TECHNICAL CATALOGUE TK 503/17 EN

ZX0.2

Gas-insulated medium voltage switchgear

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1. Introduction

Switchgear systems and their components rank among the most important facilities for electrical power transmission and distribution. Their versatile functions and the opportunities they provide contribute on the one hand to safety in general, and on the other hand they secure the availability of electrical energy.

Our ZX product family consists of the following product types.

Product types	U_r	I_r	I_k
ZX0:	...24 kV	...1250 A	...25 kA
ZX0.2:	...36 kV	...2500 A	...31.5 kA
ZX1.2:	...40.5 kV	...2500 A	...31.5 kA
ZX2:	...40.5 kV	...3150 A	...40 kA

The product family covers the entire spectrum of primary distribution applications.

Flexible combination, reliability, availability and economy are the attributes that make it easy for our clients in industry and utilities to decide in favor of products from the ZX series. Together with complete conventional solutions, the use of digital protection and control technology, sensor systems and plug-in connections makes ZX systems unrestrictedly fit for the future, and the primary function of reliable power distribution is fulfilled with no ifs and buts. This is ensured by ABB's uncompromising approach to quality, which leaves no customer's wishes unfulfilled. Aligned to each need, the product types of the ZX family offer a solution for each requirement. In over 70 countries the customers rely on gas-insulated switchgears from ABB.

The ZX series leave our works as tested panels and, as SF_6 switchgear, are exemplary in terms of safety, economy and availability. Their compact design permits installation in even the most constricted spaces. The hermetically sealed enclosures make the systems shockproof and protect the high voltage components from all environmental influences.

ABB AG's Calor Emag Medium Voltage Products division develops, manufactures and installs switchgear systems and components for electrical power distribution in the medium voltage range. Based in Ratingen, Germany, we have the know-how, global project experience and local partners for the supply of panels and turnkey medium voltage switchgear systems.

2. Applications

Utilities
- Coal, gas and oil power plants
- Onshore and offshore wind farms
- Solar farms
- Transmission substations
- Distribution substations

Industry
- Steel works
- Paper manufacturing
- Cement industry
- Chemicals industry
- Automobile industry
- Petrochemicals
- Pipeline systems
- Electronics and semiconductor manufacturing
- Mining

Transport
- Airports
- Harbors
- Railways
- Underground railways

Building and infrastructure
- Data centers
- Supermarkets
- Shopping centers
- Hospitals

3. Characteristics

Basic characteristics
- SF_6 (Sulfur hexafluoride) as insulating gas
- Hermetically sealed pressure systems
- Solid insulated busbar
- Rated voltages up to 36 kV
- Up to 2500 A and 31.5 kA
- Single busbar design
- Stainless steel encapsulation, manufactured from laser cut sheet material
- Modular structure
- Switchgear with a leakage rate of less than 0.1% per annum
- Integral leakage testing of the panels
- Indoor installation
- Wall mounting installation and free-standing installation
- Operator controls separate from low voltage compartment
- Operator controls on the panel accessible from the outside
- Also suitable for site altitudes over 1000 m above sea level

Panel variants
- Incoming and outgoing feeder panels with circuit breaker and three position disconnector
- Outgoing feeder panels with three position switch disconnector and fuses
- Cable termination panels
- Busbar sectionalizer panels
- Busbar riser panels
- Transfer panels

Switching devices
- Vacuum circuit-breakers with series three position disconnector
- Three position switch disconnector with fuses

Terminals
- Outer cone termination system to EN 50181, type A for panels with switch disconnector, type C for all other panels with cable terminations
- Connection facility for surge arresters on the cable connector and on the busbar

Current and voltage metering
- Current and voltage transformers outside the gas compartments
- Alternative: Current and voltage sensors outside the gas compartments

Protection and control
- Mechanical operation on site
- Combined protection and control devices
- Discrete protection devices with conventional control

Protection against maloperation
- Mechanical switch interlocking with manual mechanisms between the circuit-breaker and the three position disconnector
- Additional electrical switch interlocks for motor-operated mechanisms
- Various interlocks for manual circuit-breaker operation

Pressure relief
- Pressure relief into the switchgear room
- Pressure relief via ducts to the outside

Installation
- No gas work at site

4. Your benefit

Maximum operator safety

- All live components are enclosed to prevent accidental contact.
- As the high voltage compartments are independent of external influences (degree of protection IP65), the probability of a fault during operation is extremely low.
- As evidenced by arc fault testing, our switchgear systems are notable for maximum operator safety.
- A further increase in operator safety can be achieved by providing pressure relief to the outside the switchgear room.

Minimum overall costs

- The compact design of the panels reduces the space required and therefore the size of the station. The result is a lower investment requirement.
- Freedom from maintenance is achieved by constant conditions in the high voltage compartments in conjunction with the selection of suitable materials. The injurious influences of dust, vermin, moisture, oxidation and contaminated air in the high voltage compartments are precluded, as the gastight compartments are filled with SF_6. As a rule, therefore, isolation of the switchgear to perform maintenance work is not required.
- The panels are designed for an expected service life of over 40 years.
- The systematic selection during the development process of the materials used provides for complete recycling or reuse of those materials at the end of the service life.
- The panels only leave our production facilities after documented routine testing. Thanks to the plug-in technology applied in the areas of the busbars, cables and secondary systems, extremely short installation times are possible.
- No gas work is required as a rule at site. There is thus no need to evacuate and fill the high voltage compartments, test them for leakage and measure the dew point of the insulating gas at site.

Maximum availability

- The plug-in busbar technology without screw couplings permits simple and therefore safe assembly.
- In spite of the extremely low failure probability of the ZX switchgear systems, replacement of components in the gas compartments and therefore a rapid return to service after repairs is possible.
- In gas-insulated switchgear, earthing of switchgear sections is performed by a high quality vacuum circuit-breaker. The circuit-breaker can close onto a short-circuit significantly more frequently and reliably than a positively making earthing switch.

5. Technical data

5.1. Technical data of the panel

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Table 5.1.1.: Technical data of the panel

Panels with a width of 450 mm	Rated voltage	U_r	kV	12	17.5	24	
	Maximum operating voltage		kV	12	17.5	24	
	Rated power frequency withstand voltage	U_d	kV	28	38	50	
	Rated lightning impulse withstand voltage	U_p	kV	75	95	125	
	Rated normal current	I_r	A				...630
	Rated short-time withstand current	I_k	kA				...25
	Rated peak withstand current	I_p	kA				...63
Panels with switch disconnector and fuses (width 600 mm)	Rated voltage	U_r	kV	12	17.5	24	
	Maximum operating voltage		kV	12	17.5	24	
	Rated power frequency withstand voltage	U_d	kV	28	38	50	
	Rated lightning impulse withstand voltage	U_p	kV	75	95	125	
	Rated normal current	I_r	A	...100	...80	...63	
Panels with or without Circuit-breaker and a width of 600 mm	Rated voltage	U_r	kV	12	17.5	24	36
	Maximum operating voltage		kV	12	17.5	24	36
	Rated power frequency withstand voltage	U_d	kV	28	38	50	70
	Rated lightning impulse withstand voltage	U_p	kV	75	95	125	170
	Rated normal current	I_r	A				...1250
	Rated short-time withstand current	I_k	kA				...31.5
	Rated peak withstand current	I_p	kA				...80
Panels with a width of 900 mm and 1200 mm	Rated voltage	U_r	kV	12	17.5	24	36
	Maximum operating voltage		kV	12	17.5	24	36
	Rated power frequency withstand voltage	U_d	kV	28	38	50	70
	Rated lightning impulse withstand voltage	U_p	kV	75	95	125	170
	Rated normal current	I_r	A				...2500
	Rated short-time withstand current	I_k	kA				...31.5
	Rated peak withstand current	I_p	kA				...80
	Rated duration of short-circuit	t_k	s				...3
	Rated frequency	f_r	Hz				50 ([1])

1. 60 Hz on request

Insulating gas system[1,2]				
			Rated voltage U_r up to 24 kV	Rated voltage U_r up to 36 kV
Alarm level for insulation	p_{ae}	kPa[3]	120[4]	140
Rated filling level for insulation	p_{re}	kPa	130[5]	150
Minimal functional level for operation [6]	p_{mm}	kPa	140	
Rated filling level for switch [6]	p_{sw}	kPa	150	

Degree of protection for gas filled panel modules		IP65
Degree of protection of low voltage compartment and the mechanism bay [7]		IP3X
Ambient air temperature, maximum [8]	°C	+40
Ambient air temperature, maximum 24 hour averages [8]	°C	+35
Ambient air temperature, minimum	°C	-5
Site altitude [9]	m	...1000

1. Insulating gas: SF_6 (sulfur hexafluoride)
2. All pressures stated are absolute pressures at 20 °C
3. 100 kPa = 1 bar
4. Switch disconnector panels: 140 kPa
5. Switch disconnector panels: 150 kPa
6. Only relevant for three position switch disconnector panels
7. Higher degrees of protection on request
8. Higher ambient air temperature on request
9. Higher site altitude on request

Classifications according to IEC 62271 - 200

Internal arc classification

The panels are arc fault tested in accordance with IEC 62271-200.

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Table 5.1.2: Internal arc classification of the switchgear in accordance with IEC 62271-200

Wall mounting installations	Systems containing panels of 450 mm width	Classification IAC Internal arc	AFL 25 kA 1 s
	Systems containing panels of 600, 900 and/or 1200 mm width	Classification IAC Internal arc	AFL 31.5 kA 1 s
Free-standing installations	Systems containing panels of 450 mm width	Classification IAC Internal arc	AFLR 25 kA 1 s
	Systems containing panels of 600, 900 and/or 1200 mm width	Classification IAC Internal arc	AFLR 31.5 kA 1 s

Key to table 5.1.2.:

IAC — Internal arc classification

AFLR
- R: Accessibility from the rear (R - rear)
- L: Accessibility from the sides (L - lateral)
- F: Accessibility from the front (F - front)
- A: Switchgear installed in closed rooms with access restricted to authorized personnel only

The internal arc classification requires a minimum number of panels or a minimum system length. You will find information on this in the chapter pressure relief systems.

