

Manufactured by:



Medium Voltage Switchgear and Switches

MV Switchgear up to 24 kV, 1250 A
SF₆-Insulated, Modular Design



- Maintenance-free concept with SF₆-pressurised containers as a hermetically sealed pressure system
- Minimum space requirement
- High level of functional reliability
- Great operator safety
- Up to four-fold cable connection systems in circuit-breaker sections
- Metal-encapsulated plug-in voltage transformer can be retrofitted optionally on the busbar side or on the outgoing side on circuit-breaker sections
- Conventional current transformers can be easily exchanged together outside of the SF₆-pressurised container

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General Information/Description

Benefits of SF₆-insulated, metal-encapsulated, modular switchgear assemblies

- Largely climate resistant
- Maintenance-free concept with SF₆-pressurised containers as a hermetically sealed pressure system
- Minimum space requirement
- Comprehensive personnel protection
- High level of functional reliability
- Great reliability of supply
- Great operator safety
- Great versatility due to availability of circuit-breaker, isolator and load-break switch sections
- Straightforward side-by-side fitting of sections by means of inner cone plug-in systems for the busbar connection
- Up to four-fold cable connection systems in circuit-breaker sections
- Metal-encapsulated plug-in voltage transformer can be retrofitted
 - Optionally on the busbar side or on the outgoing side on circuit-breaker sections
 - Optionally on the busbar side at riser panels
 - Optionally with isolating/earthing switch
- Conventional current transformers can be easily exchanged together outside of the SF₆-pressurised container

Features

The switchgear assemblies are type-tested, factory-built, metal-encapsulated SF₆-insulated switchgear installations made up of sections.

Applications

Suitable for use in substations and switching stations, and also as load centers:

- In electricity supply company networks, substations, main distribution substations, combined heating & power stations, cavern systems, etc.
- In industrial networks with medium-voltage network infrastructure
 - Primary-level main distribution board/incomers/feeders,
 - Power stations (own production, combinational power station),
 - Node distribution boards,
- In buildings with medium-voltage network infrastructure, e.g. in railway stations, department stores, hospitals, barracks, law courts, administrative buildings, etc.
 - Primary-level main distribution board/incomers/feeders,
 - Power stations (own production/stand-by power supply),
- In environmental projects with medium-voltage network infrastructure, e.g. in wind energy, biogas, sludge digestion, resource-recycling/-recovery plant, etc.
 - Primary-level main distribution boards,
 - Combined heating & power stations.



Front view



Front view with open front cover

Voltage transformer

Plug-in, metal-encapsulated, single-pole voltage transformers to IEC 60044-2 and VDE 0414 Part 2 are optionally flanged directly above the gas tank to the bus-sectionalizer panels with vacuum circuit-breaker -1LSV(G)-/6/, the riser sections -1HT-/6/ and the cable riser sections -1AT-/6/.

They are optionally switched as busbar voltage transformers or outdoor voltage transformers.

An upstream isolating or earthing switch in SF₆ is optionally available (with outgoing voltage transformers it is standard). This isolating or earthing switch is operated via a drive feature that is located behind the interlocked front cover of the cable termination area. The drive feature must be equipped with a padlock.

The voltage transformers can be optionally supplied with certifiable or calibrated measuring core.



Current transformer

In outgoing panels and bus sectionalizer panels with circuit breakers and those with load-break switches, low-voltage ring and spectacle-core current transformers to IEC 600441-1 and VDE 0414 Part 1 are laid around the extended external cone bushings.

The protective and optional measuring cores are together built into a transformer block.

The voltage transformers can be optionally supplied with certifiable or calibrated measuring core.

The current transformers can be fitted or exchanged easily without intervention in the gas tank.

In addition, it is possible to use split-core current transformers laid around the earthed cable screens of the single-core cables in the cable connection compartment or the cable duct.



Technical Data

Switchgear panels (rated values)

		Rated voltage U_r			
		7.2 kV	12 kV	17.5 kV	24 kV ¹⁾
Rated insulation level					
Rated power-frequency withstand voltage, AC U_d	kV	20	28	38	50
Rated lightning impulse withstand voltage U_p	kV	60	75	95	125
Rated frequency f_r	Hz	50/60	50/60	50/60	50/60
Rated normal current I_r	For busbars A	1 250	1 250	1 250	1 250
Rated short-time current I_k	at $t_k = 3s$ Up to kA	20	20	16	16
Rated peak withstand current I_p	Up to kA	50	50	40	40
Rated short-circuit making current I_{ma}	Up to kA	50	50	40	40
Ambient temperature T	°C	-5 to +40 ^{2), 3)}			
	With reduced current ratings	°C Above +40			
Relative humidity	%	Maximally 95			
Rated filling pressure of insulating gas at 20°C and 101.3 kPa	kPa	130 (30 kPa overpressure)/LSF panel 150 (50 kPa overpressure)			
Insulating gas		SF ₆			
Rated density of insulating gas	kg/m ³	7.9			
Encapsulation of the HV compartment	IP	Hermetically welded tank, IP65			
Encapsulation of fuse compartment	IP	Single-pole arcing-free encapsulation and 3-phase metal encapsulation, IP44			
Encapsulation of the drive housing, relay cabinet	IP	IP44/IP3XD			
Enclosure of the cable connection compartment	IP	IP44			
Internal arc test compliant with VDE 0671, Part 200, Appendix AA and resp. IEC 62271-200	kA	IAC AFL 20 kA, 1 s for HV compartments			
	kA	IAC AFL 20 kA, 1 s for terminal compartments			
Colour of panel paint finish	RAL	7 035 (light grey)			
Loss of service continuity category		LSC 2A			
Partition class		PM			

