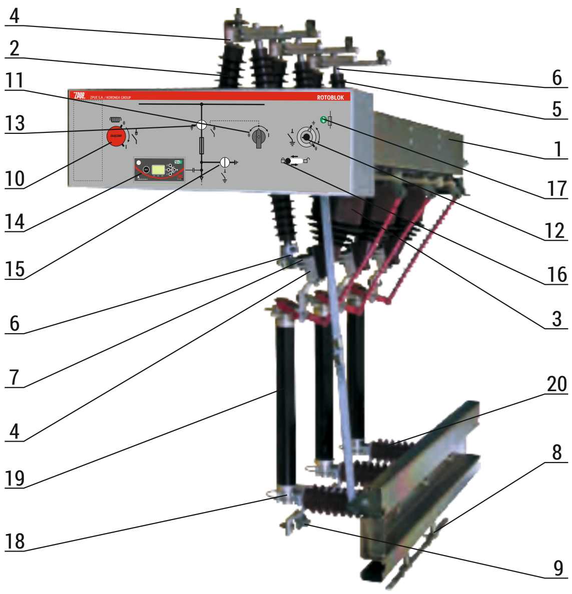
- GTR1, GTR 2, GTR 2V type switch disconnectors (ZPUE)
- GTR 4, GTR 4W type disconnectors (ZPUE)
- circuit breakers by leading manufacturers

View of the GTR 1 switch disconnector in the "on" position



1 - zinc-coated steel frame
2,3 - resin insulators
4 - fixed contacts
5 - main insulating shaft
6 - moving contacts
7 - arcing moving contact
8 - lower earthing switch
9 - earthing switch contact
10 - switch disconnector socket
1 - earthing switch socket
12 - switch disconnector position indicator
13 - voltage indicator
14 - earthing switch position indicator
15 - door interlock lever

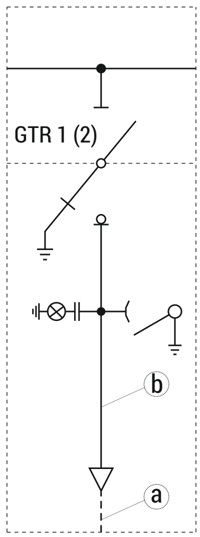
View of the GTR 2V switch disconnector in the “on” position



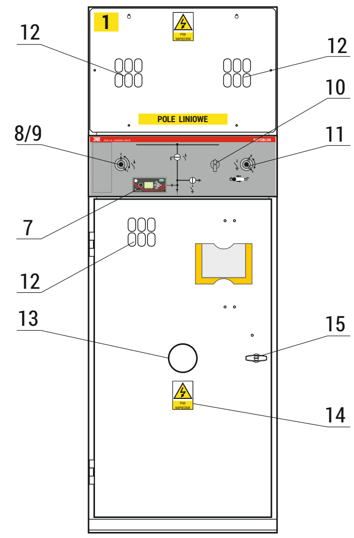
1	-	zinc-coated steel frame
2,3	-	resin insulators
4	-	fixed contacts
5	-	main insulating shaft
6	-	moving contacts
7	-	arcing moving contact
8	-	lower earthing switch
9	-	earthing switch contact
10	-	charging socket and charging indicator
11	-	“on”/“off” switch
12	-	earthing switch socket
13	-	switch disconnector position indicator
14	-	voltage indicator
15	-	earthing switch position indicator
16	-	door interlock lever
17	-	fuse link position indicator
18	-	fuse base
19	-	fuse link
20	-	post insulator or capacitive voltage divider

Line feeder with manual drive

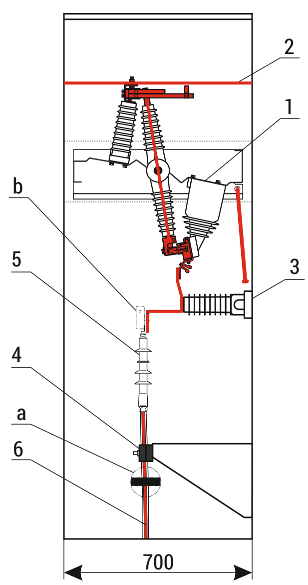
Electrical diagram



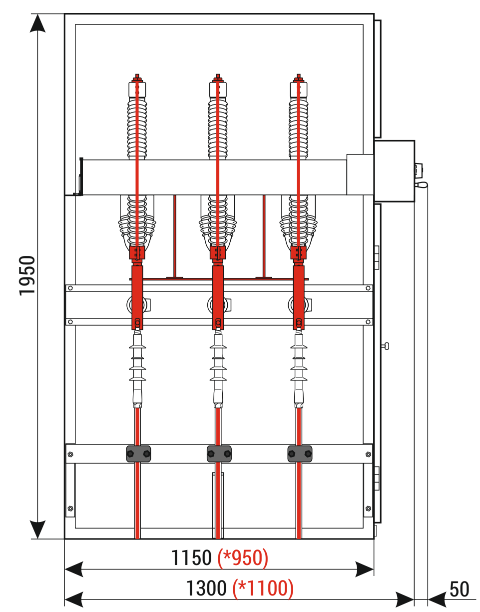
Front view



Inside front view



Inside side view



Standard equipment

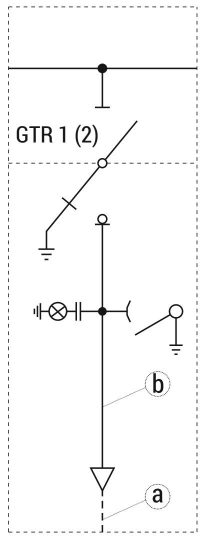
	Device name	Type	Amount
1	Switch disconnector with a lower earthing switch	GTR 1 lub GTR 2	1
2	Busbar circuit	P 40x5 / P 40x10	3
3	Capacitive voltage divider		3
4	Cable clamp	UKZ	3
5	Cable termination	See page 263	3
6	Cable	See page 263	3
7	Neon voltage indicator operating with the capacitive voltage divider		1
8	Switch disconnector socket (for GTR 1)		1
9	Charging socket and indicator (for GTR 2)		1
10	"On"/"off" switch (for GTR 2)		1
11	Earthing switch socket		1
12	Inspection window		1
13	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		3
14	Warning plate		1
15	Door handle		1

	Additional equipment at the customer's request		
a	Short-circuit current indicator attached by cable		1
b	Short-circuit current indicator attached by busbar		3

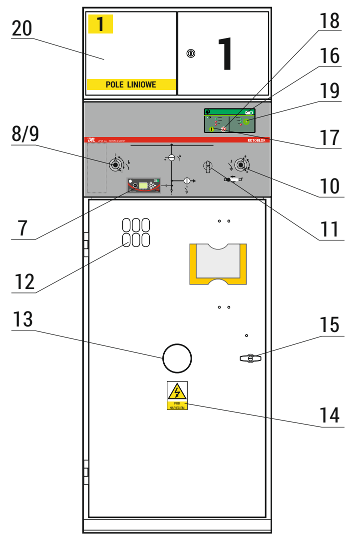
*- Rotoblok 17.5 kV switchgear depth

Line feeder with motor drive

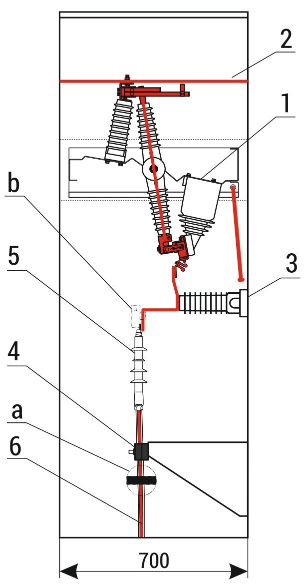
Electrical diagram



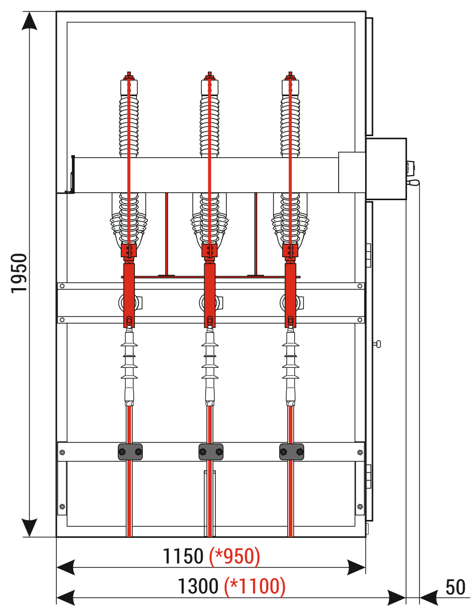
Front view



Inside front view



Inside side view



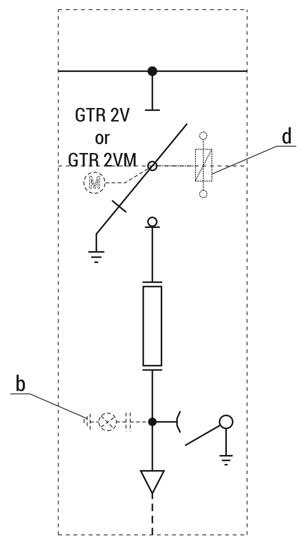
Standard equipment

	Device name	Type	Amount
1	Switch disconnector with a lower earthing switch and motor drive adapted for remote control via cables or via radio	GTR 1M lub GTR 2M	1
2	Busbar circuit	P. 40x5 / P 40x10	3
3	Capacitive voltage divider		3
4	Cable clamp	UKZ	3
5	Cable termination	See page 263	3
6	Cable	See page 263	3
7	Neon voltage indicator operating with the capacitive voltage divider		1
8	Switch disconnector socket (for GTR 1M)		1
9	Charging socket and indicator (for GTR 2M)		1
10	"On"/"off" switch (for GTR 2M)		1
11	Earthing switch socket		1

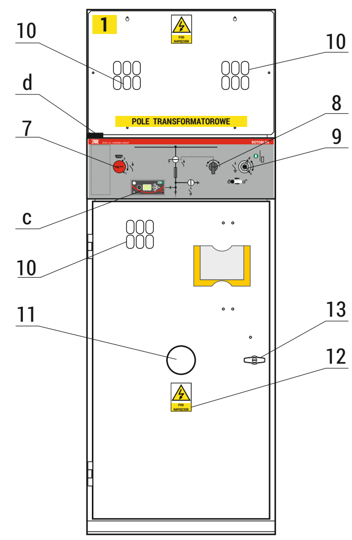
12	Inspection window		1
13	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		3
14	Warning plate		1
15	Door handle		1
16	Control panel for motor drive		1
17	"Close" button		1
18	"Open" button		1
19	Operation mode selection switch		1
20	Auxiliary circuits compartment		1
	Additional equipment at the customer's request		
a	Short-circuit current indicator attached by cable		1
b	Short-circuit current indicator attached by busbar		3