Loss of service continuity to IEC 62271-200

The various LSC categories of the standard define the possibility to keep other compartments and/or panels energized when opening a main circuit compartment.

Gas-filled compartments cannot be opened, as they would then lose their functionality. This means that there is no criterion for loss of service continuity of inaccessible compartments.

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Table 5.1.3.:
Loss of service continuity of the switchgear

Systems without a switch-disconnector panel with fuses	LSC2
Systems with at least one switch-disconnector panel with fuses	LSC2A

Key to table 5.1.3.:
LSC2: On access to the cable terminations of a panel, the busbar and all other panels can remain energized.
LSC2A: On access to all accessible compartments of a panel (in this case cable termination and fuse box), the busbar and all other panels can remain energized.

Note from VDE 0671-200:2012-08 / IEC 62271-200 Edition 2.0: The LSC category does not describe ranks of reliability of switchgear and control gear.

Partition class to IEC 62271-200

The partition class to IEC 62271-200 defines the nature of the partition between live parts and an opened, accessible compartment.

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Table 5.1.4.:
Partition class in accordance with IEC 62271-200

Partition class	PM

Key to table 5.1.4:
PM: partition of metal

Panels of partition class PM provide continuous metallic and earthed partitions between opened accessible compartments and live parts of the main circuit.

5.2. Technical data of the circuit-breaker

Table 5.2.1: Technical data of the circuit-breaker

Rated voltage	U_r	kV	12	17.5	24	36
Maximum operating voltage		kV	12	17.5	24	36
Rated power frequency withstand voltage	U_d	kV	28	38	50	70
Rated lightning impulse withstand voltage	U_p	kV	75	95	125	170
Rated frequency (1)	f_r	Hz				50
Rated normal current (2)	I_r	A				...630, ...1250, ...2500
Rated short-circuit breaking current	I_{SC}	kA				...25, ...31.5
Rated short-circuit making current	I_{ma}	kA				...63, ...80
Rated short-time withstand current	I_k	kA				...25, ...31.5
Rated duration of short-circuit	t_k	s				...3
Operating sequence						O - 0.3 s - CO - 3 min - CO (3)
Closing time	t_{cl}	ms				ca. 60
Rated opening time	t_3	ms				≤ 45
Rated break time	t_b	ms				≤ 60
Rated auxiliary voltage		V DC				60, 110, 220 (4)
Power consumption of charging motor		W				max. 260
Power consumption of closing coil		W				max. 250
Power consumption of opening coil		W				max. 250
Power consumption of blocking magnet		W				10
Power consumption of undervoltage release		W				5

Permissible numbers of operating cycles of the vacuum interrupters	
30000 × I_r	(I_r = Rated normal current)
50 × I_{SC}	(I_{SC} = Rated short-circuit breaking current)

Classification according IEC 62271-100

Rated voltage / kV		Classification
up to 36	All circuit-breakers	M2, E2, C2
up to 24	Application: Switching of back-to-back capacitor banks, Special circuit-breaker	C2
up to 36	Application: Switching of a single capacitor bank	C1

1. Rated current for 60 Hz on request
2. Higher operating currents on request
3. Different operating sequences on request
4. Different auxiliary voltages on request

5.3. Technical data of the three position disconnector

Table 5.3.1: Technical data of the three position disconnector

Rated voltage	U_r	kV	12	17.5	24	36
Maximum operating voltage		kV	12	17.5	24	36
Rated power frequency withstand voltage across the isolating distance		kV	32	45	62	80
Rated lightning impulse withstand voltage across the isolating distance		kV	85	110	145	195
Rated normal current	I_r	A				...630, ...1250, ...2500
Rated short-time withstand current	I_k	kA				...25, ...31.5
Rated peak withstand current	I_p	kA				...63, ...80
Rated duration of short-circuit	t_k	s				...3
Rated auxiliary voltage ([1])	U_a	V DC				60, 110, 220 ([2])
Power consumption of operating mechanism motor		W				210 (maximum), 35 (average)
Motor running time on opening or closing the disconnector ([3])		s				6-8
Motor running time on opening or closing the earthing switch ([3])		s				6-8

Classification according IEC 62271-102
E0, M1 (2000 mechanical operations) ([1])

5.4. Technical data of the three position switch disconnector with HV HRC fuses

Table 5.4.1: Technical data of the three position switch disconnector with HV HRC fuses

				IEC ratings	
Rated voltage	U_r	kV	12	17.5	24
Maximum rated voltage		kV	12	17.5	24
Rated power frequency withstand voltage across the isolating distance		kV	32	45	60
Rated lightning impulse withstand voltage across the isolating distance		kV	85	110	145
Rated normal current	I_r	A	...100	...80	...63
Rated short-time withstand current of the cable side earthing switch	I_k	kA		2 kA / 1s	
Rated peak withstand current of the cable side earthing switch	I_p	kA		5 kA	
Rated duration of short-circuit	t_k	s		...3	
Rated auxiliary voltage for the release coil	U_a	V DC		60, 110, 220 ([2])	

Classification according IEC 62271-102
E2 (5 x earthing switch ON)

Classification according IEC 62271-103
M1 (2000 mechanical operations)

1. When a motor-operated drive is used
2. Different auxiliary voltages on request
3. At rated auxiliary voltage

5.5. HV HRC fuses

Fuses from ABB, type CEF-TCU and type CEF-S-TCU and from Siba (44534 Lünen, Germany) of 442 mm in length and a maximum diameter of 67 mm are used. Shorter fuses have to be fitted with a length adapter. The fuses have thermal protection. Tables 5.5.1 to 5.5.4 below show the assignment of transformer ratings to possible HV HRC fuses. As the fuses are installed in a fuse box inside the panel, the operating current is limited to 60% of the rated current of the fuse.

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Table 5.5.1: Selection table for HV HRC fuses, (U_r up to 12 kV), ABB type

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Type	Rated current of the HV-fuse	
[kV]	[kVA]	[%]	[A]		min. [A]	max. [A]
6 ... 7.2	50	4	4.8	CEF-TCU	16	16
	75	4	7.2	CEF-TCU	16	16
	100	4	9.6	CEF-TCU	20	20
	125	4	12.0	CEF-TCU	20	20
	160	4	15.4	CEF-TCU	25	31.5
	200	4	19.2	CEF-TCU	31.5	40
	250	4	24.1	CEF-TCU	40	40
	315	4	30.3	CEF-TCU	50	63
	400	4	38.5	CEF-TCU	63	63
10 ... 12	50	4	2.9	CEF-TCU	10	10
	75	4	4.3	CEF-TCU	10	10
	100	4	5.8	CEF-TCU	16	16
	125	4	7.2	CEF-TCU	16	16
	160	4	9.2	CEF-TCU	20	20
	200	4	11.5	CEF-TCU	20	25
	250	4	14.4	CEF-TCU	25	31.5
	315	4	18.2	CEF-TCU	31.5	40
	400	4	23.1	CEF-TCU	40	40
	400	6	23.1	CEF-S-TCU	50	50
	500	4	28.9	CEF-TCU	50	50
	630	4	36.4	CEF-TCU	63	63

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Table 5.5.2: Selection table for HV HRC fuses, (U_r 13.8 up to 24 kV), ABB type

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Type	Rated current of the HV-fuse	
[kV]	[kVA]	[%]	[A]		min. [A]	max. [A]
13.8	75	4	3.1	CEF-TCU	10	10
	100	4	4.2	CEF-TCU	10	10
	125	4	5.2	CEF-TCU	16	16
	160	4	6.7	CEF-TCU	16	16
	200	4	8.4	CEF-TCU	16	16
	250	4	10.5	CEF-TCU	20	20
	315	4	13.2	CEF-TCU	25	31.5
	400	4	16.7	CEF-TCU	31.5	40
	400	6	16.7	CEF-S-TCU	40	40
	500	4	20.9	CEF-TCU	40	40
15 ... 17.5	75	4	2.9	CEF-TCU	10	10
	100	4	3.8	CEF-TCU	10	10
	125	4	4.8	CEF-TCU	16	16
	160	4	6.2	CEF-TCU	16	16
	200	4	7.7	CEF-TCU	16	16
	250	4	9.6	CEF-TCU	20	20
	315	4	12.1	CEF-TCU	20	25
	400	4	15.4	CEF-TCU	31.5	31.5
	500	4	19.2	CEF-TCU	31.5	40
	500	6	19.2	CEF-TCU	31.5	31.5
	630	4	24.2	CEF-TCU	40	40
	630	6	24.2	CEF-TCU	40	40
24	100	4	2.9	CEF-TCU	10	10
	125	4	3.6	CEF-TCU	10	10
	160	4	4.6	CEF-TCU	10	10
	200	4	5.8	CEF-TCU	16	16
	250	4	7.2	CEF-TCU	16	20
	315	4	9.1	CEF-TCU	20	20
	400	4	11.5	CEF-TCU	20	25
	500	4	14.4	CEF-TCU	25	25
	630	4	18.2	CEF-TCU	40	40
	630	6	18.2	CEF-S-TCU	40	40