1) Higher rated voltage (25kV) on request

2) Operation at lower temperatures on request

3) Depending to secondary technic

Standards

The switchgear installation complies with the following standards and regulations:

IEC 60265-1 (62271-103*)	/ VDE 0670 Part 301 (VDE 0671 Part 103*)
IEC 60282-1	/ VDE 0670 Part 4
IEC 62271-1 (IEC 60694**)	/ VDE 0670 Part 1000 (VDE 0671 Teil 1*)
IEC 62271-100	/ VDE 0671 Part 100
IEC 62271-102	/ VDE 0671 Part 102

IEC 62271-105	/ VDE 0671 Part 105
IEC 62271-200 (60298**)	/ VDE 0671 Part 200 (VDE 0670 Part 6**)

* = future

** = up to now

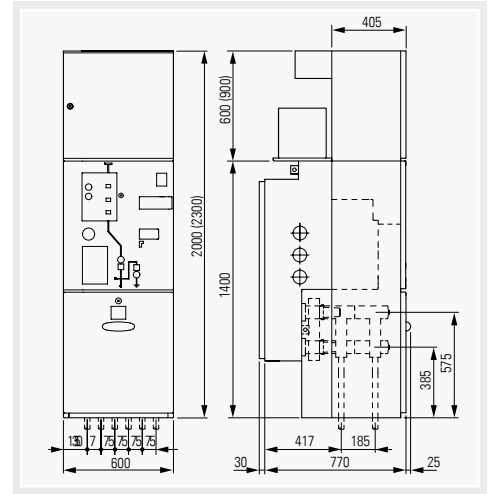
Range

Outgoing feeder panel with vacuum circuit-breaker

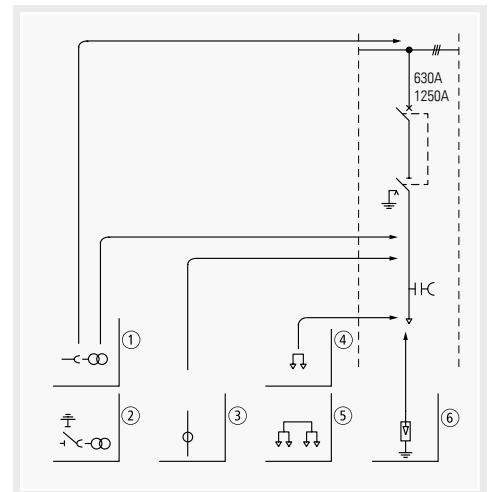
Type -1LSV-/6/

Standard equipment

- Vacuum circuit-breaker with stored energy operated – ON and OFF –:
 - Auxiliary contacts: 10 NO and 10 NC,
 - Tripping device – ON, OFF – DC or AC,
 - Signalling contact for “Starting sections charged”,
 - Mechanical counter,
- SF₆ three-position isolating and earthing switch:
 - Interlocked with circuit-breaker,
 - Manual operation,
 - Earthing switch with spring operated – ON and OFF –,
- 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On both sides of the SF₆-gas tank: inner cone plug-in systems for external busbar connection,
- Capacitive voltage indication ledges in relay cabinet front cover,
- Gas leakage indication
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant cable termination compartments,
- Single set of cable connection bushings for maximally double cable connection via external cone plug XLPE 2 x 1 x 500 mm²:
 - One connection plug replaceable for surge arrester,
- Relay- and control compartment height 600 mm.



- ① Plug-in voltage transformers
- ② Plug-in voltage transformers with isolating- and earthing feature
- ③ Current transformer
- ④ Maximally double cable connection
- ⑤ Maximally fourfold cable connection with double set of bushings
- ⑥ Surge arrester

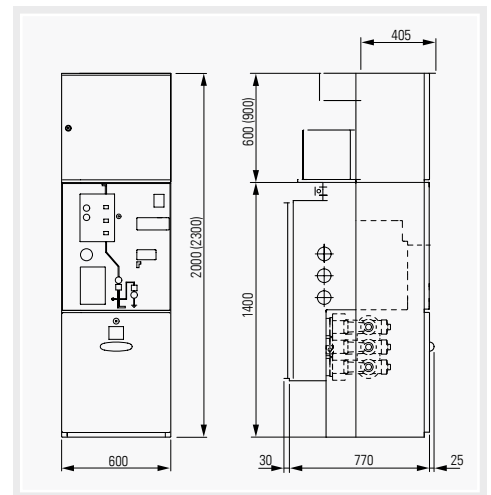


Outgoing panel with vacuum circuit-breaker

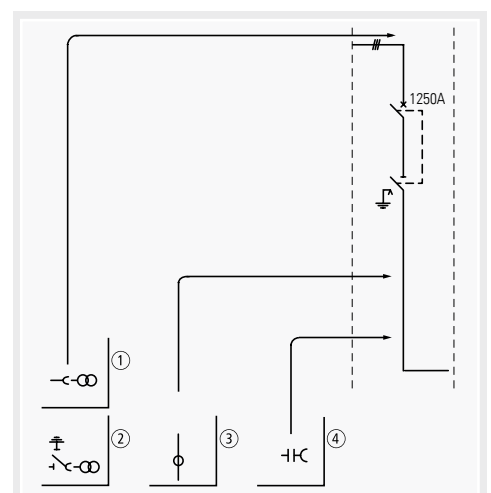
Type -1LSVG-/6/

Standard equipment

- Vacuum circuit-breaker with stored energy operated – ON and OFF –:
 - Auxiliary contacts: 10 NO and 10 NC,
 - Tripping device – ON, OFF – DC or AC,
 - Signalling contact for “Starting sections charged”,
 - Mechanical counter,
- SF₆ three-position isolating and earthing switch:
 - Interlocked with circuit-breaker,
 - Manual operation,
 - Earthing switch with spring operated – ON and OFF –,
- 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On one side of the SF₆-gas tank: inner cone plug-in systems for external busbar connection,
- Silicone insulated, controlled, external busbar to the riser panel-1HT-/6/,
- Capacitive voltage indication ledges in relay cabinet front cover,
- Gas leakage indication,
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant cable termination compartments,
- Relay- and control compartment height 600 mm.