*- Rotoblok 17.5 kV switchgear depth

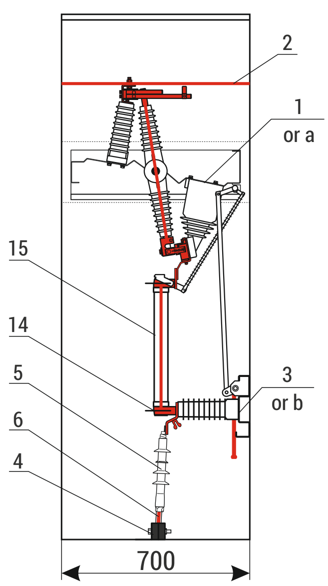
Electrical diagram



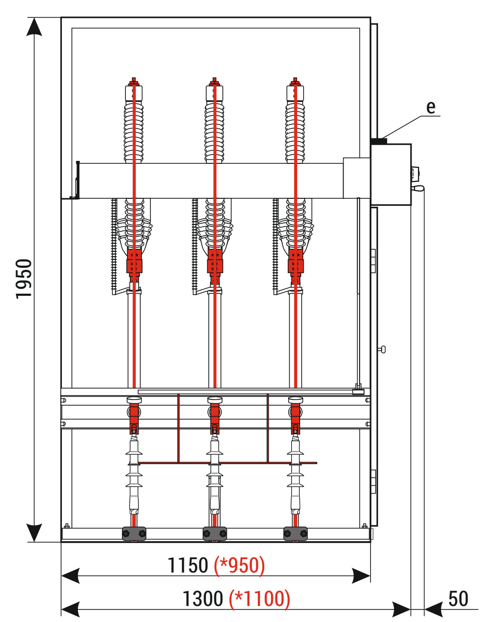
Front view



Inside front view



Inside side view



Standard equipment

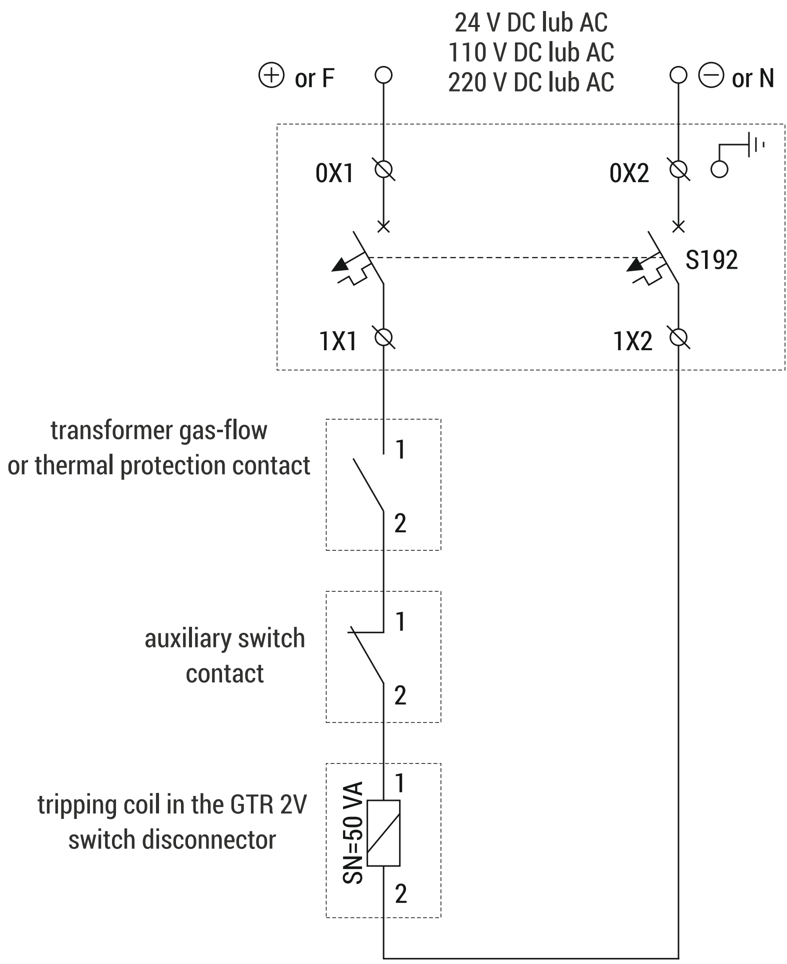
	Device name	Type	Amount
1	Fuse switch disconnector with earthing switch	GTR 2V	1
2	Busbar circuit	P. 40x5 / P 40x10	3
3	Post insulator		3
4	Cable clamp	UKZ	3
5	Cable termination	See page 263	3
6	Cable	See page 263	3
7	Charging socket and indicator		1
8	“On”/“off” switch		1
9	Earthing switch socket		1
10	Inspection window		1
11	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		3
12	Warning plate		1
13	Door handle		1
14	Fuse base which forms an integral part of the switch disconnector		1
15	Fuse link		1

Additional equipment at the customer's request			
a	Fuse switch disconnector with earthing switch and motor drive	GTR 2VM	1
b	Capacitive voltage divider		3
c	Neon voltage indicator operating with the capacitive voltage divider		1
d	Tripping coil		1
e	Gland for cable entry with the use of a tripping coil		1

Note! The earthing switch in the switch disconnector earths the lower part of the fuse link.

* - Rotoblok 17.5 kV switchgear depth

Tripping coil operation in a transformer bay with gas-flow protection or thermal protection of the transformer

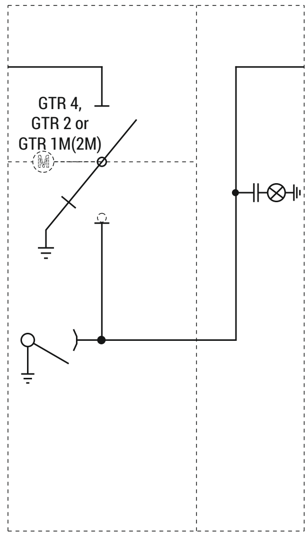


NOTE!

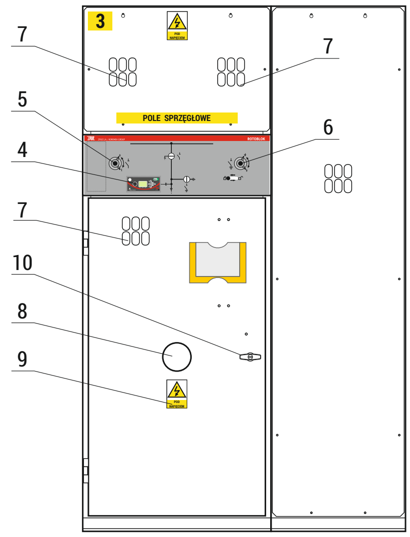
Cable cross-section and protection currents should be selected according to the tripping coil supply voltage.

BUS COUPLER UNIT DESIGN

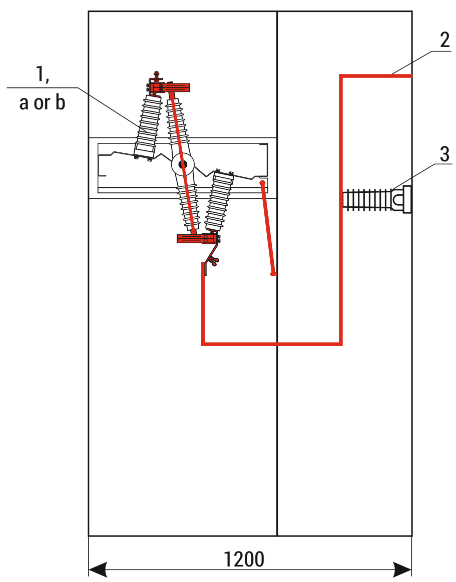
Electric diagram



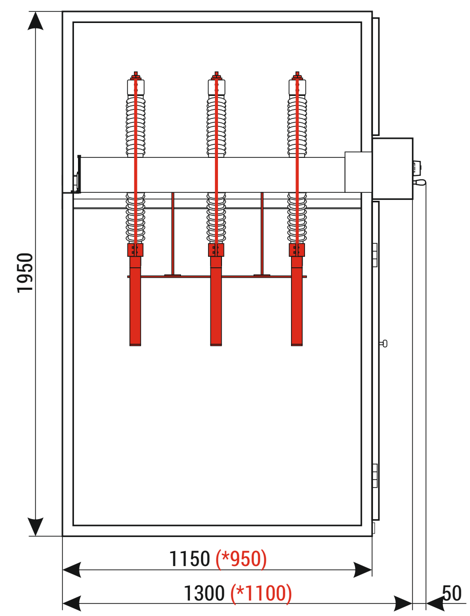
Front view



Inside front view



Inside side view



Standard equipment

	Device name	Typ	Amount
1	Disconnector with a lower earthing switch	GTR 4	1
2	Busbar circuit	P 40x5 / P 40x10	3
3	Post insulator or capacitive voltage divider		3
4	Neon voltage indicator operating with the capacitive voltage divider		1
5	Disconnector socket		1
6	Earthing switch socket		1
7	Inspection window		1
8	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		3
9	Warning plate		1
10	Door handle		1

Additional equipment at the customer's request

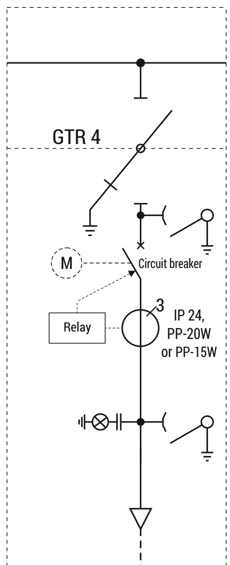
a	Switch disconnector with a lower earthing switch	GTR 2	1
b	Switch disconnector with a lower earthing switch and motor drive	GTR 1M or GTR 2M	1

Note! The construction of a bus coupler bay without a lower earthing switch is possible