Table 5.5.3: Selection table for HV HRC fuses, (U_r up to 13.8 kV), Siba type

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Type	Rated current of the HV-fuse	
[kV]	[kVA]	[%]	[A]		min. [A]	max. [A]
6. …7.2	50	4	4.8	HHD-B	16	16
	75	4	7.2	HHD-B	16	20
	100	4	9.6	HHD-B	20	25
	125	4	12.0	HHD-B	20	31.5
	160	4	15.4	HHD-B	31.5	40
	200	4	19.2	HHD-B	40	50
	250	4	24.1	HHD-B	40	50
	315	4	30.3	HHD-B	50	63
	400	4	38.5	HHD-B	63	63
	400	6	38.5	HHD-B	63	63
	500	4	48.1	HHD-B	80	80
	500	6	48.1	HHD-BSSK	100	100
10 … 12	50	4	2.9	HHD-B	10	10
	75	4	4.3	HHD-B	10	10
	100	4	5.8	HHD-B	16	16
	125	4	7.2	HHD-B	16	16
	160	4	9.2	HHD-B	20	25
	200	4	11.5	HHD-B	20	31.5
	250	4	14.4	HHD-B	25	40
	315	4	18.2	HHD-B	31.5	50
	400	4	23.1	HHD-B	40	50
	400	6	23.1	HHD-B	40	40
	500	4	28.9	HHD-B	50	63
	500	6	28.9	HHD-B	50	50
	630	4	36.4	HHD-B	63	63
	630	6	36.4	HHD-BSSK	80	80
	800	6	46.2	HHD-BSSK	80	80
	1000	6	57.7	HHD-BSSK	100	100
13.8	75	4	3.1	HHD-B	10	10
	100	4	4.2	HHD-B	10	10
	125	4	5.2	HHD-B	16	16
	160	4	6.7	HHD-B	16	16
	200	4	8.4	HHD-B	20	20
	250	4	10.5	HHD-B	20	25
	315	4	13.2	HHD-B	25	31.5
	400	4	16.7	HHD-B	31.5	40
	400	6	16.7	HHD-B	31.5	31.5
	500	4	20.9	HHD-B	40	50
	630	4	26.4	HHD-B	50	63
	800	6	33.5	HHD-BSSK	63	63

Table 5.5.4: Selection table for HV HRC fuses, (U_r 15 up to 24 kV), Siba type

Operating Voltage	Transformer Rating	Relative impedance voltage u_K	Rated transformer current	Type	Rated current of the HV-fuse	
[kV]	[kVA]	[%]	[A]		min. [A]	max. [A]
15 … 17.5	75	4	2.9	HHD-B	10	10
	100	4	3.8	HHD-B	10	10
	125	4	4.8	HHD-B	16	16
	160	4	6.2	HHD-B	16	16
	200	4	7.7	HHD-B	20	20
	250	4	9.6	HHD-B	20	25
	315	4	12.1	HHD-B	20	31.5
	400	4	15.4	HHD-B	31.5	40
	500	4	19.2	HHD-B	40	50
	630	4	24.2	HHD-B	40	63
	630	6	24.2	HHD-B	40	40
	800	6	30.8	HHD-BSSK	63	63
	1000	6	38.5	HHD-BSSK	80	80
20 … 24	100	4	2.9	HHD-B	10	10
	125	4	3.6	HHD-B	10	10
	160	4	4.6	HHD-B	10	16
	200	4	5.8	HHD-B	16	16
	250	4	7.2	HHD-B	16	16
	315	4	9.1	HHD-B	20	25
	400	4	11.5	HHD-B	20	31.5
	400	6	11.5	HHD-B	20	20
	500	4	14.4	HHD-B	25	40
	500	6	14.4	HHD-B	25	25
	630	4	18.2	HHD-B	31.5	50
	630	6	18.2	HHD-B	31.5	31.5
	800	6	23.1	HHD-B	40	40
	1000	6	28.9	HHD-B	50	50
	1250	6	36.1	HHD-BSSK	63	63

6. Fundamental structure of the panels

—
Fig. 6.1:
Feeder panel 1250 A (free standing installation)

—
Fig. 6.2:
Feeder panel 1600 A with voltage transformers on the busbar and on the outgoing feeder (wall mounting installation)

—
Fig. 6.3:
Feeder panel 1250 A with optional pressure relief duct (free standing installation or wall mounting installation)

Modular structure

Each cable feeder panel consists of the gas filled panel module A, the solid insulated busbars B, the cable termination compartment C, the low voltage compartment D and the mechanism bay E. There are no gas connections between the two compartments in adjacent panels.

The switchgear system is suitable for both free-standing installation (fig. 6.1) and wall mounting installation (fig. 6.2 and fig. 6.3).

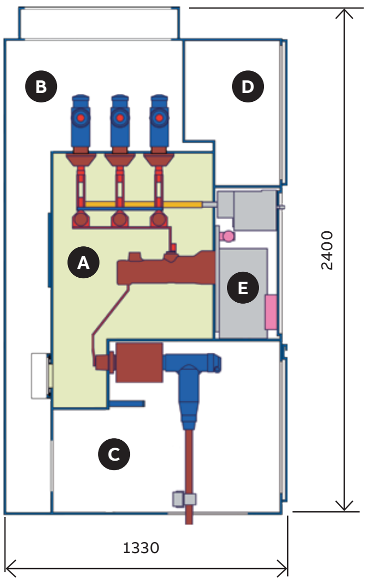

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Fig. 6.1

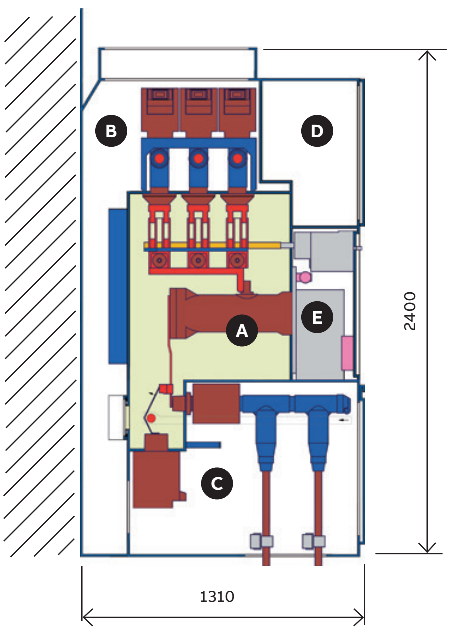

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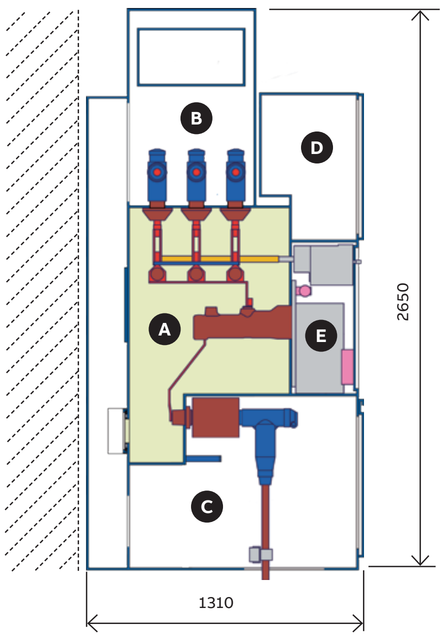
Fig. 6.2



—
Fig. 6.3

Fig. 6.4:
Panel module with circuit-breaker and current transformers, 1250 A, panel width 600 mm

The panel module A

The panel module essentially contains all the live high voltage parts, i.e. the switching devices, bushings for connection of the busbar and outer cones for connection of the high voltage cables. Current and voltage transformers and sensors are located outside of the panel modules.

The pressure relief disk for the panel module is located in the rear wall of the enclosure.

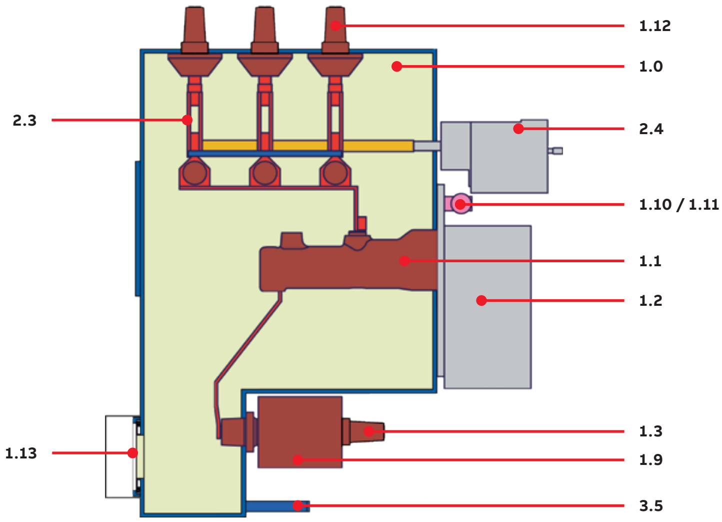
The seals of the components are o-ring seals, which are not exposed to any UV radiation.

The gas systems of panel modules in a switchgear system consisting of several panels are not connected together.

Three position disconnectors, circuit-breakers with three position disconnectors and switch disconnectors with HV HRC fuses can be used.

Panel module with circuit-breaker and three position disconnector (fig. 6.4 to fig. 6.6)

The circuit-breaker operating mechanism, the gas density sensor and the gas filling valve are located on the circuit-breaker mounting plate, which is bolted to the front wall of the panel module. The operating mechanism of the three position disconnector is positioned above the circuit-breaker operating mechanism on the front wall of the panel module. The live high voltage parts of the switches are located inside the panel module, and the operating mechanisms are easily accessible outside the gas compartment.