- ① Plug-in voltage transformers
- ② Plug-in voltage transformers with isolating- and earthing feature
- ③ Current transformer
- ④ Capacitive voltage indication ledge

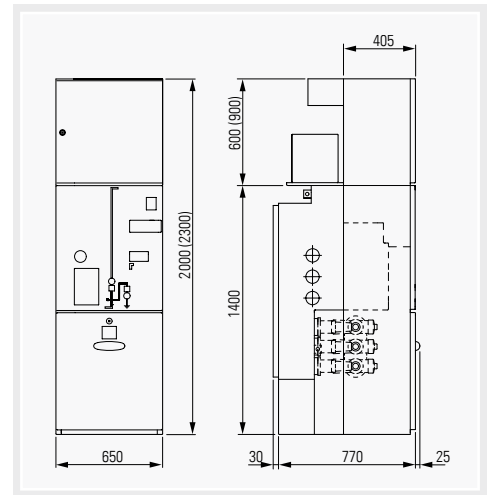


Busbar riser panel with isolating switch

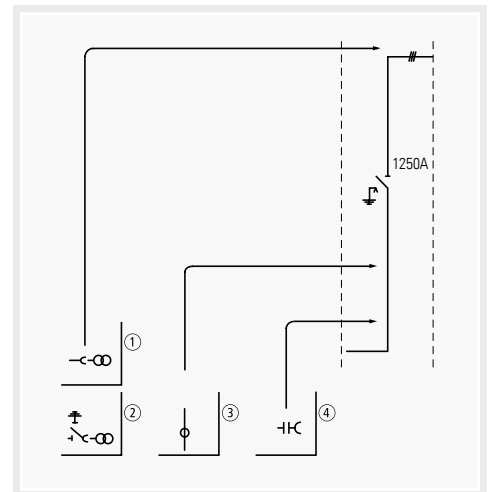
Type -1HT-/6/

Standard equipment

- SF₆ three-position isolating and earthing switch:
 - Interlocked
 - Handle
 - Earthing switch with spring operated – ON and OFF –
- 3-pole SF₆-insulated busbar in the SF₆ compartment
- On one side of the SF₆-gas tank: inner cone plug-in systems for external busbar connection
- Silicone insulated, controlled, external busbar to the bussectionalizer panel -1LSVG-/6/
- Gas leakage indication
- Pressure relief in the event of arcing directed into the cable well, panel floor open
- Lockable operators
- Arc-fault resistant terminal compartments
- Relay- and control compartment height 600 mm
- Intermediate frame B = 50 mm to the bus-sectionalizer panel.



- ① Plug-in voltage transformers
- ② Plug-in voltage transformers with isolating- and earthing feature
- ③ Current transformer
- ④ Capacitive voltage indication ledge

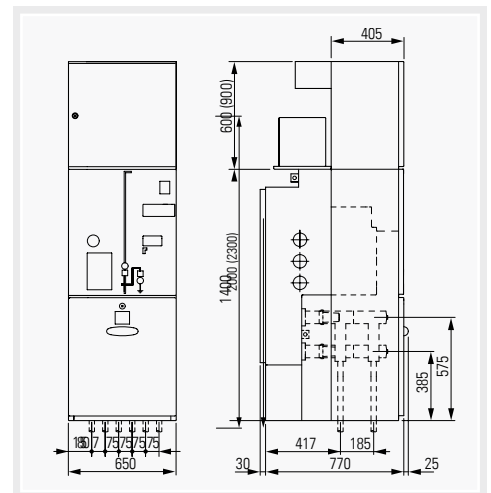


Cable riser panel with isolating switch

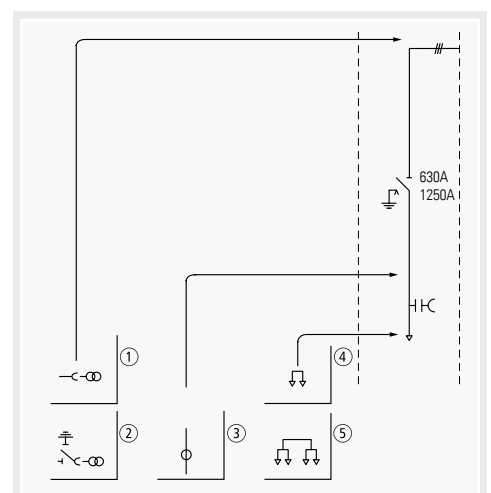
Type -1AT-/6/

Standard equipment

- SF₆ three-position isolating and earthing switch:
 - Interlocked
 - Handle
 - Earthing switch with spring operated – ON and OFF –
- 3-pole SF₆-insulated busbar in the SF₆ compartment
- On both sides of the SF₆-gas tank: inner cone plug-in systems for external busbar connection
- Gas leakage indication
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators
- Arc-fault resistant terminal compartments
- Single set of cable connection bushings for maximally double cable connection via external cone plug XLPE 2 x 1 x 500 mm², (One connection plug replaceable for surge arrester)
- Relay- and control compartment height 600 mm
- Intermediate frame B = 50 mm to the bus-sectionalizer panel.