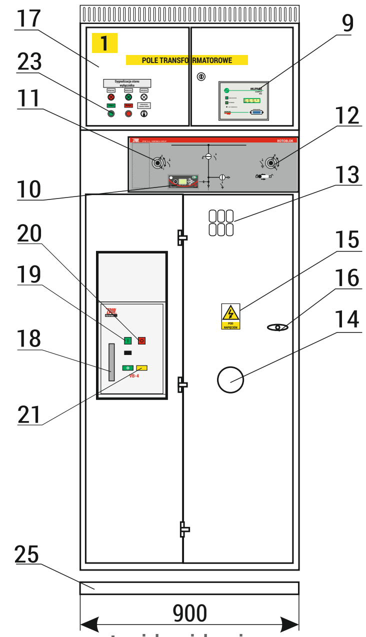
* - Rotoblok 17.5 kV switchgear depth

DESING OF TRANSFORMER FEEDER TYPE RWT

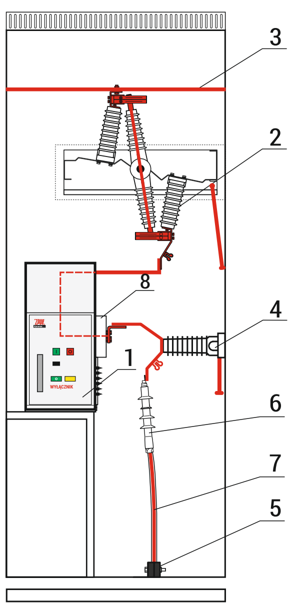
Electric diagram



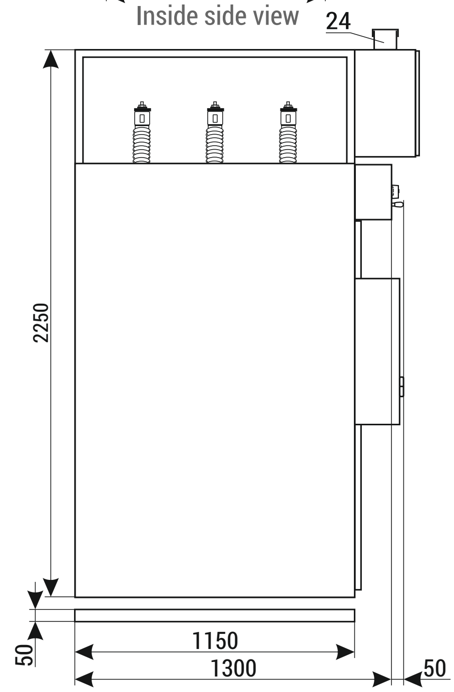
Front view



Inside front view



Inside side view

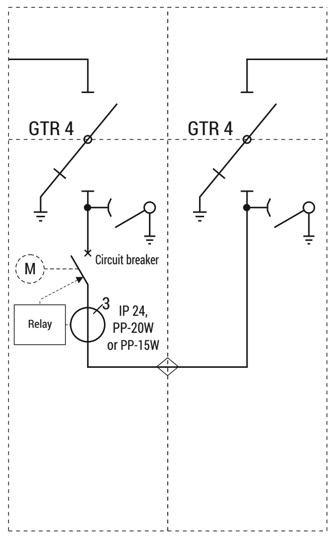


Standard equipment

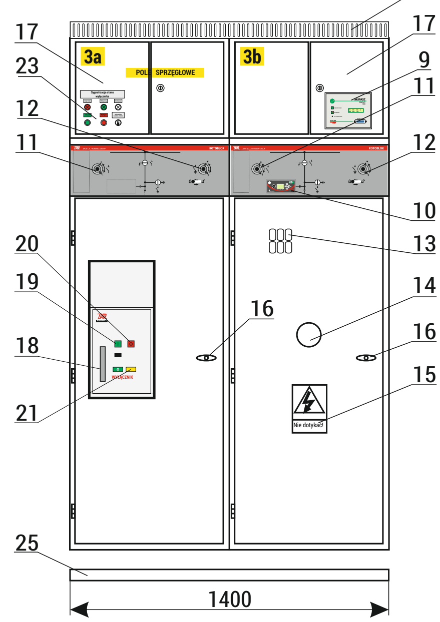
	Device name	Type	Amount
1	Circuit breaker		1
2	Disconnector with a lower earthing switch	GTR 4	1
3	Busbar circuit	P 40x5 / P 40x10	3
4	Capacitive voltage divider		3
5	Cable clamp	UKZ	3
6	Cable termination	See page 263	3
7	Cable	See page 263	3
8	Current transformer operating with the protection system	IP 24 / PP-20W / PP-15W	3
9	Protection system	Mupasz / REF MiCOM	1
10	Neon voltage indicator operating with the capacitive voltage divider		1
11	Disconnector socket		1
12	Earthing switch socket		1
13	Inspection window		1
14	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		1
15	Warning plate		1
16	Door handle		1
17	Auxiliary circuits compartment		1
18	Charging socket		1
19	“ON” button		1
20	“OFF” button		1
21	Charging indication		1
23	Control switches and lamps		1
24	Cable tray		1
25	Load-bearing frame		1

DESING OF BUS CUPLER UNIT TYPE RWS

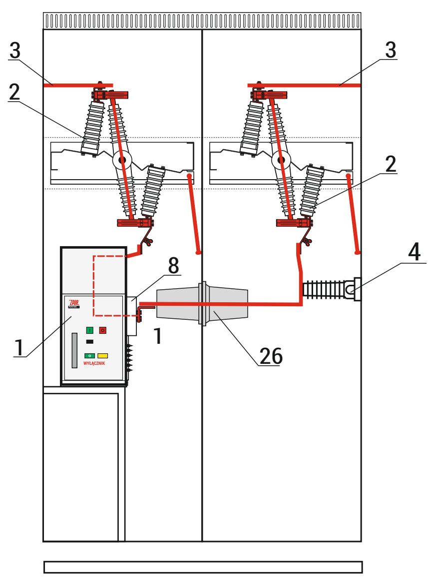
Electric diagram



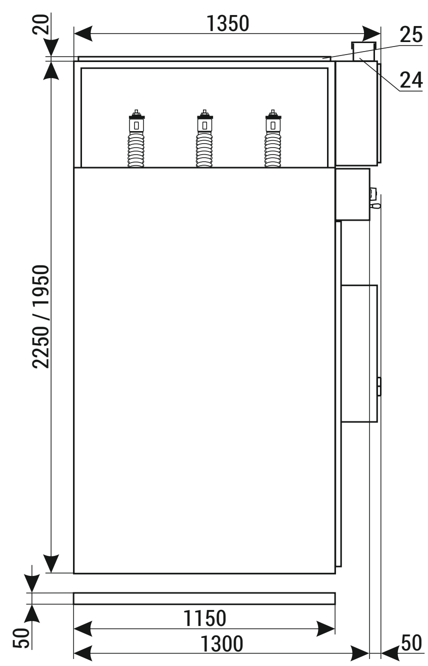
Front view



Inside front view



Side view



Standard equipment

	Device name	Type	Amount
1	Circuit breaker		1
2	Disconnector with a lower earthing switch	GTR 4	1
3	Busbar circuit	P 40x5 / P 40x10	3
4	Capacitive voltage divider		3
8	Current transformer operating with the protection system	IP 24 / PP-20W / PP-15W	3
9	Protection system	Mupasz / REF MiCOM	1
10	Neon voltage indicator operating with the capacitive voltage divider		1
11	Disconnector socket		1
12	Earthing switch socket		1
13	Inspection window		1

14	Window which allows the use of a torch to check the position of contacts in case of a lighting failure		1
15	Warning plate		1
16	Door handle		1
17	Auxiliary circuits compartment		1
18	Charging socket		1
19	„ON" button		1
20	„OFF" button		1
21	Charging indication		1
23	Control switches and lamps		1
24	Cable tray		1
25	Load-bearing frame		1
26	Insulating bushing		1

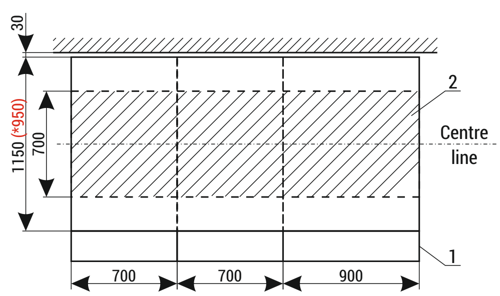
CONTROL CIRCUITS PANEL: “AUXILIARY CIRCUITS COMPARTMENT”

The auxiliary circuits compartment (17) contains control strips, protection units, control & metering devices and buttons. Based on documentation provided by the customer, the manufacturer determines the position of the auxiliary circuit devices in the switchgear. Auxiliary circuit leads and cables are placed in the compartment in cable trays, and exit the compartment through glands. The auxiliary circuits in the remaining compartments run in protection tubes. The bypass circuits between adjacent bays run in trays. It is recommended that auxiliary circuit cables are run from individual distribution bays to the control room in a cable duct or on cable ladders installed on the walls.

CONSTRUCTION METHOD FOR A CABLE DUCT UNDER THE ROTOBLOK TYPE MV SWITCHGEARS

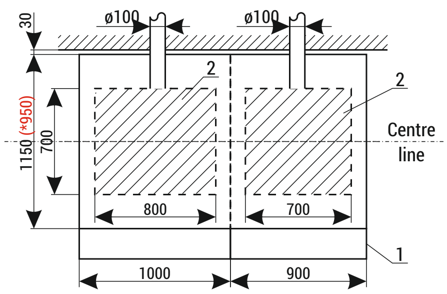
Figures 1, 2, 3 present a cable duct construction proposal. The cable bending radius (which depends on its outside diameter, according to PBUE) should taken into account when establishing the dry and oil cables duct depth. It is possible to avoid or reduce the depth of the cable duct by using a raised base or a raised floor.

Fig. 1 Top view
- version with a common duct along the Rotoblok switchgear



Note!: Minimum distance from the wall 30 mm
1) Example bays with a width of 700, 700, 900 mm (respectively, from the left)
2) Duct under the switchgear.

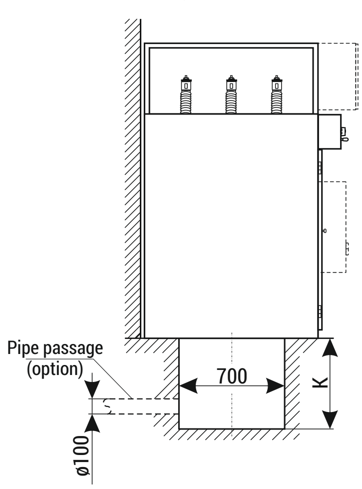
Fig. 2 Top view
- version with separate outgoing feeders and cable entries at the rear of the Rotoblok switchgear



* - Rotoblok 17.5 kV switchgear depth

Uwaga!: Minimum distance from the wall 30 mm
1) Example bays with a width of 1000, 900 mm (respectively, from the left)
2) Duct under the switchgear.

Fig. 3 Side view



Dry single-core cable		
Cable cross-section (mm^2)	Bending radius (mm)	Duct depth **K** (mm)
50	370	400
70	400	430
95	440	470
120	470	500
150	500	550
185	540	600
240	590	700

Switch disconnector and circuit breaker feeder bays

<table>
<tr><th rowspan="2">Cable type</th><th colspan="4">Cable termination</th></tr>
<tr><th>Manufacturer</th><th colspan="2">Type</th><th>Cable cross-section [mm^2]</th></tr>
<tr><td rowspan="15">Single core, with plastic insulation e.g. YHAKXs, YHKX, XUHAKXs, XRUHKs, ...</td><td rowspan="6">CELLPACK</td><td rowspan="2" colspan="2">CHE-I 24kV</td><td>25-150</td></tr>
<tr><td>70-240</td></tr>
<tr><td rowspan="2" colspan="2">CAE-I 24kV</td><td>35-120</td></tr>
<tr><td>70-240</td></tr>
<tr><td rowspan="2" colspan="2">CAESK-I 24kV</td><td>70-150</td></tr>
<tr><td>120-240</td></tr>
<tr><td rowspan="5">Nexans (EUROMOLD)</td><td colspan="2">ITK224 (stretch sleeve)</td><td>25-240</td></tr>
<tr><td colspan="2">AIP20 (slip-on)</td><td>25-120</td></tr>
<tr><td colspan="2">AIS20 (slip-on)</td><td>70-300</td></tr>
<tr><td colspan="2">AIN20 (slip-on)</td><td>25-1200</td></tr>
<tr><td colspan="2">24MONOi1 (shrink sleeve)</td><td>25-240</td></tr>
<tr><td rowspan="4">TYCO ELECTRONIC</td><td>Rated voltage</td><td>Typ (stretch sleeve)</td><td></td></tr>
<tr><td>6/10</td><td>POLT-12xxx</td><td>25-1200</td></tr>
<tr><td>8,7/15 i 12/20</td><td>POLT-24xxx</td><td>25-800</td></tr>
<tr><td>18/30</td><td>POLT-42xxx</td><td>35-800</td></tr>
</table>

*) **Note:** The manufacturer should be consulted regarding the manner of connection of cables and used terminations

Transformer bays

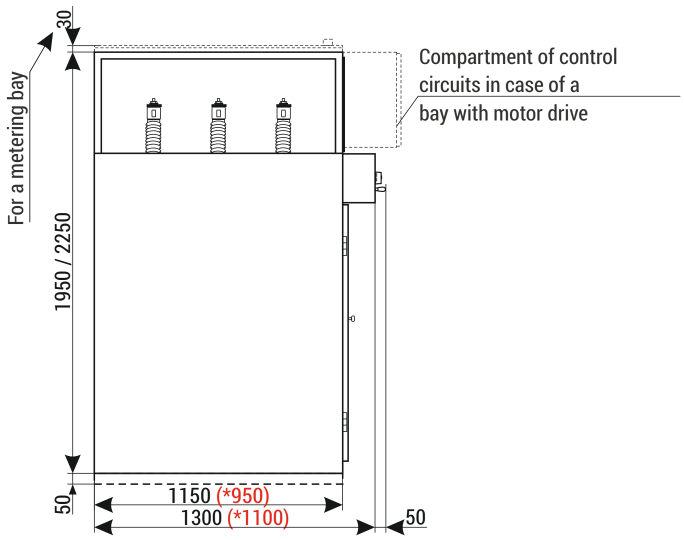
Single core, with plastic insulation e.g. YHAKXs, YHKX, XUHAKXs, XRUHKs, ...	As in feeder bays
Tri-core oil-filled with paper insulation saturated with non-running saturant and common coating, e.g.: HAKnFta, KnY, KnFTA, ...	The manufacturer should be consulted regarding the manner of connection of cables and used terminations

NOTE!