1.0 Panel module (enclosure)
1.1 Circuit-breaker pole
1.2 Circuit-breaker operating mechanism
1.3 Outer cone
1.9 Current transformer
1.10 Gas density sensor
1.11 Gas filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
2.3 Three position disconnector
2.4 Three position disconnector operating mechanism
3.5 Main earthing bar
Insulating gas SF_6

—
Fig. 6.5:
Panel module with circuit-breaker and current and voltage transformers, 2000 A, panel width 1200 mm

—
Fig. 6.6:
Panel module with circuit-breaker and sensors, panel width 600 mm

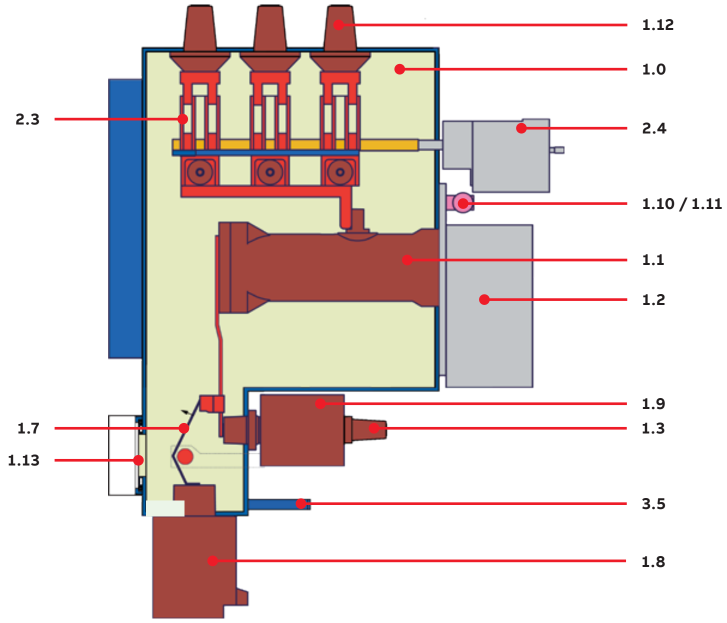


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Fig. 6.5

1.0 Panel module (enclosure)
1.1 Circuit-breaker pole
1.2 Circuit-breaker operating mechanism
1.3 Outer cone
1.7 Isolating system for voltage transformer
1.8 Voltage transformer
1.9 Current transformer
1.10 Gas density sensor
1.11 Gas filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
2.3 Three position disconnector
2.4 Three position disconnector operating mechanism
3.5 Main earthing bar
Insulating gas SF_6

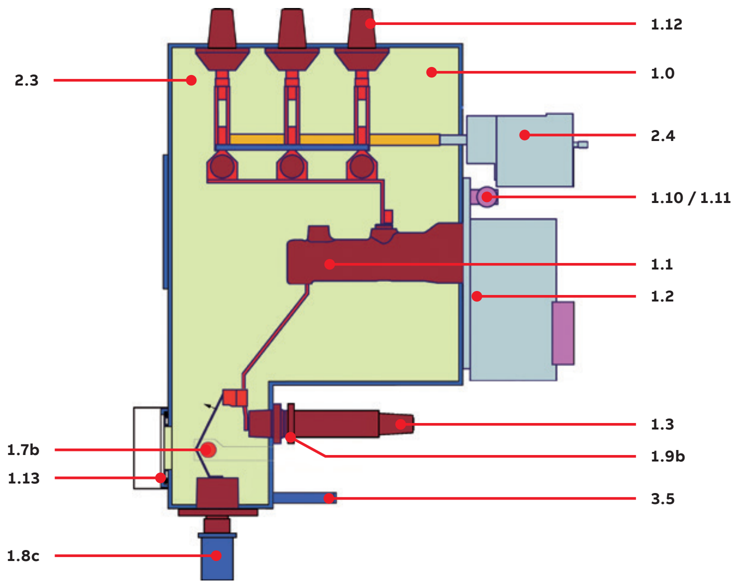

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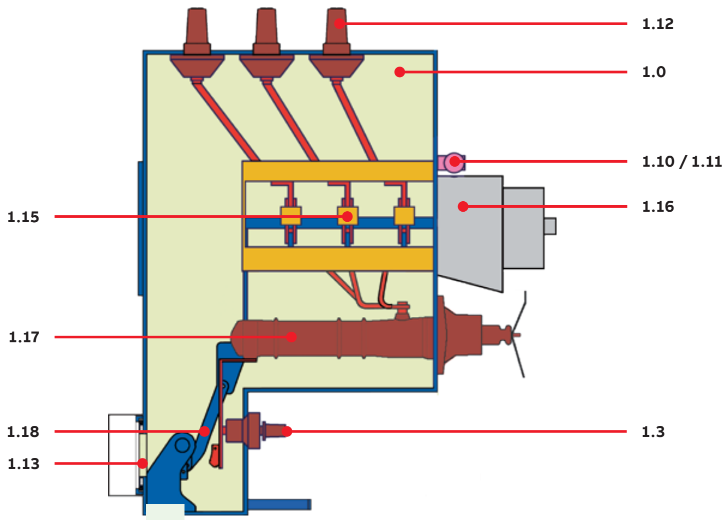
Fig. 6.6

1.0 Panel module (enclosure)
1.1 Circuit-breaker pole
1.2 Circuit-breaker operating mechanism
1.3 Outer cone
1.7b Isolating system for voltage sensor
1.8c Voltage sensor
1.9b Current sensor
1.10 Gas density sensor
1.11 Gas filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
2.3 Three position disconnector
2.4 Three position disconnector operating mechanism
3.5 Main earthing bar
Insulating gas SF_6

—
Fig. 6.7:
Panel module with three position switch disconnector and fuses

Panel module with three position switch disconnector and fuses (fig. 6.7)
The live parts of the switch are inside the panel module and the operating mechanism is located in an easily accessible position outside the gas compartment. The optional fuses can be replaced without any gas work.

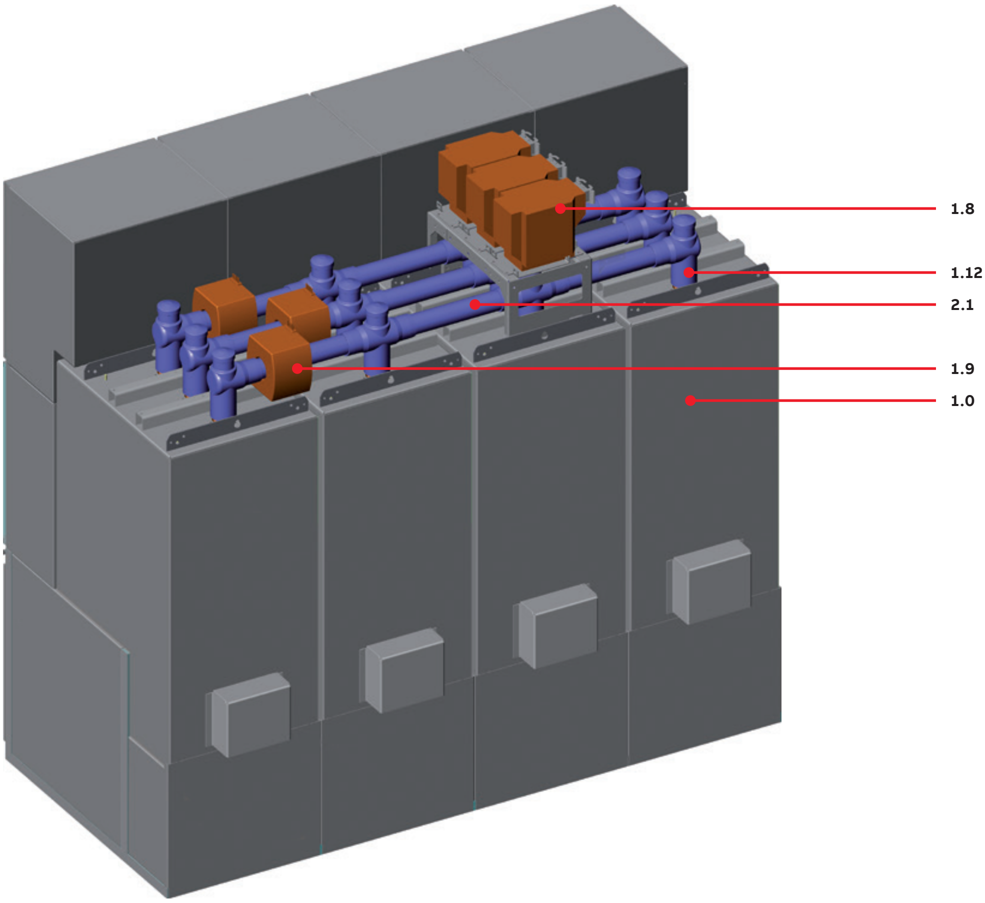


1.0 Panel module (enclosure)
1.3 Outer cone
1.10 Gas density sensor
1.11 Gas filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
1.15 Three position switch disconnector
1.16 Three position switch disconnector operating mechanism
1.17 Fuse box
1.18 Earthing switch
Insulating gas SF_6

—
Fig. 6.8:
Busbar with optional current and voltage transformers on a four-panel ZX0.2 switchgear system (viewed from the rear) as an example, shown without cover plates on the busbar

Busbar B

The solid insulated busbar is located on the roof plates of the panel modules. The insulating silicone parts of the busbar (end adapters, cross adapters and conductor insulation) have a conductive, earthed coating on the outside. The busbar can be fitted with voltage and current transformers and voltage and current sensors.



1.0 Panel module (enclosure)
1.8 Voltage transformer (also voltage sensors feasible)
1.9 Current transformer (also voltage sensors feasible)
1.12 Cast resin bushing to busbar
2.1 Busbar

—
Fig. 6.8:
Cable termination compartment (C), example configuration with one cable per phase

—
Fig. 6.9:
Cable termination compartment (C), example configuration with fixed mounted voltage transformers and two cables per phase

The cable termination compartment C

The cable termination compartment (figs. 6.8 and 6.9) represents a supporting frame for the panel, manufactured from aluminum sections and galvanized steel sheets. The cable termination compartments of adjacent panels are segregated from each other by sheet steel walls.

The cable termination compartment contains the main earthing bar (3.5), the high voltage cables (3.2) with cable connectors (3.1) and cable fasteners (3.3), optional surge arresters, current transformers and optional voltage transformers (1.8) or sensors and the mechanism for the isolating device for voltage transformers (3.8) or voltage sensors.