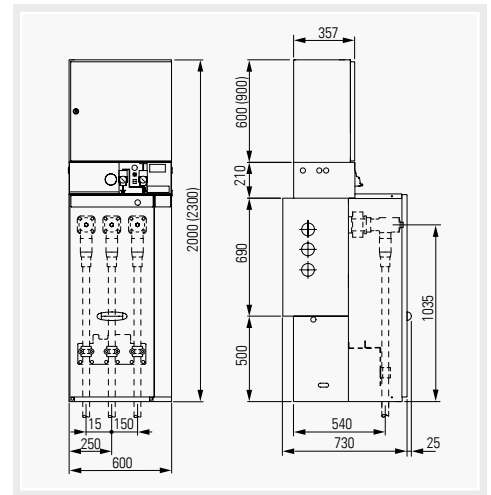
- ① Plug-in voltage transformers
- ② Plug-in voltage transformers with isolating- and earthing feature
- ③ Maximally double cable connection
- ④ Maximally fourfold cable connection with double set of bushings



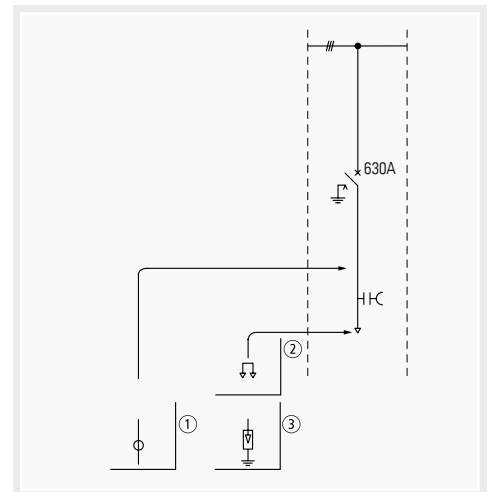
Outgoing feeder panel with SF₆ circuit-breaker based on arc quenching coil Type -1LSF-/6/

Standard equipment

- SF₆ three-position circuit-breaker and earthing switch:
 - Including interlock,
 - Handle,
 - Circuit-breaker with spring operated – ON, and stored energy operated – OFF,
 - Earthing switch with spring operated – ON and OFF –,
- Manual Emergency-Stop push-button,
- 3-pole SF₆ insulated busbar in the SF₆ compartment,
- On both sides of the SF₆ gas tank: inner cone plug-in systems for external busbar connections,
- Capacitive voltage indication ledges,
- Gas leakage indication,
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant cable termination compartments,
- Single set of cable connection bushings for maximally double cable connection via external cone plug XLPE 2 x 1 x 500 mm², (One connection plug replaceable for surge arrester),
- Relay- and control compartment, height 600 mm.



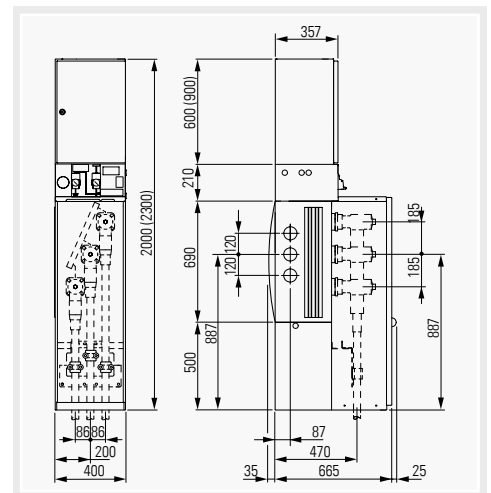
- ① Current transformer
- ② Maximally double cable connection
- ③ Surge arrester



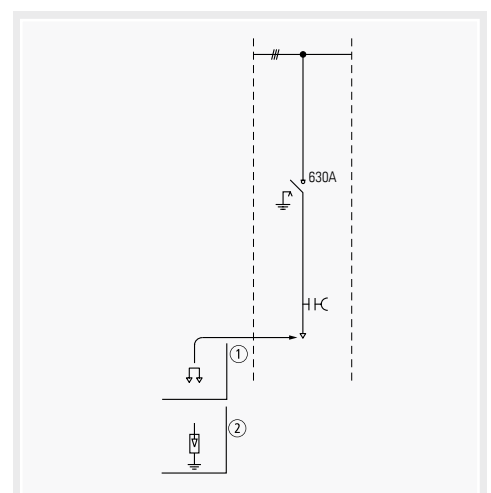
Cable panel with load-break switch and vertically arranged bushings Type -1K-/4/

Standard equipment

- SF₆ three-position load-break and earthing switch:
 - Including interlock,
 - Manual operation,
 - Load-break and earthing switches with spring-operated – ON and OFF –,
- 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On both sides of the SF₆-gas tank: inner cone plug-in systems for external busbar connection,
- Capacitive voltage indication ledges,
- Gas leakage indication
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant cable termination compartments,
- Single set of cable connection bushings for maximally double cable connection via external cone plug XLPE 2 x 1 x 500 mm², (One connection plug replaceable for surge arrester),
- Relay- and control compartment height 600 mm.



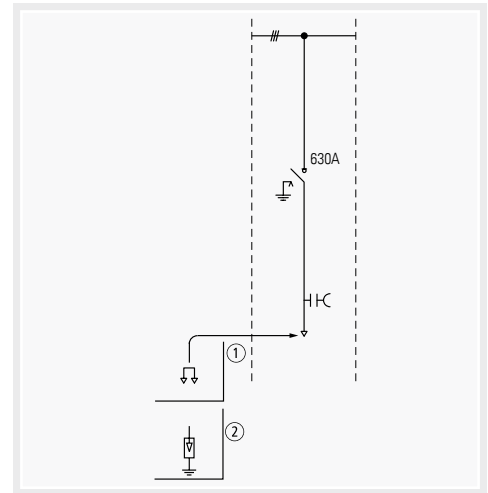
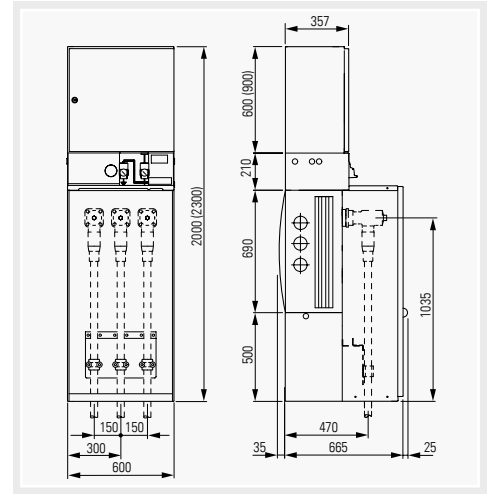
- ① Maximally double cable connection
- ② Surge arrester