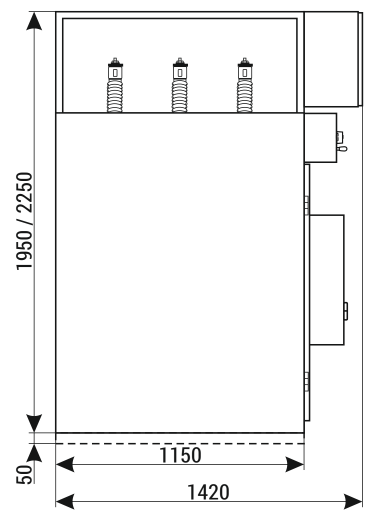
In all cases a cable duct is required under the switchgears. As an option, the switchgear may be placed on a raised base or on a raised floor. In case other type of terminations is used, please contact the manufacturer.

VARIOUS TYPES OF ROTOBLOK SWITCHGEAR UNITS

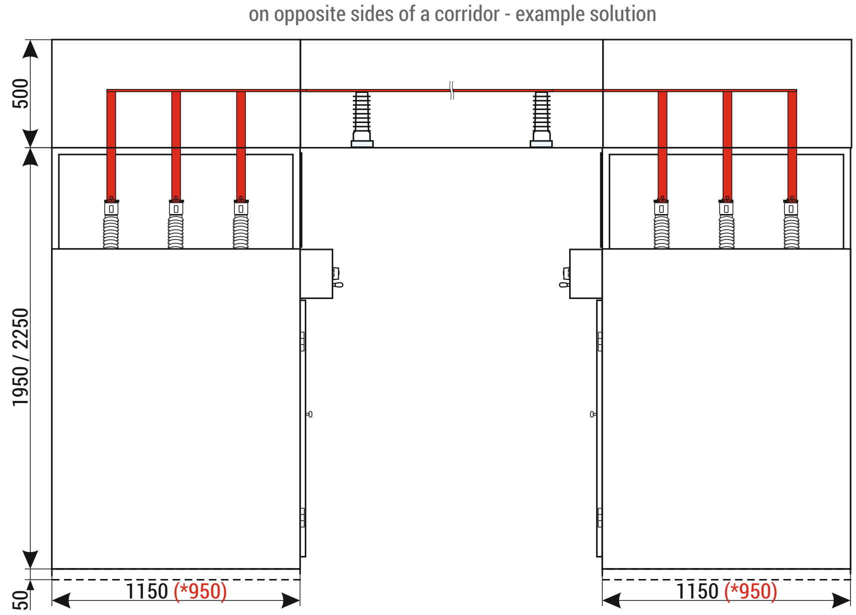
Side view of a circuit breaker or switch disconnector bay



Side view of an MV circuit breaker bay



Side view of a switchgear with a busbar bridge combining two sections placed on opposite sides of a corridor - example solution



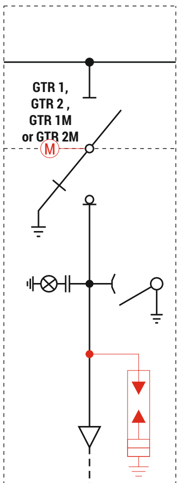
* - Rotoblok 17.5 kV switchgear depth.

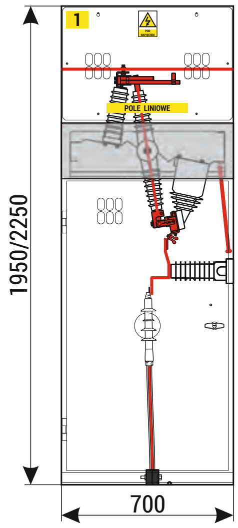
NOTE!

Figures shown on subsequent pages are only an example of bay equipment. It is possible to adapt the bay configuration to specific requirements of the end user. In this case manufacturer should be asked to provide drawings.

Electric diagram	Cross-section Front view	Electric diagram	Cross-section Front view

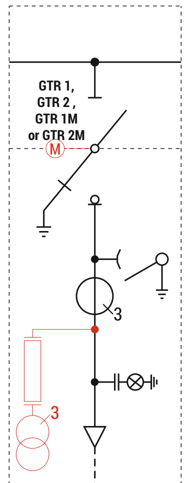
RL1
(line feeder)

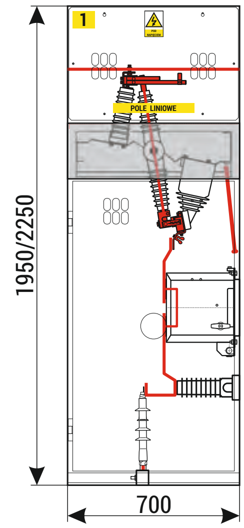




mass = 206(214)kg

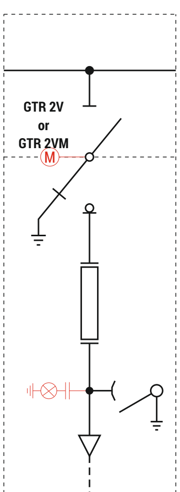
RL4
(line feeder with metering)

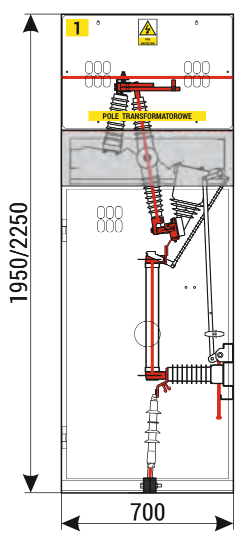




mass = 311(430)kg

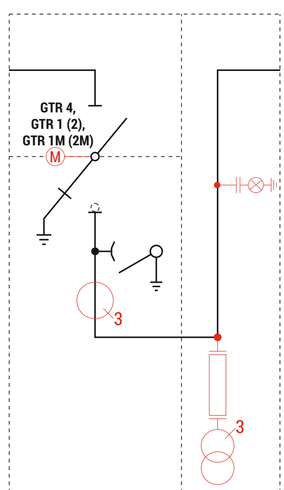
RT1
(transformer feeder)

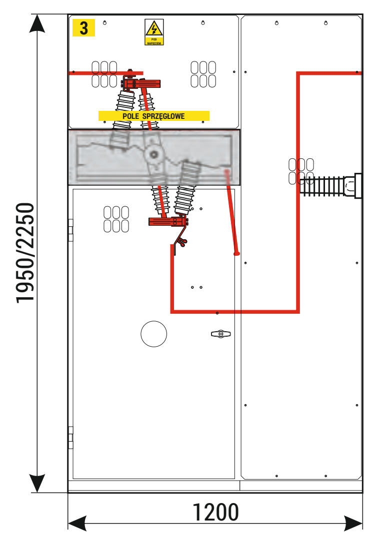




mass = 215kg

RS1L[1)]
(bus coupler unit with disconnector or switch disconnector on the left side)

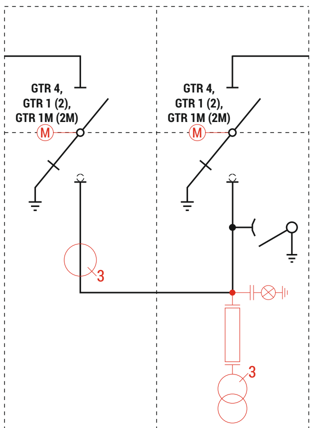




mass = 233 (450)kg

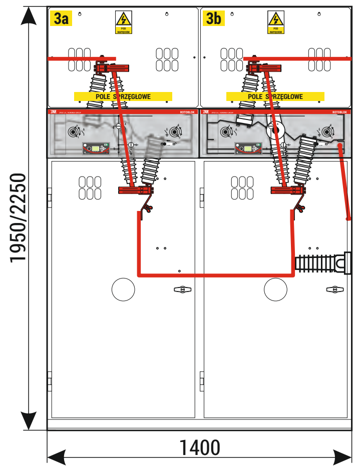
RS4
(bus coupler unit with disconnector or switch disconnector on the left side)

Electric diagram



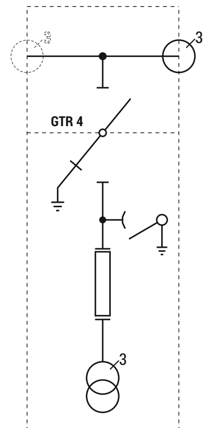
mass = 405 (622)kg

Cross-section Front view



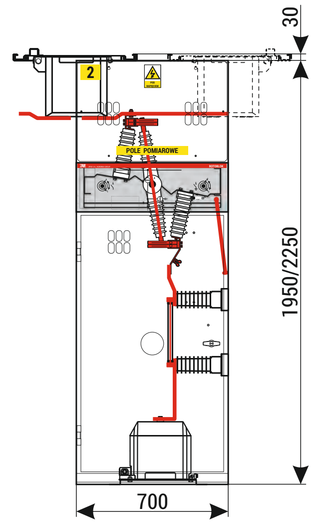
RP1
(metering unit)

Electric diagram

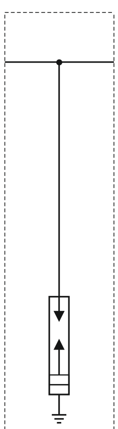


mass = 422kg

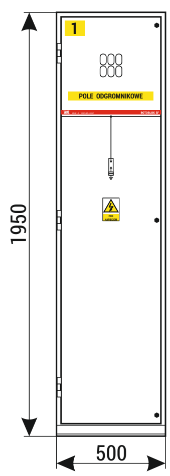
Cross-section Front view



R01
(lightning arrester unit)



mass = 100 kg



NOTE!

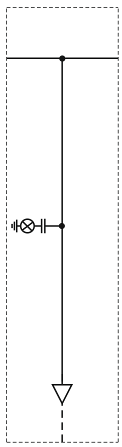
Optional equipment was marked with red on the electrical diagram.