The cover of the cable termination compartment may optionally be interlocked so that the cable termination compartment is only accessible when the cables are earthed.

In the unlikely event of an internal arc fault in the cable termination compartment, the pressure is discharged to the rear.

Partitioning of the cable termination compartment from the cable basement is effected by split floor plates in the area of the cables. The cable termination compartment is safe to touch when appropriate cable connectors are used.

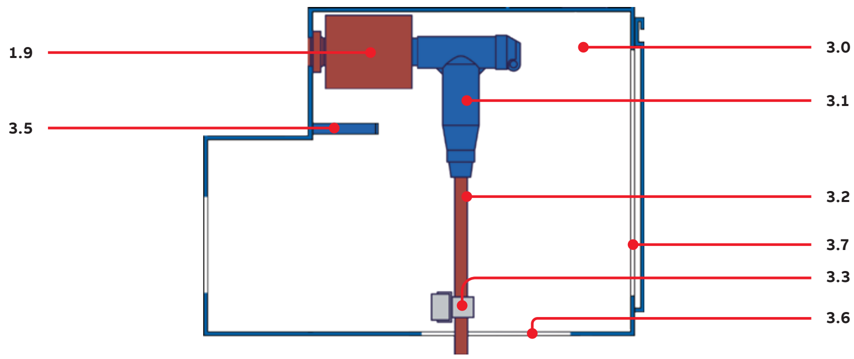


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Fig. 6.8

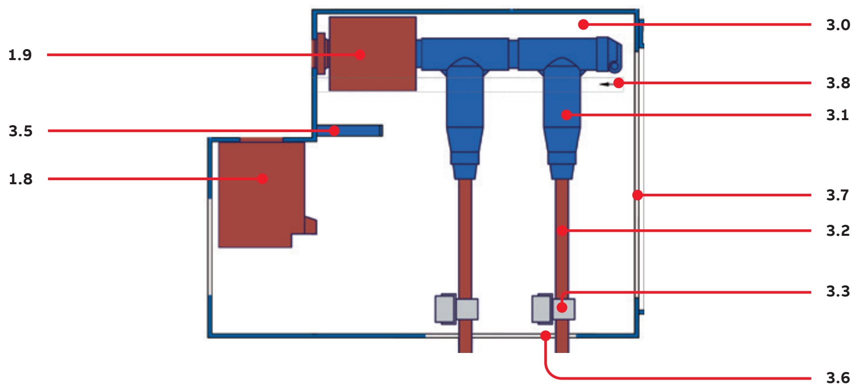

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Fig. 6.9

1.8 Voltage transformers, in this case fixed mounted
1.9 Current transformers
3.0 Cable termination compartment
3.1 Cable connector
3.2 High voltage cable
3.3 Cable fastener
3.5 Main earthing bar
3.6 Floor plate
3.7 Cover
3.8 Mechanism for the voltage transformer isolating device (optional)

—
Fig. 6.10:
Low voltage compartment and mechanism bay

—
Fig. 6.11:
Panel with tall low voltage compartment

The low voltage compartment D and the mechanism bay E
The low voltage compartment and the mechanism bay are two independent metal enclosures. The low voltage compartment has a door (door stop alternatively right- or left-hand side), and the mechanism bay a screw-fastened cover.

The low voltage compartment accommodates the protection devices and further secondary equipment with wiring. The mechanism bay houses the operating mechanism for the circuit-breaker (1.2), the operating mechanism for the three position disconnector (2.5) or operating mechanism for the three position switch disconnector, and the sensors for gas density monitoring (1.10) and the filler valve (1.11) of the gas compartment.

The sockets for the capacitive voltage indicator system (1.5) are located in the cover of the mechanism bay.

The controls and indicators of the operating mechanisms are accessible from the outside.

The entry for external secondary cables (6.5) is located in the roof plate of the low voltage compartment. Optionally, the entries for secondary cables can be provided in the floor plate of the cable termination compartment. In that case, the secondary cables are led in through the floor plate of the cable termination compartment at the left and laid through the cable termination compartment and through the mechanism bay towards the low voltage compartment in a cable duct at the side.

Tall low voltage compartment
A 500 mm taller low voltage compartment is optionally available. This brings the panel height to 2750 mm. The separate transport of the panels and tall low voltage compartments is possible.

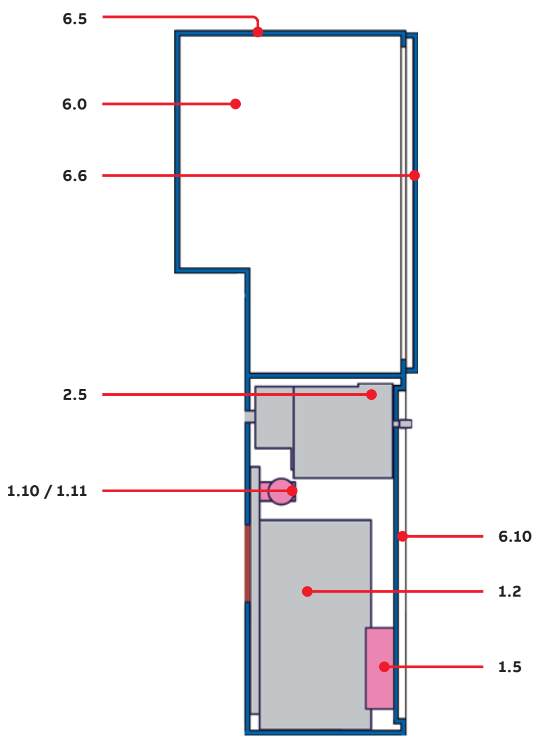

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Fig. 6.10

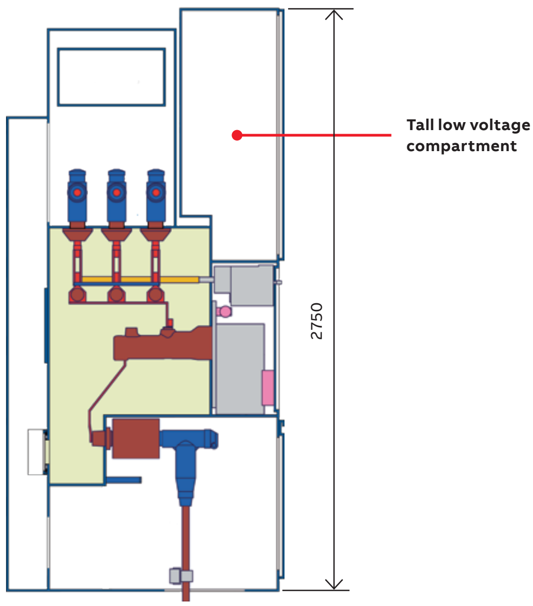

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Fig. 6.11

1.2 Circuit-breaker operating mechanism
1.5 Measuring sockets for capacitive voltage indicator system
1.10 Gas density sensor
1.11 Gas filling valve
2.5 Three position disconnector operating mechanism
6.0 Low voltage compartment
6.6 Low voltage compartment door
6.5 Secondary cable entry
6.10 Mechanism bay