Cable panel with load-break switch and horizontally arranged bushings Type -1K-/6/

Standard equipment

- SF₆ three-position load-break and earthing switch:
 - Including interlock,
 - Handle,
 - Load-break and earthing switches with spring-operated – ON and OFF –,
 - 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On both sides of the SF₆ gas tank: inner cone plug-in systems for external busbar connection,
- Capacitive voltage indication ledges,
- Gas leakage indication
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant cable termination compartments,
- Single set of cable connection bushings for maximally double cable connection via external cone plug XLPE 2 x 1 x 500 mm², (One connection plug replaceable for surge arrester),
- Relay- and control compartment height 600 mm.

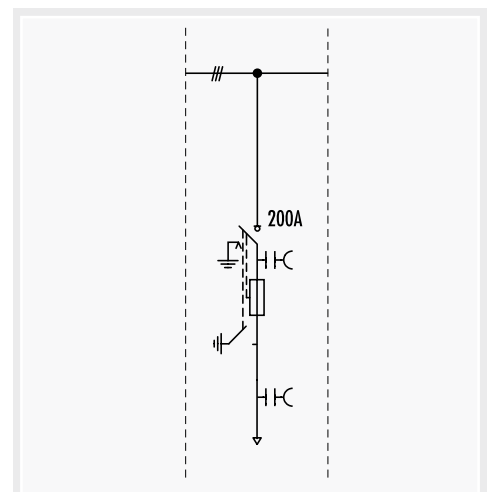
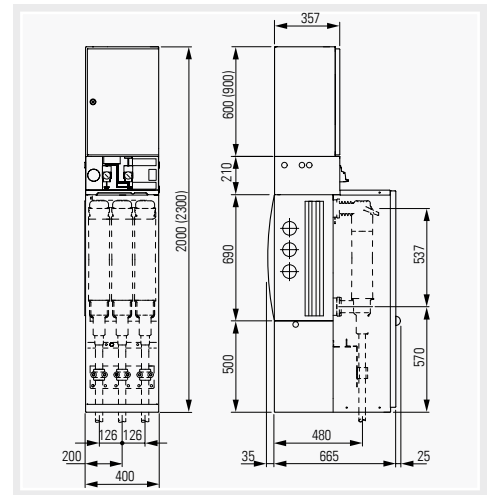


- ① Maximally double cable connection
- ② Surge arrester

Transformer feeder panel with fused load-break switch Type -1TS-/4/

Standard equipment

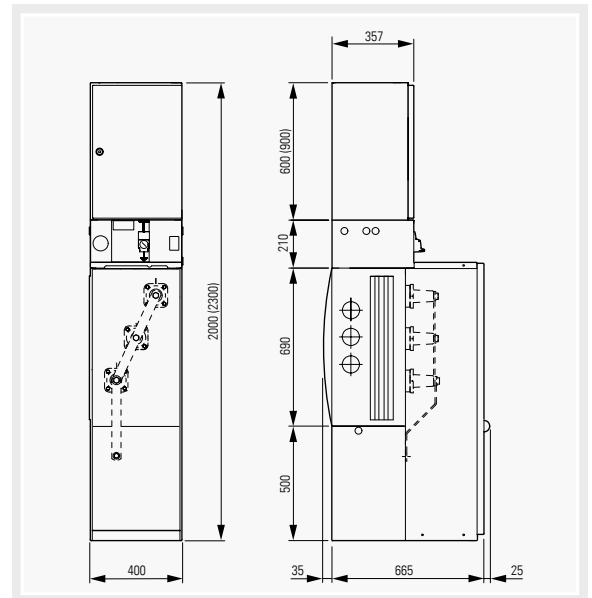
- SF₆ three-position load-break and earthing switch:
 - Including interlock,
 - Manual operation,
 - Load-break switch with spring operated – ON, and stored energy operated – OFF,
 - Earthing switch with spring operated – ON and OFF –,
- Indication of tripped fuse,
- 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On both sides of the SF₆-gas tank: inner cone plug-in systems for external busbar connection,
- 3-phase plug-on fuse arrangement,
- Earthing switch in SF₆ downstream of the HRC fuse,
- 3-pole slip-on type cable termination for transformer cables, maximally XLPE 1 x 240 mm²,
- Capacitive voltage indication ledges upstream and downstream of the fuse,
- Gas leakage indication,
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant terminal compartment,
- Relay- and control compartment, height 600 mm.