1) It is possible to design the unit in mirrored version

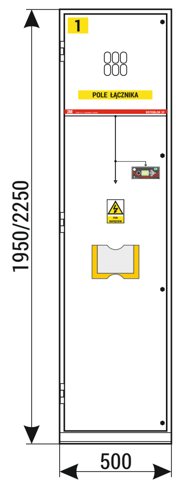
2) It is possible to design the bus coupler unit without a lower earthing switch

Electric diagram	Cross-section Front view	Electric diagram	Cross-section Front view

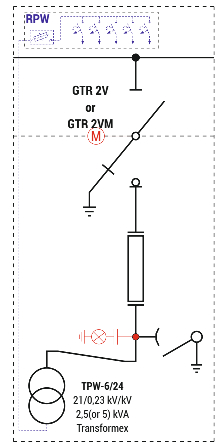
RŁ2
(Incoming cable-connection feeder)

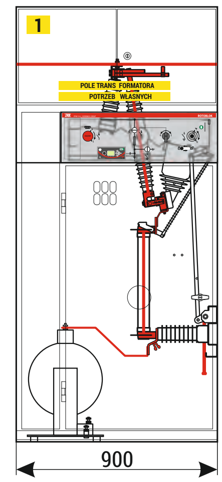


mass = 100 kg

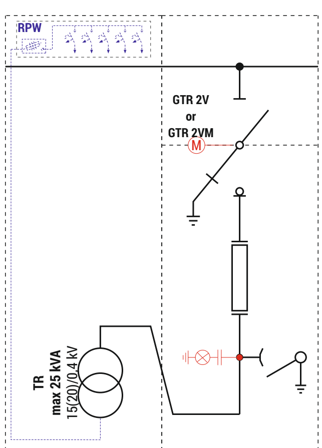


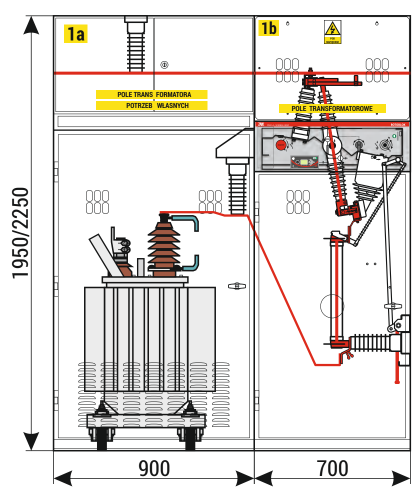
Rtpwł4
(auxiliary transformer unit)



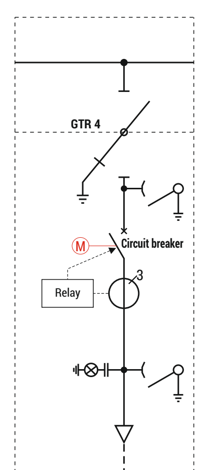


Rtpwł 25kVA + RT1
(auxiliary transformer unit - max. power 25 kVA)

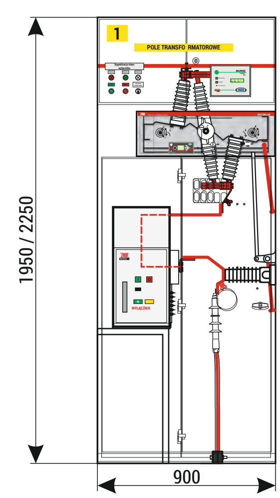




RWT
(circuit breaker transformer feeder)

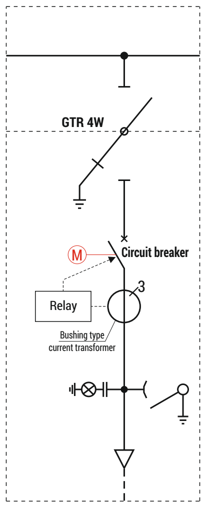


mass = 333 kg

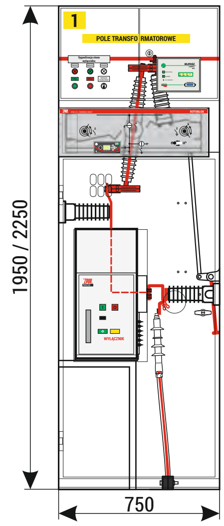


Electric diagram	Cross-section Front view	Electric diagram	Cross-section Front view

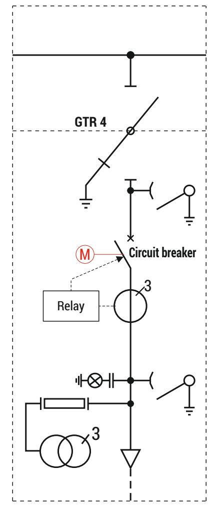
RWT3
(circuit breaker transformer feeder)



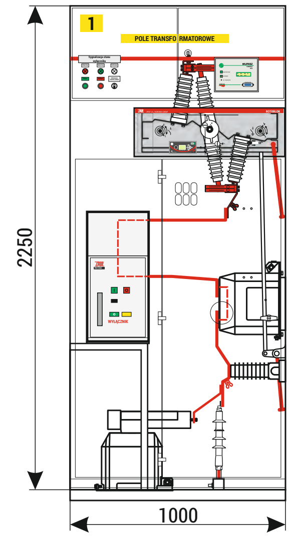
mass = 323kg



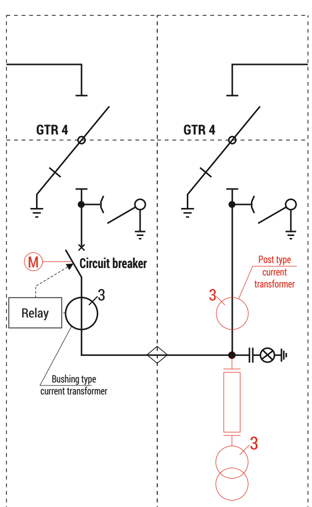
RWTp14
(circuit breaker transformer feeder with voltage measurement)



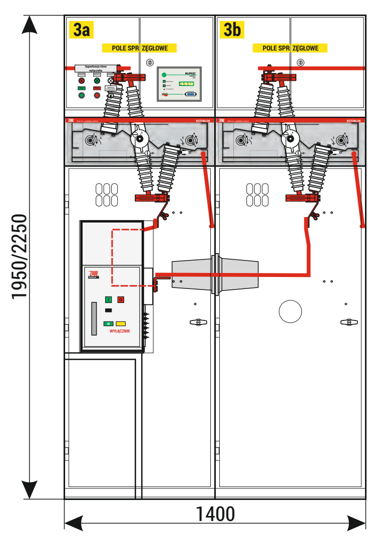
mass = 545kg



RWS
(bus coupler unit with
with disconnectors and circuit breaker)



mass = 466 (676)kg



NOTE!

Optional equipment was **marked with red** on the electrical diagram.

Medium Voltage switchgear

6 / Rotoblok SF

INTRODUCTION

The subject of this document is a Rotoblok SF type state-of-the-art, indoor medium voltage switchgear intended for distribution of three-phase alternating current with a frequency of 50 Hz, at a rated voltage up to 25 kV, in industrial and commercial power sector distribution grids. The switchgears are configured from standard single modules with varied equipment. The information and technical data specified herein enable the designer to assemble a switchgear from typical modules. In case modules with equipment not specified herein or with changed dimensions are needed, the scope of equipment should be arranged with the manufacturer.

CHARACTERISTICS

The Rotoblok SF type switchgear is a two compartment, indoors air insulated switchgear (AIS) in a mental enclosure made of zinc-coated metal sheet (which ensures equipotential bonding), with a single primary busbars system. The switchgear is equipped with state-of-the-art, three-position disconnectors and switch disconnectors in SF_6 insulation.

The tank of each of these devices is constructed with stainless steel, which ensures maintaining a perfect technological condition of the switchgear over its entire operation period. It has separate primary busbars and cable compartments, and the arc-proof design ensures high level of operational safety.

The distribution bays have the following properties

- reduced dimensions compared to air insulated switchgear while maintaining high electrical parameters such as insulation level, rated currents and short-circuit current resistance
- two-compartment bay ensuring the separation of the primary busbar circuit from the section used to connect power supply cables
- high reliability of operation
- long operating period without the need for troublesome maintenance operations
- high corrosion resistance, the switchgear design uses zinc-coated metal sheet
- universality in designing different switchgear configurations with any number of bays
- use of state of the art, reliable switching devices, such as GTR SF type disconnectors and switch disconnectors (ZPUE), and VCB GIS type circuit breakers (ZPUE) or by other leading manufacturers,
- adapted for the installation of state of the art protection and control devices
- the possibility of wall-mounting of the switchgear, saving space in the switching room, which is particularly important during retrofits and expansions of existing switching stations
- easy and quick access to switchgear devices for supervision and maintenance
- simple operation

SYSTEM OF INTERLOCKS AND PROTECTIONS

- arc-proof design - resistance to internal arcing effects
- specially reinforced bay design (enclosures, locks, hinges)
- mechanical interlocks, which prevent incorrect switching operations and touching live devices
- access to controlgear and control circuits is possible while the primary circuits parts cannot be touched by the operator
- the use of monitoring and signalling systems, and mechanical and electrical position indicators, and inspection windows
- use of three-position “on - off - earth” disconnectors and switch disconnectors with mechanical position indicators
- the use of fast earthing switch with an impulse drive
- the use of fast earthing switch with an impulse drive guarantee safety in case of an incorrect switch to a short-circuit

BASIC TECHNICAL DATA

Compliance with standards:

The Rotoblok type switchgear meets the requirements of the following standards:

- **(PN-EN) IEC 62271-1** - "High-voltage switchgear and controlgear. Common specifications",
- **(PN-EN) IEC 62271-200** - "High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV standard,"
- **(PN-EN) IEC 62271-100** - "High-voltage switchgear and controlgear. Alternating-current circuit-breakers",
- **(PN-EN) IEC 62271-102** - "High-voltage switchgear and controlgear. Alternating current disconnectors and earthing switches",
- **(PN-EN) IEC 62271-103** - "High-voltage switchgear and controlgear. Switches for rated voltages above 1 kV up to and including 52 kV",
- **(PN-EN) IEC 62271-105** - "High-voltage switchgear and controlgear. Alternating current switch-fuse combinations".

Basic electrical data:	
	Rotoblok SF
Rated network voltage	20 kV
Highest device voltage	25 kV
Rated frequency / number of phases	50 Hz / 3
Rated short-time network frequency withstand voltage	50 kV / 60 kV
Rated withstand lightning surge voltage 1.2/50 µs	125 kV / 145 kV
Continuous rated current	630 A
Rated short-time withstand current	20 kA (1s)
Rated peak withstand current	50 kA
Resistance to internal arc effects	16 kA (1s)
IP protection rating	IP4X

Service conditions:	
Ambient temperature	
- peak short-time	+ 40°C
- highest day average	+ 35°C
- highest annual average	+ 20°C
- lowest long-term	- 25°C[1)]
Relative humidity of air	
- highest day average 95%	95 %
- highest month average 90%	90 %
- highest day average vapour pressure 2.2 kPa	2,2 kPa
- highest month average vapour pressure 1.8 kPa	1,8 kPa
Atmosphere at the place of installation	no significant contamination with salt, vapour, dust, smoke, flammable or corrosive gasses and lack of icing, frosting and dewing
Installation altitude	up to 1000 m asl [2)]
Vibrations	vibrations caused by external factors or earthquakes negligible

NOTE!

[1)] Unless the manufacturer of instrumentation & control and protection devices has specified otherwise.
[2)] If the switchgear installation altitude is higher than 1000 m ASL the switchgear insulation level should corrected by an indicator in accordance with the guidelines of item 2.2.1 of the PN-EN 62271-1 standard.