7. Components

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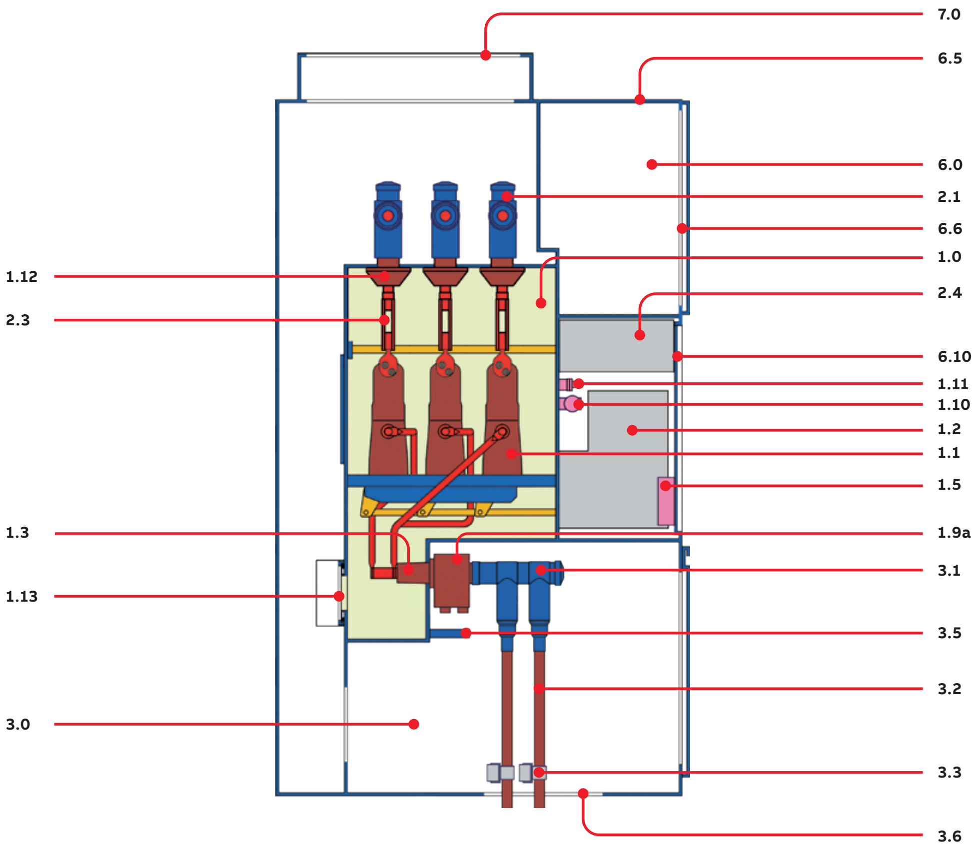
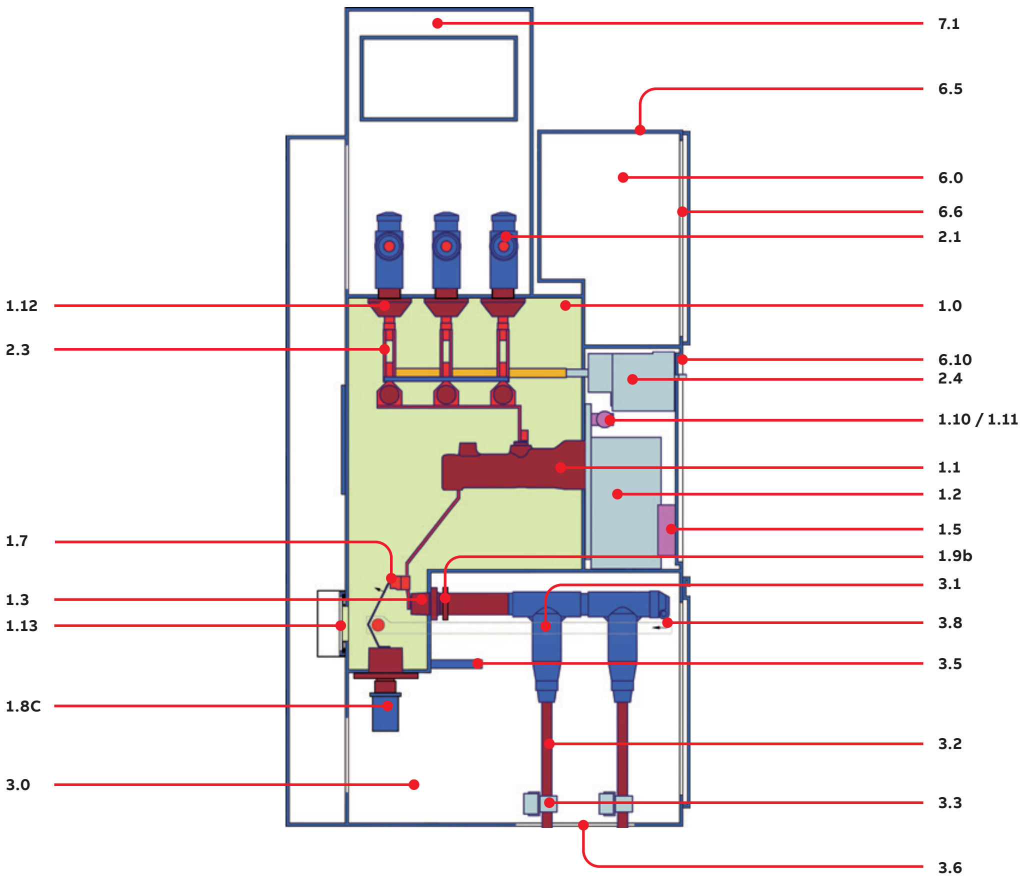
Fig. 7.1:
Circuit-breaker panel, 24 kV, 630 A, panel width 450 mm, example configuration with current transformers



1.0	Panel module	3.1	Cable connector
1.1	Circuit-breaker pole	3.2	High voltage cable
1.2	Circuit-breaker operating mechanism	3.3	Cable fastener
1.3	Outer cone	3.5	Main earthing bar
1.5	Measuring sockets for capacitive voltage indicator system	3.6	Floor plate
1.9a	Current transformer	3.8	Mechanism for isolating device for optional voltage transformer or sensor
1.9b	Current sensor	6.0	Low voltage compartment
1.10	Gas density sensor	6.5	Secondary cable entry
1.11	Filling valve	6.6	Low voltage compartment door
1.12	Cast resin bushing to busbar	6.10	Mechanism bay
1.13	Pressure relief disk	7.0	Busbar cover (pressure relief into the switchgear room)
2.1	Busbar	7.1	Pressure relief duct (optional, for pressure relief to the outside)
2.3	Three position disconnector		Insulating gas SF_6
2.4	Three position disconnector mechanism		
3.0	Cable compartment		

—
Fig. 7.2:
Circuit-breaker panel, 1250A, panel width 600 mm, example configuration with sensors



1.0 Panel module
1.1 Circuit-breaker pole
1.2 Circuit-breaker operating mechanism
1.3 Outer cone
1.5 Measuring sockets for capacitive voltage indicator system
1.7 Isolating system for voltage transformer or sensors
1.8c Voltage sensor
1.9a Current transformer
1.9b Current sensor
1.10 Gas density sensor
1.11 Filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
2.1 Busbar
2.3 Three position disconnector
2.4 Three position disconnector mechanism
3.0 Cable compartment
3.1 Cable connector
3.2 High voltage cable
3.3 Cable fastener
3.5 Main earthing bar
3.6 Floor plate
3.8 Mechanism for isolating device for optional voltage transformer or sensor
6.0 Low voltage compartment
6.5 Secondary cable entry
6.6 Low voltage compartment door
6.10 Mechanism bay
7.0 Busbar cover (pressure relief into the switchgear room)
7.1 Pressure relief duct (optional, for pressure relief to the outside)

Insulating gas SF_6

—
Fig. 7.3:
Circuit-breaker panel, 1250 A, panel width 600 mm, example configuration with current transformers

—
Fig. 7.4:
Circuit-breaker panel, 2500 A, panel width 1200 mm, example configuration with current and voltage transformers