Busbar earthing panel with earthing switch Type -1E-/4/

Standard equipment

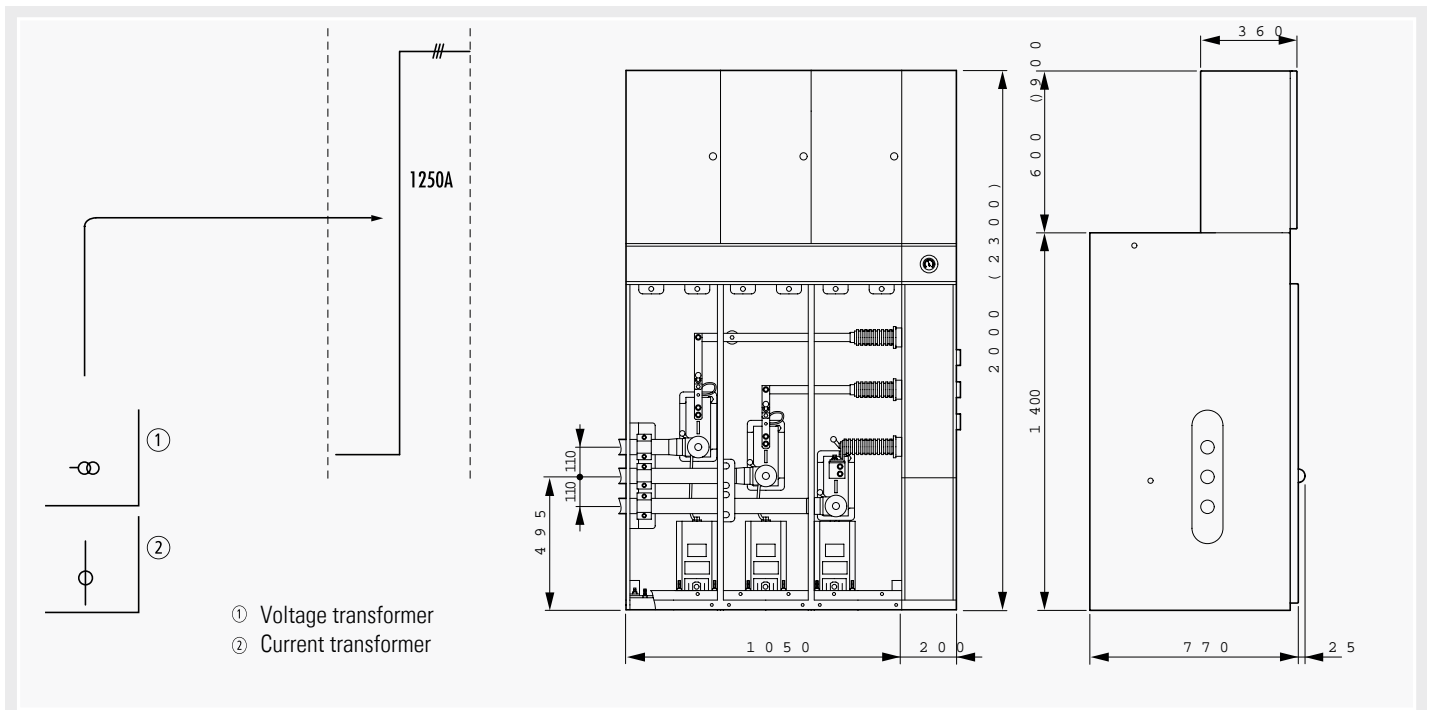
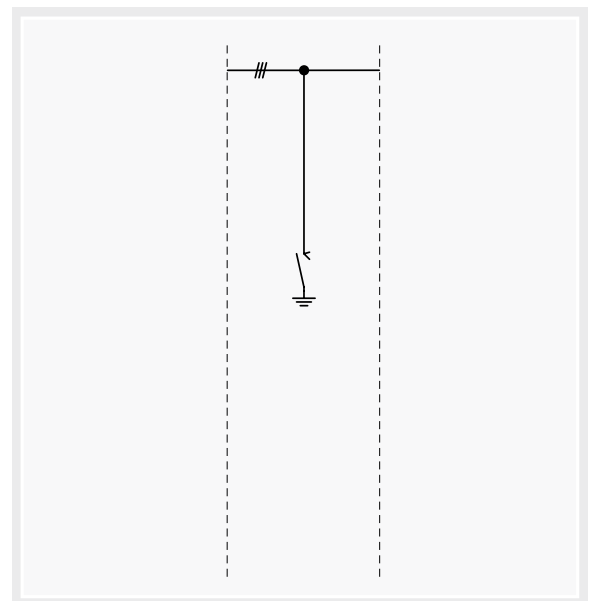
- SF₆-insulated 3-pole earthing switch for busbar earthing:
 - Earthing function as three-position switch,
 - Manual operation,
 - Spring operated – ON and OFF –,
- 3-pole SF₆-insulated busbar in the SF₆ compartment,
- On both sides of the SF₆-gas tank: inner cone plug-in systems for external busbar connection,
- Earthed short-circuit bridge via vertical, frontal external cone bushing arrangement,
- Gas leakage indication,
- Pressure relief in the event of arcing directed into the cable well, panel floor open,
- Lockable operators,
- Arc-fault resistant terminal compartments,
- Relay - and control compartment, height 600 mm.



Metering panel with busbar riser Type -1M1-/12,5/

Standard equipment

- 3-pole busbar for bus-sectionaler circuit-breaker panel -1LSVG-,
- On one side of the metering panel: inner cone plug-in systems for external busbar connections,
- Compact insulators - current- and/or voltage transformers, DIN 42660 part 8 resp. 9, IEC 600441,
- Arc-fault resistant terminal compartments,
- Relay - and control compartment, height 600 mm.



Front panel

Front panel with:

- Mimic diagram
- Switch position indication
- Operator surface for the actuators
- Capacitive voltage indicators
- Gas leakage indication
- Short-circuit indicators
- Padlocking facility
- Drive sealed against dust, sand and insects
- Housing IP44



Type -1K-



Type -1TS-



Type -1LSV-

Gas leakage indication

Each gas tank has a pressure display for verification of the SF overpressure within, allowing its functional safety to be inspected.



Meaning of the indication:
Green = operating pressure OK
Red = operating pressure not OK.