Rated power of transformers that can be connected and disconnected using GTR SF 2V, GTR SF 2VM switch disconnectors, depending on voltages on the MV side:		
Rated network voltage	Rated current	Max. transformer power
6 kV	77 A	800 kVA
10 kV	57,7 A	1000 kVA
15 kV	61,6 A	1600 kVA
20 kV	57,7 A	2000 kVA

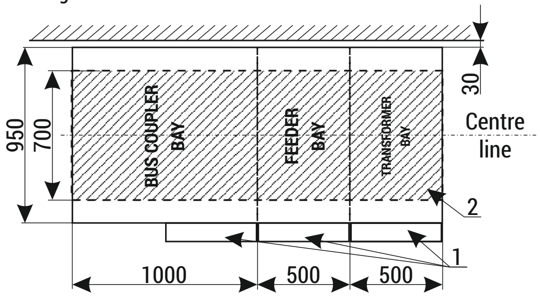
In Rotoblok SF type switchgear typical fuse links are used acc. to the IEC 282-1, DIN 43625 standard, with thermal protection.

- **GTR SF 1** - switch disconnector with earthing switch
- **GTR SF 1M** - switch disconnector with earthing switch and motor drive
- **GTR SF 2V** - fused switch disconnector with earthing switch
- **GTR SF 2VM** - fused switch disconnector with earthing switch and motor drive
- **GTR SF 4** - disconnector with earthing switch
- **VCB GIS** circuit breaker with disconnector and earthing switch

METHOD OF CABLE DUCT CONSTRUCTION UNDER ROTOBLOK SF AND ROTOBLOK SF TYPE MV SWITCHGEARS

The Rotoblok SF type switchgear is a two compartment, indoors air insulated switchgear (AIS) in a mental enclosure made of zinc-coated metal sheet (which ensures equipotential bonding), with a single primary busbars system. The switchgear is equipped with state-of-the-art, three-position disconnectors and switch disconnectors in SF_6 insulation.
The tank of each of these devices is constructed with stainless steel, which ensures maintaining a perfect technological condition of the switchgear over its entire operation period. It has separate primary busbars and cable compartments, and the arc-proof design ensures high level of operational safety.

Fig. 1 Cable duct proposal, to be constructed under Rotoblok SF switchgear

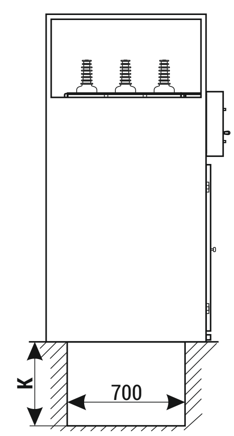


Note!: Minimum distance from the wall 30 mm

1) Example bays with a width of 1000, 500, 500 mm (respectively, from the left)
2) Cable duct under the switchgear

Fig. 3. Proposed depth of the cable duct under the Rotoblok SF switchgear

Dry single-core cable		
Cable cross-section (mm^2)	Bending radius (mm)	Duct depth **k** (mm)
50	370	400
70	400	430
95	440	470
120	470	500
150	500	550
185	540	600
240	590	700



ROTOBLOK SF SWITCHGEAR CABLE CONNECTIONS

Switch disconnector and circuit breaker feeder bays

<table>
<tr><th rowspan="2">Cable type</th><th colspan="4">Cable termination</th></tr>
<tr><th>Manufacturer</th><th colspan="2">Type</th><th>Cable cross-section [mm^2]</th></tr>
<tr><td rowspan="16">Single-core with plastic insulation e.g. YHAKXs, YHKX, XUHAKXs, XRUHKs, ...</td><td rowspan="6">CELLPACK</td><td colspan="2" rowspan="2">CHE-I 24kV</td><td>25-150</td></tr>
<tr><td>70-240</td></tr>
<tr><td colspan="2" rowspan="2">CAE-I 24kV</td><td>35-120</td></tr>
<tr><td>70-240</td></tr>
<tr><td colspan="2" rowspan="2">CAESK-I 24kV</td><td>70-150</td></tr>
<tr><td>120-240</td></tr>
<tr><td rowspan="5">Nexans (EUROMOLD)</td><td colspan="2">ITK224 (stretch sleeve)</td><td>25-240</td></tr>
<tr><td colspan="2">AIP20 (slip-on)</td><td>25-120</td></tr>
<tr><td colspan="2">AIS20 (slip-on)</td><td>70-300</td></tr>
<tr><td colspan="2">AIN20 (slip-on)</td><td>25-1200</td></tr>
<tr><td colspan="2">24MONOi1 (shrink sleeve)</td><td>25-240</td></tr>
<tr><td rowspan="4">TYCO ELECTRONIC</td><td>Rated voltage</td><td>Type (stretch sleeve)</td><td></td></tr>
<tr><td>6/10</td><td>POLT-12xxx</td><td>25-1200</td></tr>
<tr><td>8,7/15 i 12/20</td><td>POLT-24xxx</td><td>25-800</td></tr>
<tr><td>18/30</td><td>POLT-42xxx</td><td>35-800</td></tr>
</table>

NOTE!

The manufacturer should be consulted regarding the manner of connection of cables and used terminations

Transformer bays

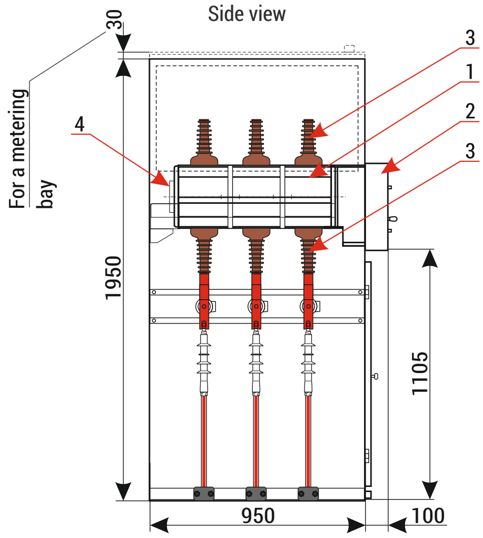
Single-core with plastic insulation e.g. YHAKXs, YHKX, XUHAKXs, XRUHKs, ...	As in feeder bays
Tri-core oil-filled with paper insulation saturated with non-running saturant and common coating, e.g.: HAKnFta, KnY, KnFTA, ...	The manufacturer should be consulted regarding the manner of connection of cables and used terminations

NOTE!

In all cases a cable duct is required under the switchgears. As an option the switchgear may be placed on a raised base or on a raised floor.
In case other type of terminations is used, please contact the manufacturer

CONSTRUCTION OF SWITCHGEAR TYPE ROTOBLOK SF

Side view



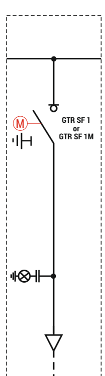
1 - Stainless steel tank filled with SF_6 gas with switching devices
2 - Drive mechanism compartment
3 - Insulating bushings
4 - Safety valve

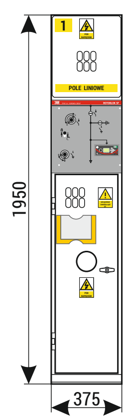
NOTE!

Figures shown on subsequent pages are only an example of bay equipment. It is possible to adapt the bay configuration to specific requirements of the end user. In this case manufacturer should be asked to provide drawings.

Electric diagram	Front view	Electric diagram	Front view

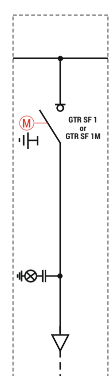
SL1
(line feeder)

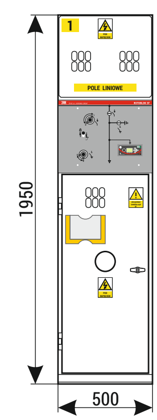




mass = 175 kg

SL2
(line feeder)

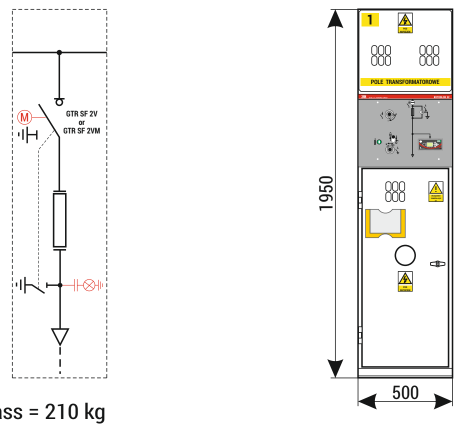




mass = 190 kg

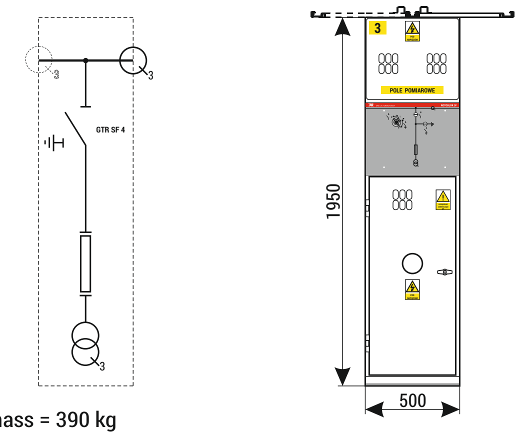
Electrical diagram	Front view	Electrical diagram	Front view

ST2
(transformer feeder)



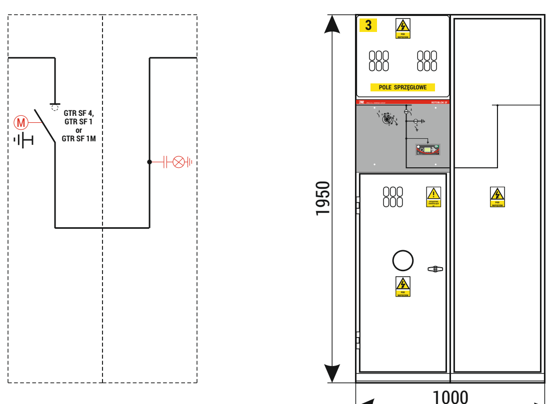
mass = 210 kg

SP1
(metering unit)



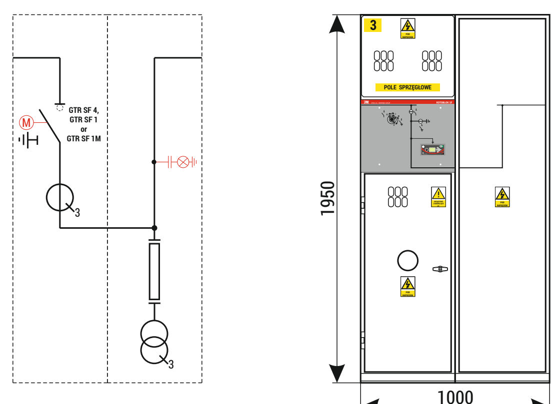
mass = 390 kg

SS1L(P.*))
(bus coupler unit with disconnector or switch disconnector on the left side)



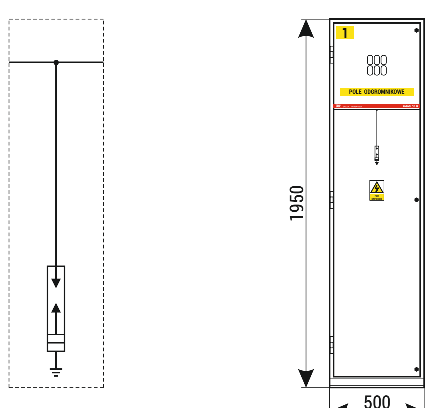
mass = 265 kg

SS2L(P.*))
(bus coupler unit with disconnector or switch disconnector on the left side)



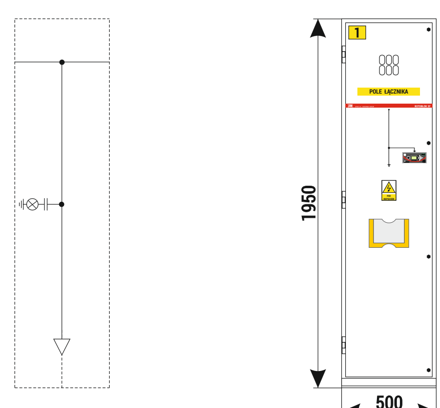
mass = 465 kg

SO1
(lightning arrester unit)



mass = 100 kg

SŁ2
(Incoming cable-connection feeder)



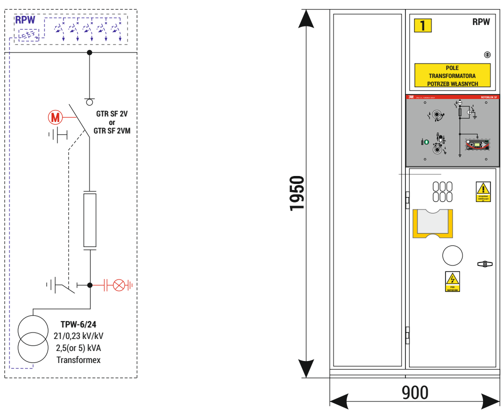
mass = 100 kg

NOTE!