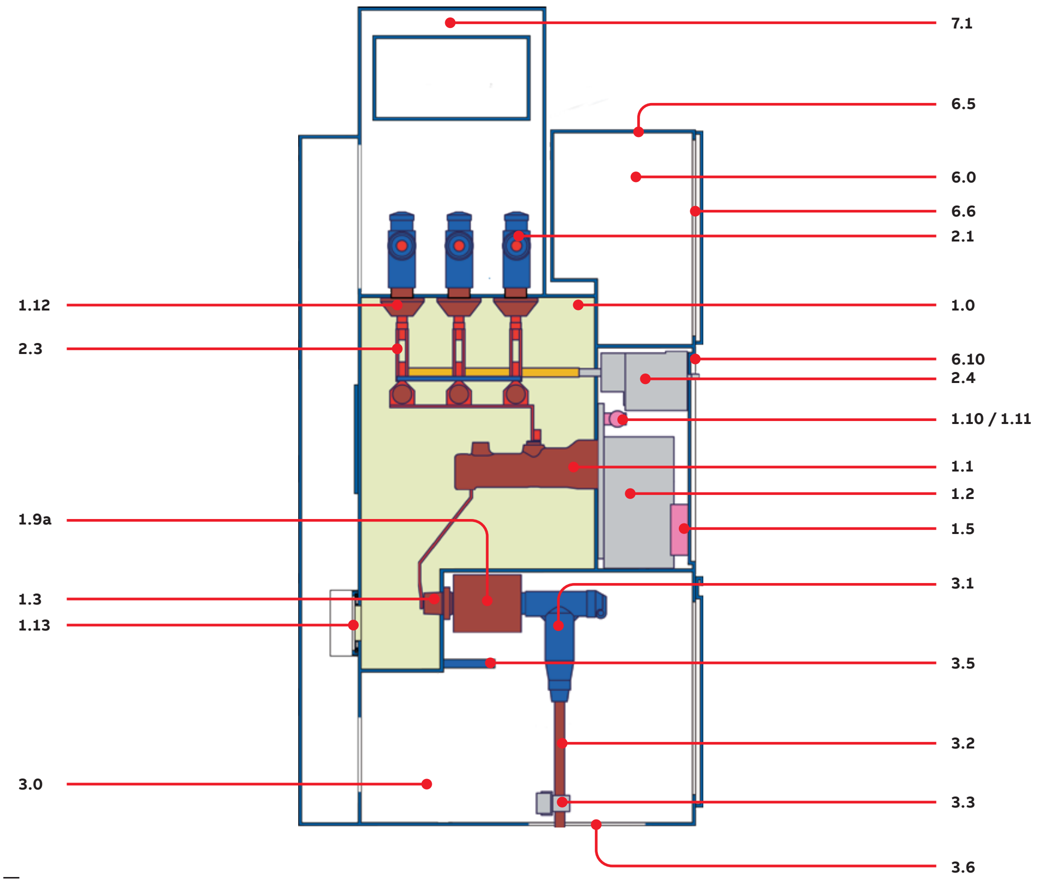


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Fig. 7.3

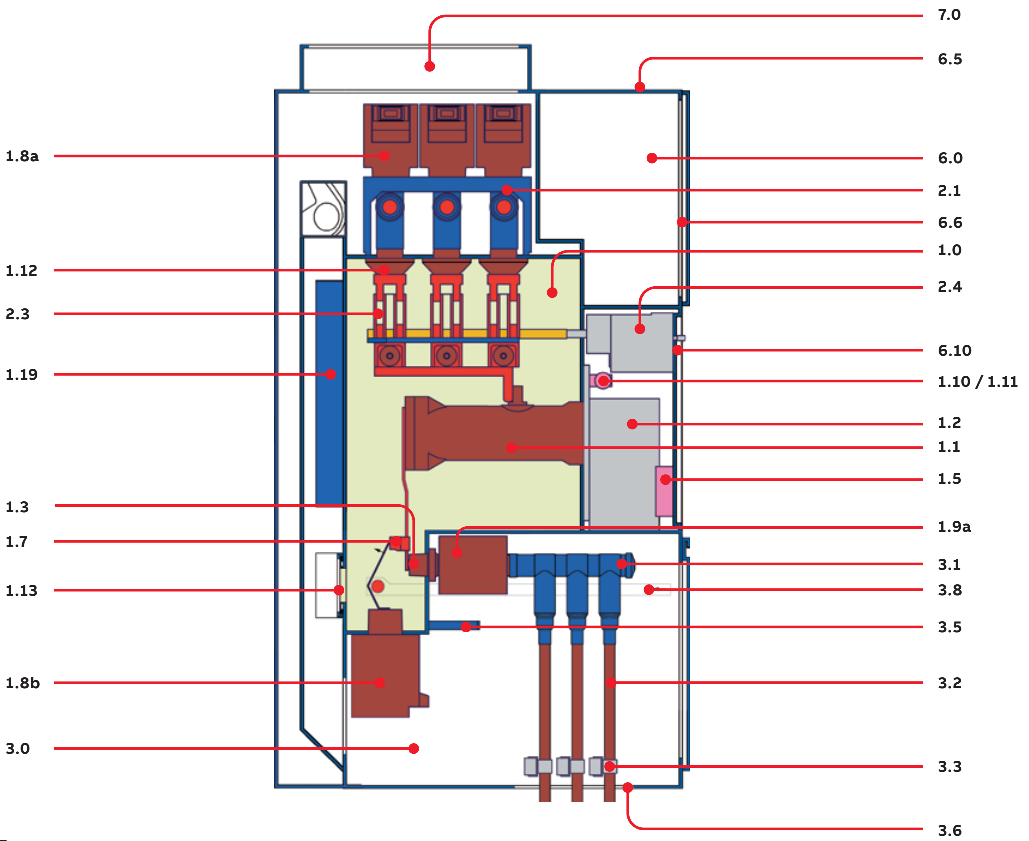

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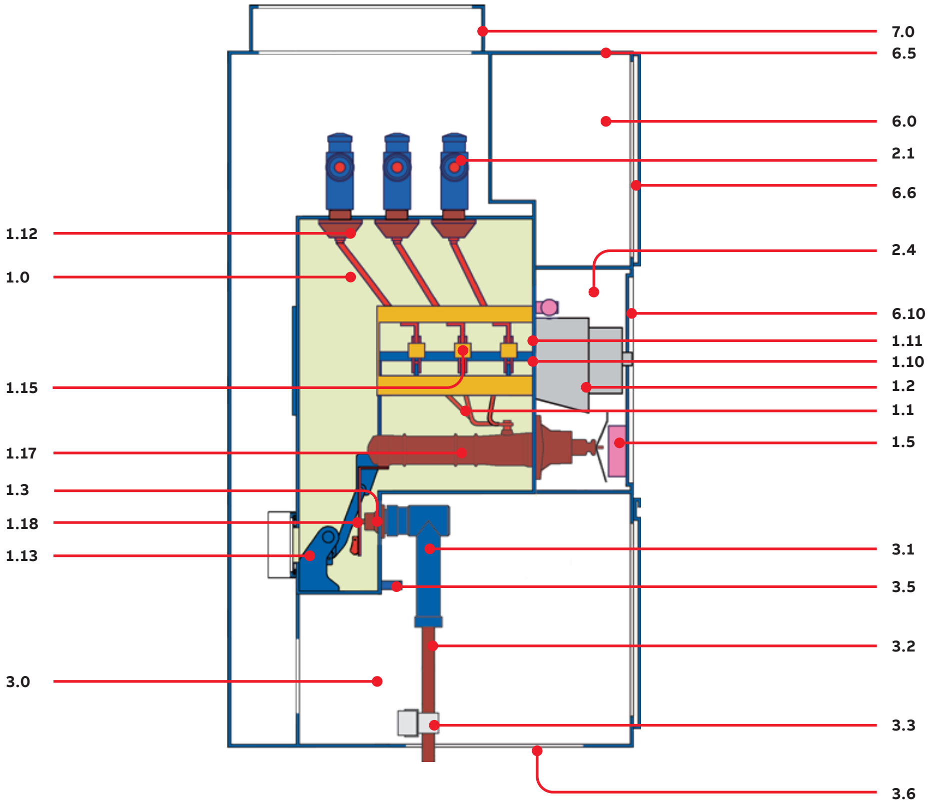
Fig. 7.4

—
Fig. 7.5:
Panel with switch disconnector and fuses, panel width 600 mm



1.0 Panel module
1.1 Circuit-breaker pole
1.2 Circuit-breaker operating mechanism
1.3 Outer cone
1.5 Measuring sockets for capacitive voltage indicator system
1.7 Isolating system for voltage transformer or sensors
1.8a Voltage transformer for busbar measurement
1.8b Voltage transformer for feeder measurement (optional)
1.9a Current transformer
1.10 Gas density sensor
1.11 Filling valve
1.12 Cast resin bushing to busbar
1.13 Pressure relief disk
1.15 Three position switch disconnector
1.16 Three position switch disconnector mechanism
1.17 Fuse box
1.18 Earthing switch
1.19 Heat sink

2.1 Busbar
2.3 Three position disconnector
2.4 Three position disconnector mechanism
3.0 Cable compartment
3.1 Cable connector
3.2 High voltage cable
3.3 Cable fastener
3.5 Main earthing bar
3.6 Floor plate
3.8 Mechanism for isolating device for optional voltage transformer
6.0 Low voltage compartment
6.5 Secondary cable entry
6.6 Low voltage compartment door
6.10 Mechanism bay
7.0 Busbar cover (pressure relief into the switchgear room)
7.1 Pressure relief duct (optional, for pressure relief to the outside)
Insulating gas SF_6

—
Fig. 7.1.1:
Operator control area, controls and indicators for the circuit-breaker (1)

7.1. Vacuum circuit-breaker

Two different circuit-breaker types with different structures are used in ZX0.2 panels. Type VD4X is used in panels with widths of 600, 900 and 1200 mm, and type VD4X PT in panels of 450 mm width.
The fixed mounted vacuum circuit-breakers are three phase switching devices and fundamentally consist of the operating mechanism and the three pole parts. The pole parts contain the switching elements proper, the vacuum interrupters.

Circuit-breaker type VD4X
The pole parts are installed on a common mounting plate. The operating mechanism is on the opposite side from the mounting plate. In this way, the pole parts, mounting plate and operating mechanism form a single assembly. The mounting plate for this assembly is screwed to the front wall of the circuit-breaker compartment in a gas-tight manner at the works.

Circuit-breaker type VD4X PT
The breaker poles, mounted vertically on a mounting plate, are arranged one behind another in the enclosure of the panel. The vacuum interrupters are located inside the thermoplastic embedded poles. The current path leads from the lower terminals of the breaker poles through the contacts in the vacuum interrupter chambers to the upper terminals.

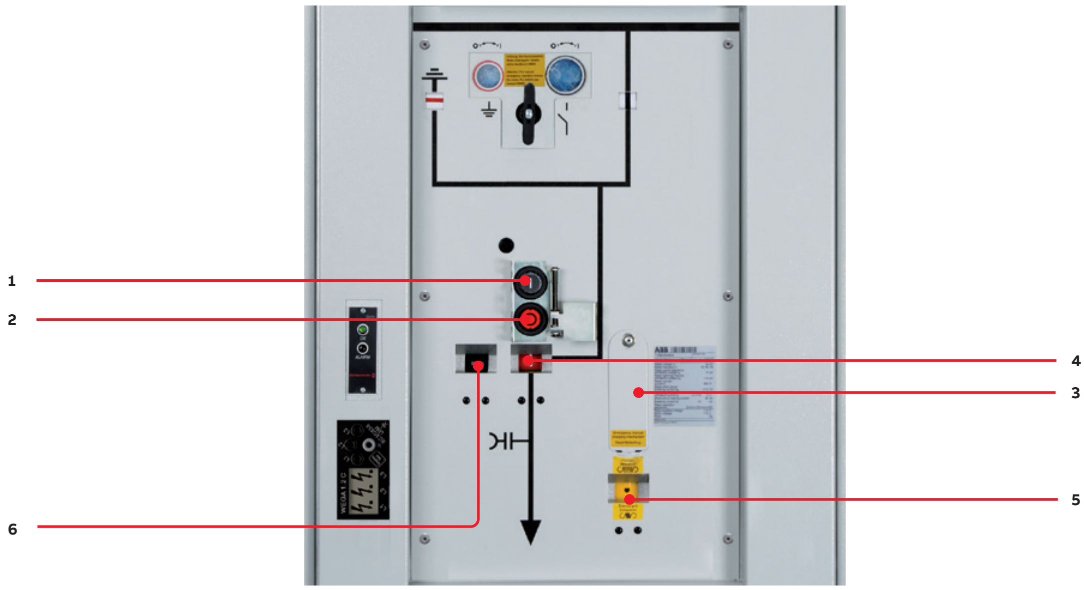
The switching motions of the moving contact are initiated by a push rod.

The pole parts of either types are located in the circuit-breaker compartment which is filled with SF_6, and are therefore protected from external influences.

Functions of the vacuum circuit-breaker
- Switching operating current on and off
- Short-circuit breaking operations
- Earthing function in conjunction with the three position disconnector.

For earthing, the three position disconnector prepares the connection to earth while in the de-energized condition. Earthing proper is performed by the circuit-breaker. A circuit-breaker functioning as an earthing switch is of higher quality than any other earthing switch.

The circuit-breaker operating mechanism is located in the mechanism bay of the panel. The indicators and controls for the circuit-breaker are located in the operator control area of the panel (fig. 7.1.1) and are accessible from the outside.



1 Mechanical ON pushbutton circuit-breaker
2 Mechanical OFF pushbutton circuit-breaker
3 Cover on the receptacle for manual charging of the stored-energy spring
4 Mechanical indicator for “Circuit-breaker ON” “Circuit-breaker OFF”
5 Mechanical indicator “Stored-energy spring charged” “Stored-energy spring discharged”
6 Operating cycle counter

1. Alternatively, the mimic diagram and the position of the switch postion indicator of the earthing switch can differ from the illustration. This has no effect on the operation and function of the drive.