Pressure switch/ Density monitor

Each gas tank can be fitted with a pressure switch and/or density monitor for remote monitoring (auxiliary contact). The lower switching point corresponds to the crossover point to the red measuring range on the gas leakage indication. The density monitor can be optionally equipped with alarm and tripping indicator auxiliary contacts.

Phase sequence indication



Voltage display and Testing

Each system is equipped with the necessary three-phase capacitive voltage detection system, Type KSO, for voltage testing to VDE 0682 Part 415 and IEC 61243-5 with HR system (other systems on request). This enables the absence of voltage in individual phases to be verified by inserting the voltage indication plugs into the corresponding pairs of sockets. The voltage detection system circuitry is designed for **rated operational voltages of 10, 15 and 20 kV**. The minimum and maximum values of the Standard for these voltage ranges are adhered to in the standard system. It is not necessary therefore to adjust them again when changing the rated operational voltage within this range. Rated operational voltage 6 kV can be implemented in a special version. The live contact sockets are touch-protected.

Voltage detection system in sealed version



Voltage indication plug

(Picture shows Horstmann device)

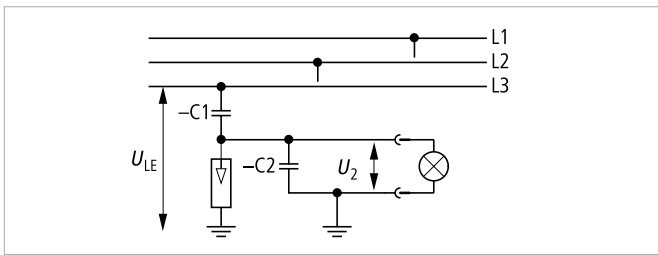


The following devices may be used:

Pfisterer	Type DSA-2
Horstmann	Type HMO-ST-1

Indication devices are also suitable for continuous duty.

Single-line diagram of a voltage indicator



Voltage indication via capacitive voltage divider, HR system.

Voltage indication plugged in.

C1 Capacitor integrated in the bushings.

C2 Capacitance of the connecting cables and the voltage indication device to earth.

$U_{LE} = U_N/\sqrt{3}$ During rated operation in a three-phase system.

$U_2 = U_A =$ Voltage at the capacitive interface of the system or at the voltage indication device.

Phase Sequence Indication by Interface Tester

(Picture shows Horstmann device, Type ORION 3.0)



The following devices may be used:

Make	Phase sequence indication	Interface tester
Horstmann	-	H-OM measuring module with Fluke ammeter Type 87 or matrix Type Mx55 (II to IV)
Horstmann	Type: Orion	Type: Orion
Pfisterer	Type: EPV	Type: Euro test-HO

Short-circuit/Earth-fault indicator.



All ring cable panels can be equipped either with a 3-phase shortcircuit or earth-fault indicator.

Manufacturer	Type
Horstmann	ALPHA M

	ALPHA E
	ALPHA automatic
	DELTA M
	DELTA E
	EKA-3
	EKA 3/1
	GAMMA 4.0
	Opto
	Sigma

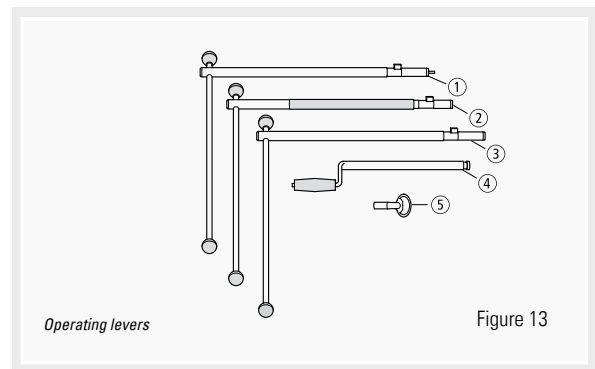
Other types and products on demand.

T connection fittings

T connection fittings are to be used as the operator thinks fit. Connectable to bushings to DIN EN 50181 connection type C (630A) with external cone and bolt contact (M16).

With non-controlled systems, the manufacturer's mounting instructions are to be adhered to implicitly.

Accessories for the system



Operating levers, keys for fasteners

- ① Operating lever (optional) for the load-break switch actuating shaft with motor operator (for manual switching e.g. in case of loss of supply voltage).
- ② Operating lever for the earthing switch (optional red shaft).
- ③ Operating lever for the load-break switch (optional plain shaft).
- ④ Charging handle for vacuum circuit-breakers
- ⑤ Key for the fastener on the front cover (controls the anti-reverse interlock).

Cable clamps

Size I

Clamping range 26 to 55 mm for cables, such as

- 12 kV: $35 \text{ mm}^2 \leq 240 \text{ mm}^2$
- 24 kV: $25 \text{ mm}^2 \leq 185 \text{ mm}^2$

Size II

Clamping range 36 to 52 mm for cables, such as

- 12kV: $\geq 300 \text{ mm}^2$
- 24kV: $\geq 240 \text{ mm}^2$

The precise cable diameter must be compared with the clamping range.