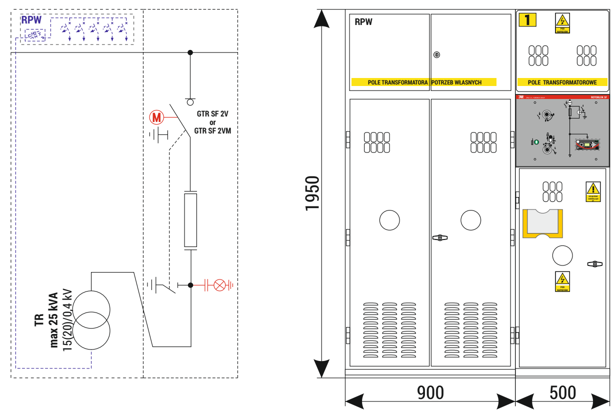
Optional equipment is **marked with red**. *) It is possible to design the unit in a mirror variant

Electrical diagram	Front view	Electrical diagram	Front view

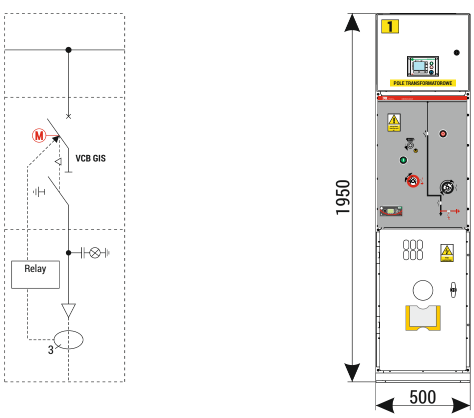
STpwł4
(auxiliary transformer unit)



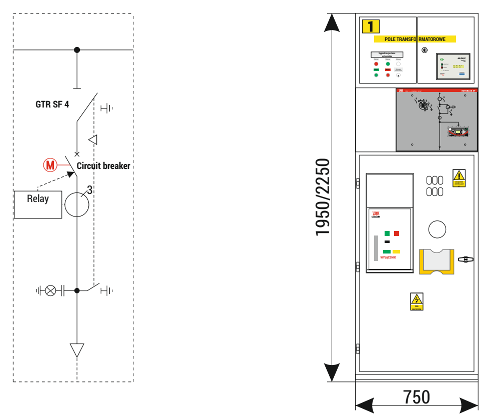
STpwł 25kVA+ST1
(bay with an auxiliary transformer with a max. power of 25 kVA)



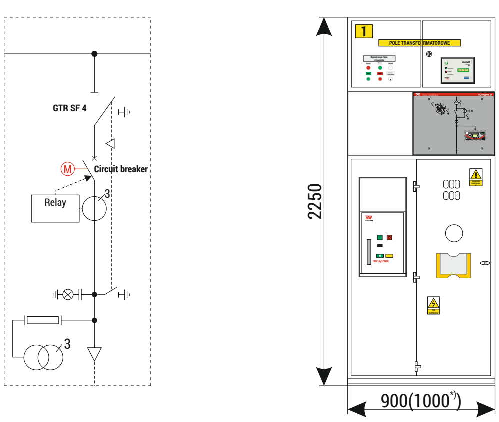
SWG1
(circuit breaker feeder)



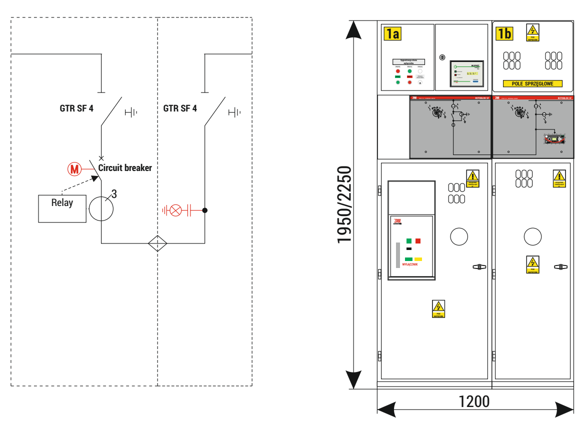
SWT(5*))
(circuit breaker transformer feeder)



SWTp(5*))
(circuit breaker transformer feeder with voltage measurement)



SWS1
(bus coupler unit with with disconnectors and circuit breaker)



NOTE!

Optional equipment is **marked with red.** *) When post type current transformers are used instead of bushing type

NOTES

Medium Voltage switchgear

INTRODUCTION

The subject of this document is a Rotoblok VCB type state-of-the-art, indoor medium voltage switchgear intended for distribution of three-phase alternating current with a frequency of 50 Hz, at a rated voltage up to 25 kV, in industrial and commercial power sector distribution grids. The modular design of the Rotoblok VCB switchgear bays enables and allows any configuration and combination with the Rotoblok and Rotoblok SF switchgear bay product range.

CHARACTERISTICS

The Rotoblok VCB type switchgear is a two compartment, indoors switchgear in metal enclosure made of zinc-coated metal sheet, with a single primary busbars system. The switchgear is an air insulated switchgear (AIS) with compact dimensions, ensured by the use of an innovative three function medium voltage isolator switch which replaces three devices used previously: circuit breaker, disconnector and earthing switch. For the quenching of electric arc vacuum chambers built into resin insulators are used, which in turn are installed on a common rotating shaft, which can be used as a disconnector. A system of mechanical interlocks prevents incorrect switching operations, and opening of the distribution bay doors before voltage is disconnected and the earthing switch is closed. Custom design and used materials guarantee high durability and reliability, but mainly very high safety.

ADVANTAGES

The distribution bays have the following properties:

- the use of a state-of-the-art TGI type device (manufactured by ZPUE S.A.) which combines three functions: circuit breaker, disconnector and earthing switch,
- miniaturisation of bay dimensions, and therefore switchgear dimensions while maintaining high electrical and utility parameters (the main width of Rotoblok VCB bay is only 500 mm),
- the interlock system is limited to a single device,
- the device may be controlled locally or remotely (e.g. by radio),
- high safety of operation is ensured by forcing of correct witching operations,
- two visible, full insulation air gaps ensure the highest level of safety,
- the device in off and open position provides by itself a mechanical and isolating partition between the primary busbar compartment and the cable connections part
- improvement of reliability by elimination of multiple mechanical and electrical interlocks
- simplification and improvement of reliability of construction through elimination of many busbar connections
- long operating period without the need for troublesome maintenance operations
- the main apparatus shaft (circuit breaker + switch disconnector) can be replaced quickly and simply during service operations,
- high corrosion resistance, the switchgear design uses metal sheet which has been zinc-coated for corrosion protection,
- adapted for the installation of state of the art protection and control devices by various manufacturers,
- the possibility of wall-mounting of the switchgear, saving space in the switching room is particularly important during retrofits and expansions of existing switching stations,
- easy and quick access to switchgear devices for supervision and maintenance,
- simple operation.

BASIC TECHNICAL DATA

Compliance with standards:
The Rotoblok VCB type switchgear meets the requirements of the following standards:
- **(PN-EN) IEC 62271-1** - “High-voltage switchgear and controlgear. Common specifications”,
- **(PN-EN) IEC 62271-100** - “High-voltage switchgear and controlgear. Alternating-current circuit-breakers”,
- **(PN-EN) IEC 62271-200** - “High-voltage switchgear and controlgear. AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV”,

The switchgear is certified by the Electrotechnical Institute.

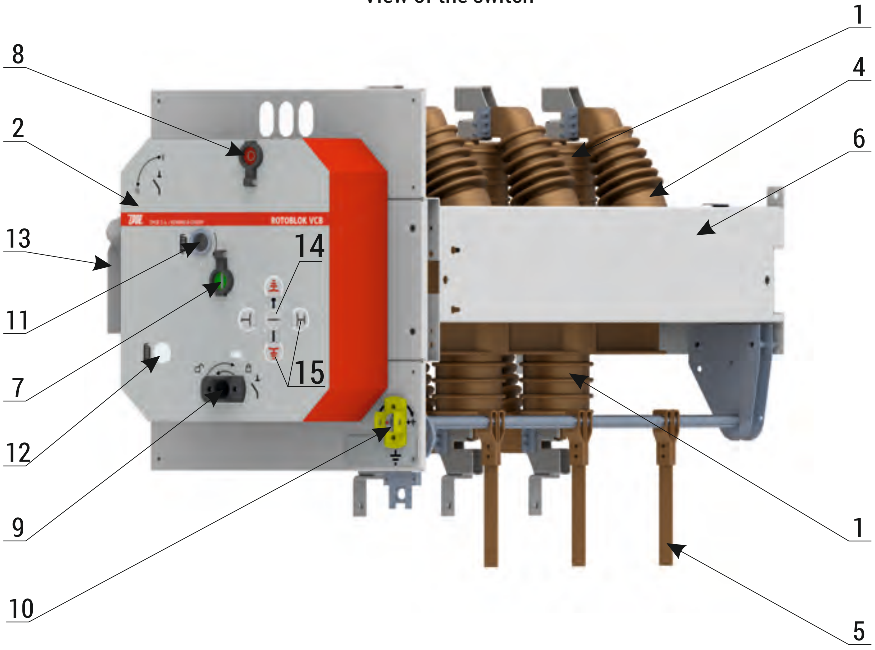
Dane elektryczne:	
Rated network voltage	20 kV
Highest device voltage	25 kV
Rated frequency / number of phases	50 Hz / 3
Rated short-time network frequency withstand voltage	50 kV / 60 kV
Rated withstand lightning surge voltage 1.2/50 µs	125 kV / 145 kV
Continuous rated current	630 A
Rated short-time withstand current	do 16 kA (3s) / do 20 kA (1s)
Rated peak withstand current	up to 50 kA
Resistance to internal arc effects	AFLR do 16 kA (1s)
IP 43 protection rating	up to IP4X

Service conditions:	
Ambient temperature	
- peak short-time	+ 40°C
- highest day average	+ 35°C
- highest annual average	+ 20°C
- lowest long-term	- 25°C[1)]
Relative humidity of air	
- highest day average	95 %
- highest month average	90 %
- highest day average vapour pressure	2,2 kPa
- highest month average vapour pressure	1,8 kPa
Atmosphere at the place of installation	no significant contamination with salt, vapour, dust, smoke, flammable or corrosive gasses and lack of icing, frosting and dewing
Installation altitude	up to 1000 m asl[2)]
Vibrations	vibrations caused by external factors or earthquakes negligible

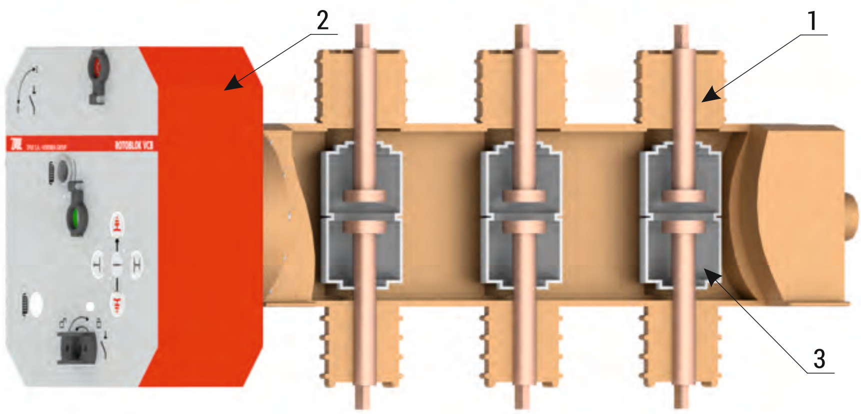
NOTE!

[1)] Unless the manufacturer of instrumentation & control and protection devices has specified otherwise.
[2)] If the switchgear installation altitude is higher than 1000 m ASL the switchgear insulation level should corrected by an indicator in accordance with the guidelines of item 2.2.1 of the PN-EN 62271-1 standard.

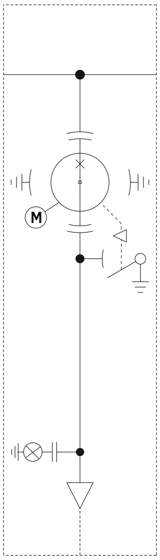
View of the switch



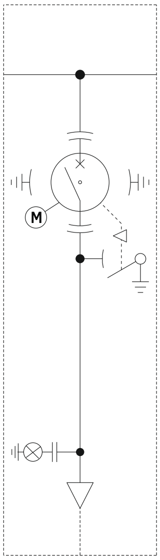
View of the main insulation shaft with a vacuum circuit breaker



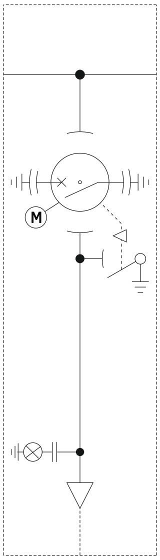
1 - insulating main shaft with circuit breaker
2 - switch drive
3 - vacuum chamber of the circuit breaker
4 - resin insulators
5 - lower earthing switch
6 - zinc-coated steel frame
7 - circuit breaker ON button
8 - circuit breaker OFF button
9 - disconnector socket
10 - earthing switch socket and indication
11 - circuit breaker spring charging socket
12 - spring charging indication
13 - plug connections for secondary circuits
14 - circuit breaker position indicator
15 - disconnector position indicator



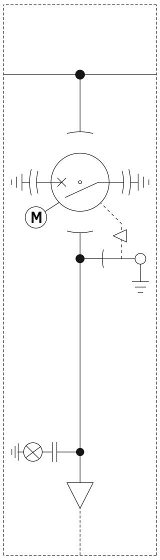
“On”
position
- closed



“Off”
position
- closed



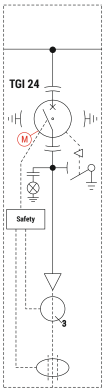
“Off”
position
- open

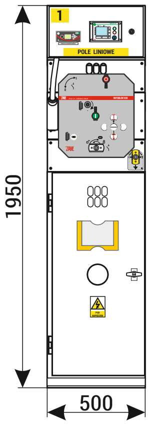


Earthed
position

Electrical diagram | Front view | Electrical diagram | Front view

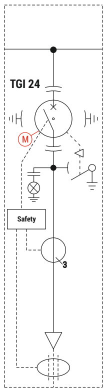
VCB 1

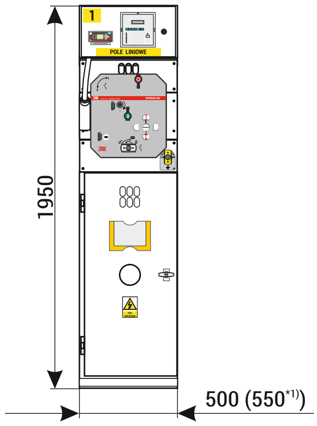




masa = 225 kg

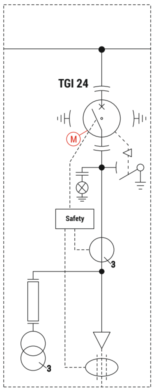
VCB 2(3[1)])

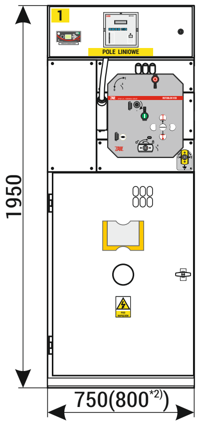




masa = 235 kg
/ 305 kg

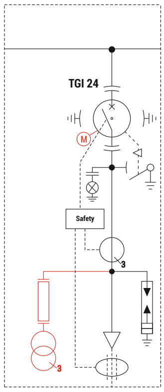
VCB 5(6[*2)])

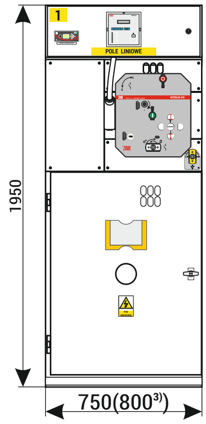




mass = 410 kg
/ 435 kg

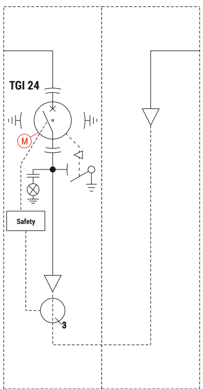
VCB 05

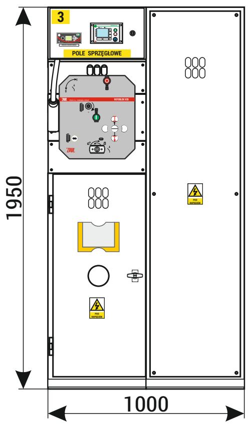




mass = 320 kg
/ 445 kg

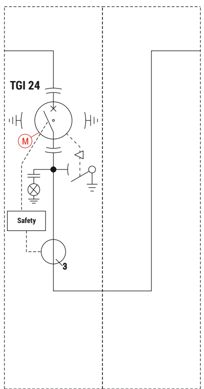
VCB S1L(P[4)])

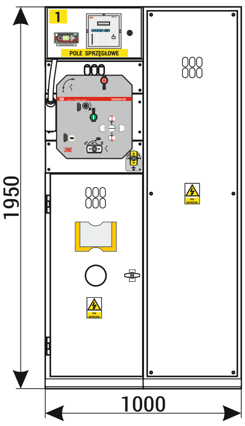




mass = 315 kg

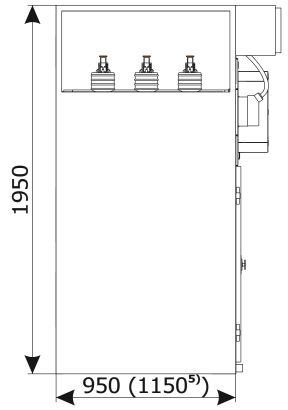
VCB S3L(P[4)])





mass = 400 kg

Side view



NOTE!

The presented figures are only an example of bay equipment. It is possible to adapt the bay configuration to specific requirements of the end user.

In this case manufacturer should be asked to provide drawings.

Optional equipment is **marked with red.**

[1] Przy zastosowaniu przekładników prądowych wsporczych na 24 kV w miejsce przepustowych.

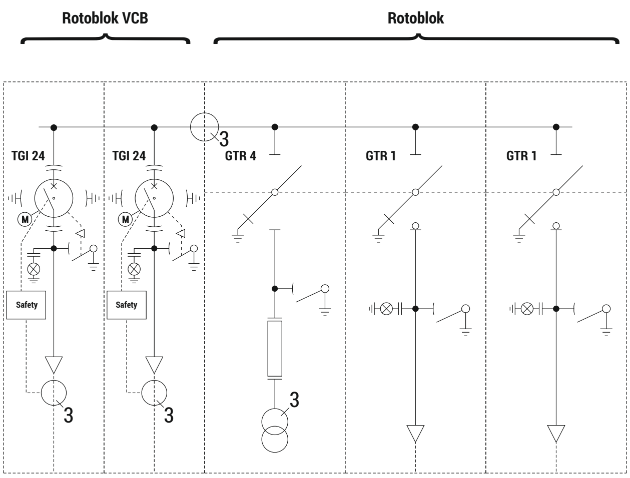
[2] Przy zastosowaniu podstaw bezpiecznikowych nad przekładnikami napięciowymi.

[3] Przy zastosowaniu przekładników napięciowych.

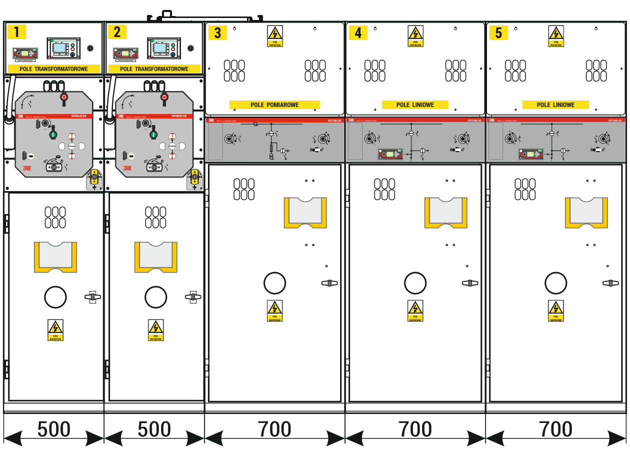
[4] Aparat TGI 24 wraz z przekładnikami prądowymi może znajdować się po prawej stronie pola.

[5] W przypadku łączenia pól rozdzielnicy Rotoblok VCB z polami rozdzielnicy Rotoblok 17,5kV i Rotoblok SF wysokość pola rozdzielnicy wynosi 1950 mm, natomiast głębokość 950 mm. W przypadku łączenia pól rozdzielnicy Rotoblok VCB z polami rozdzielnicy Rotoblok 24 wysokość pola rozdzielnicy wynosi 1950 mm, natomiast głębokość 1150 mm.

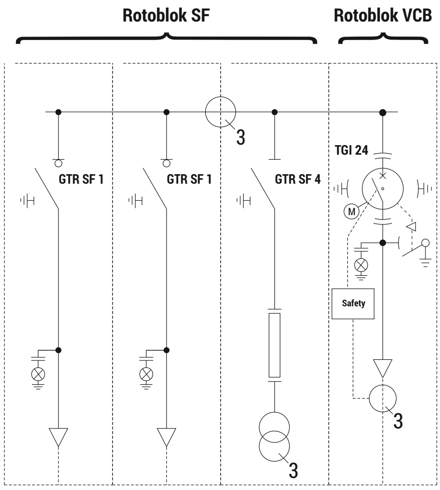
Electric diagram



Front view



Electric diagram



Front view