Coupling and bolt connection kits

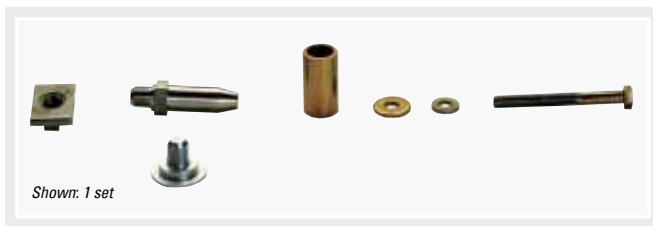
Busbar coupling kit with double gasket



Busbar end cover with single gasket

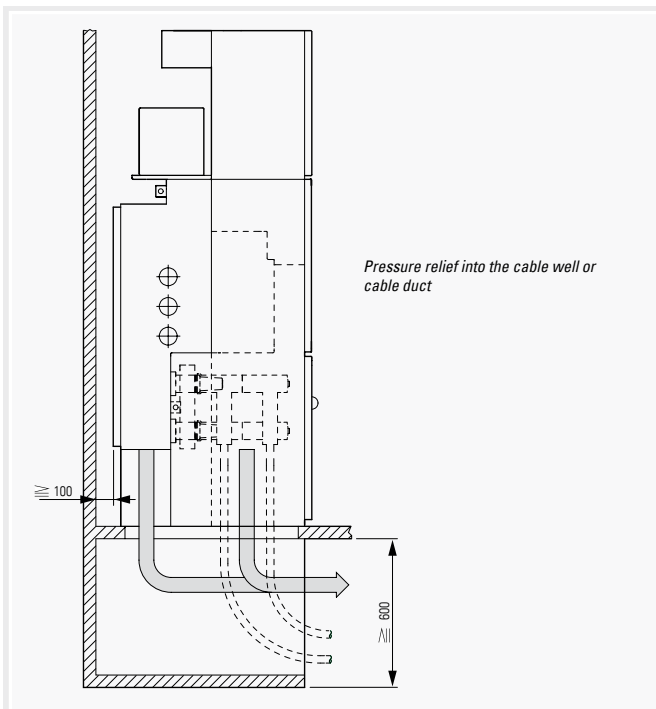


Parts for bolt connection of panels

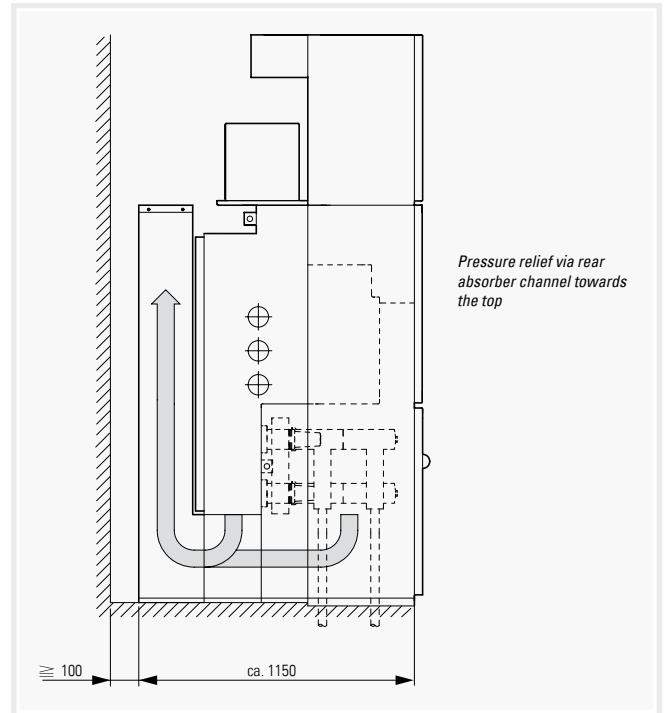


Arc fault protection, panel installation

For standard panel version with pressure relief into the cable well or cable duct.



For panel version for pressure relief via rear towards the top (panel for floor bulkhead).



Switchgear related pressure calculations can be enquired as part of services.

Protection technology

All commercially available protection relays can be installed in the switchgear for the LSV circuit breaker panels and LSF circuit breaker panels.

The variants range from transformer-operated protection relays to combined protection and control systems.

Low energy trips 0.5 VA and 0.1 VA are available for the transformer-operated relays.

In this context special relay-transformer combinations are tested.

Common protocols and interfaces, e.g. Profibus DP, Modbus, IEC 60870-5-103, IEC 60870-5-101 and IEC 61850 can be provided with related relays.

Installation is in low-voltage compartment / relay niche.

Optionally, the protection relay can also be installed in the related cover.

It is also possible to configure the parameters for the protection relay in accordance with customer requirements.

A few commercially available protection relays as examples:

“Quality and Efficiency that you can count on.”



<http://www.ppi.ph/dlfiles/orgae.pdf>

Power your business with complete services from PPI Pazifik Power, Inc. For the last 18 years we've offered quality power transmission products to the top utility and electric cooperatives.

We have a wide choice of top brand of meters, switchgears, energy transformers, UPS systems and more. Our experts will share their engineering know-how to help your business truly take off.



Disconnecting Switches
15kV up to 800kV
(Hapam, Netherlands)



Hermetically sealed and SF6
insulated compact switchgear
up to 36kV
(Ormazabal, Spain)



High efficiency and precision
Electricity Meters
(Landis+Gyr, Switzerland)



A solution package for system
integration, substation automation
and energy management system.
(PPI Pazifik Power, Inc., Philippines)



Silicon Arrester in Cage Design
and Distribution Type Arrester
(Tridelta, Germany)



Fully Automatic Measurement of
the dielectric strength of liquid
insulators up to 100 kV.
(BAUR, Austria)



Modular UPS solutions in multiple
capacity options
(Gamatronics, Israel)



Dry-type Cast Resin Glass Fibre
reinforced vacuum technology
(GVT) Power Transformers
(WTW, Germany)



Batteries that are robust energy
storage solutions, with a proven
technology that has been used for
decades.
(Sunlight, Greece)



State of the art Meter Testing and
Calibration Equipment and
Instrument Test Set
(MTE, Switzerland)



Automatic Relay Test System
(Kocos, Germany)



Turnkey Substation up to 100MVA
(PPI Pazifik Power Inc., Philippines)

Discover how we can help you with quality and efficient solutions that will improve your business.
Contact us at (02) 867 5620 or email us at info@ppi.ph.

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