Secondary equipment for the circuit-breaker operating mechanism

Table 7.1.1 and 7.1.2 show the secondary equipment for the corresponding circuit-breaker operating mechanism in an outgoing feeder panel. The "Standard" column indicates the equipment necessary for control of the panel. Over and above this, the use of further devices such as additional auxiliary switches is possible as an option to meet your specific requirements.

—

Table 7.1.1: Secondary equipment for the circuit-breaker operating mechanism in feeder panels VD4X

IEC designation	VDE designation	Equipment	Standard	Option
-MAS	-M0	Charging motor for operating mechanism	•	
-BGS1(1)	-S1	Auxiliary switch "Spring charged"	•	
-MBO1	-Y2	Shunt release OFF	•	
-MBC	-Y3	Shunt release ON	•	
-BGB1	-S3	Auxiliary switch "CB ON/OFF"	•	
-BGB2(2)	-S4	Auxiliary switch "CB ON/OFF"	•	
-BGB3(2)	-S5	Auxiliary switch "CB ON/OFF"		•
-BGB7	-S10	Auxiliary switch at the mechanical "CB ON" push button		•
-KFN	-K0	Anti-pumping device	•	
-RLE1	-Y1	Blocking magnet "CB ON"	•	
-BGL1	-S2	Auxiliary switch for blocking magnet	•	
-BGB4	-S7	Fleeting contact ≥ 30 ms for C.B. tripped indication		•
-MBU(3)	-Y4	Undervoltage release		•
-MBO3(3)	-Y7	Indirect overcurrent release		•
-MBO2	-Y9	2nd shunt release OFF		•
-BGL3		Auxiliary switch for interlocking "securing to prevent		•
-BGL4		cancellation of earthing"		•

—

Table 7.1.2: Secondary equipment options for the operating mechanism of circuit-breaker type VD4X PT

IEC designation	VDE designation	Equipment	Standard	Option
-MAS	-M0	Charging motor for operating mechanism	•	
-BGS1.1...1.5	-S1.1...1.5	Auxiliary switch "Spring charged"	•	
-MBO1	-Y2	Shunt release OFF	•	
-MBC	-Y3	Shunt release ON	•	
-BGB1	-S3	Auxiliary switch "CB ON/OFF"	•	
-BGB7	-S10	Auxiliary switch at the mechanical "CB ON" push button		•
-KFN	-K0	Anti-pumping device	•	
-RLE1	-Y1	Blocking magnet "CB ON"		•
-BGL1	-S2	Auxiliary switch for blocking magnet		•
-BGB4	-S7	Fleeting contact ≥ 30 ms for C.B. tripped indication		•
-MBU(3)	-Y4 (2)	Undervoltage release		•
-MBO3(3)	-Y7 (2)	Indirect overcurrent release		•
-MBO2	-Y9	2nd shunt release OFF		•
-BGL3		Auxiliary switch for interlocking "securing to prevent		•
-BGL4		cancellation of earthing"		•

1. For certain versions of the circuit-breaker, auxiliary switches BGS1.1...1.5 are used.
2. For certain versions of the circuit-breaker, the auxiliary switch may not be required.
In such cases the function is performed by auxiliary switch - BGB1.
3. Combination of -MU with -MO3 is not possible.

—
Fig. 7.1.2:
Securing to prevent operation of the OFF button and securing to prevent cancellation of earthing (version 1)

—
Fig. 7.1.3:
Securing to prevent operation of the OFF button and securing to prevent cancellation of earthing (version 2)

—
Fig. 7.1.4:
Securing by pad lock (locking of both buttons shown here)

—
Fig. 7.1.5:
Locking by lock switch: locking of the OFF button

Locking of the mechanical pushbuttons
The following methods of locking the mechanical pushbuttons for the circuit-breaker are available.

- Securing to prevent operation of the OFF button (securing to prevent cancellation of earthing)
  - With the option shown in fig. 7.1.2, the mechanical OFF button of the circuit breaker can only be locked if the earthing switch and the circuit breaker are switched on (earthing of feeder).
  - The option shown in fig. 7.1.3 allows the circuit breaker to be locked with a padlock regardless of the switch positions. The button is freely accessible in the unlocked state.

- Locking to prevent inadvertent operation of the OFF and/or ON buttons (fig. 7.1.4)
  - The devices permit locking of the ON and/or OFF buttons with padlocks. In the unlocked state, the buttons are hidden by the flaps.

- Locking by lock switch (fig. 7.1.5)
  - The ON and/or OFF buttons can be designed as lock switches.
  - In this option, the ON button can only be operated with a key. The button does not engage when pressed.
  - The OFF button can be operated without a key. The switch remains in the OFF position, as the button engages when pressed. Electrical closing of the circuit-breaker is not then possible. The pressed OFF button can be released locally with the key.

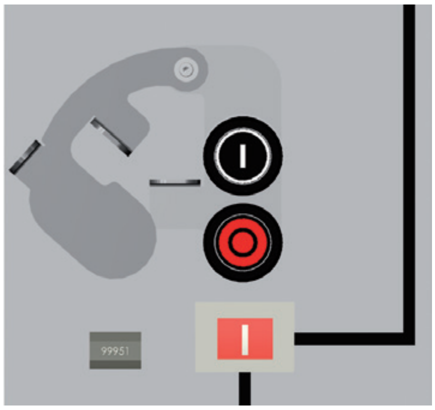


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Fig. 7.1.2

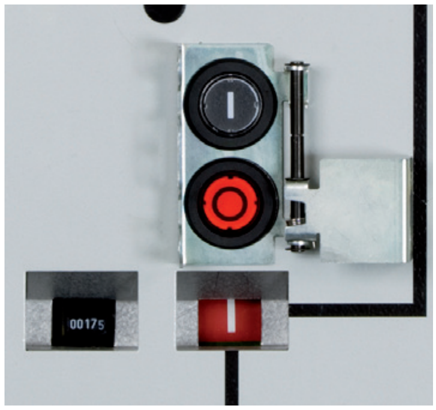

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Fig. 7.1.3

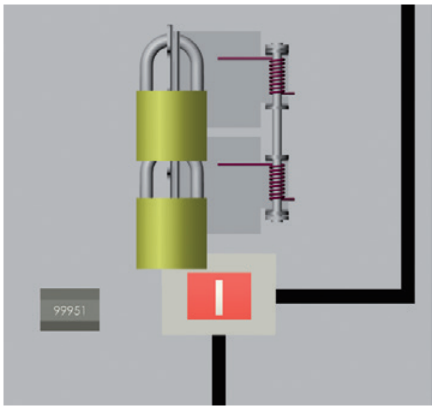

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Fig. 7.1.4

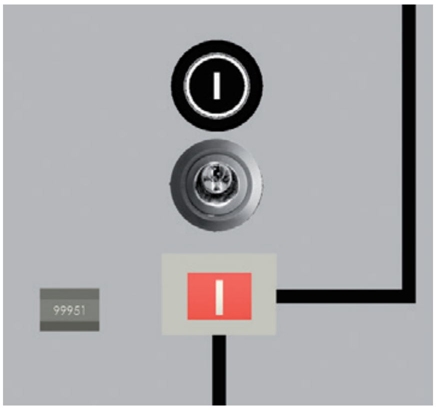

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Fig. 7.1.5

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Fig. 7.2.1:
Operator control area, mechanical controls and indicators for the three position disconnector (¹)

7.2. Three position disconnector

The three position disconnectors are combined disconnectors and earthing switches. The three switch positions, connecting, disconnecting and earthing, are clearly defined by the mechanical structure of the switch. Simultaneous connection and earthing is therefore impossible.

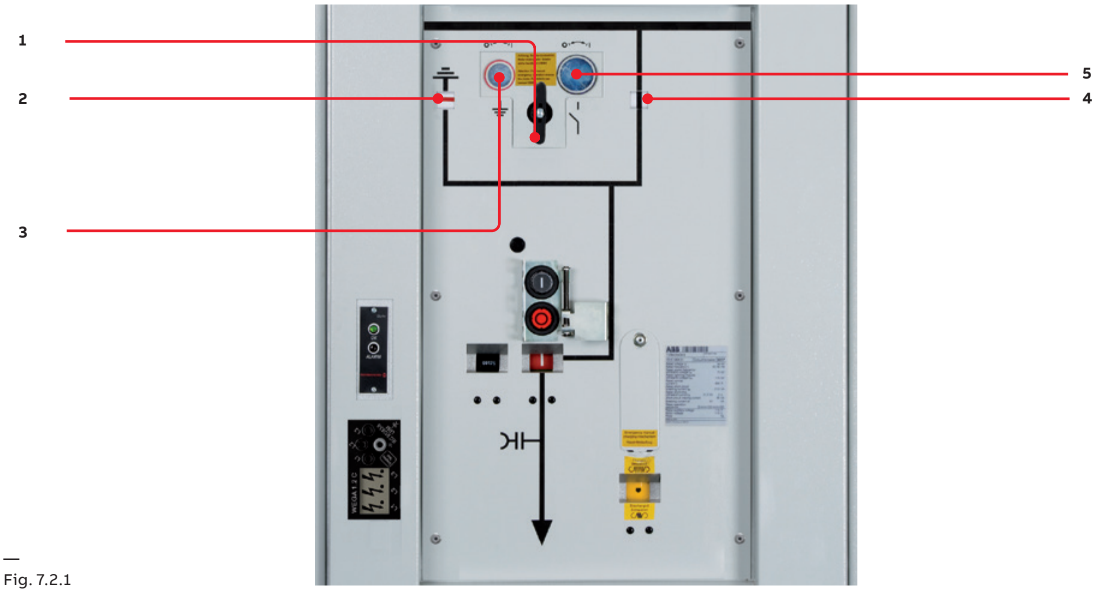
Knife-switch three position disconnectors are used. The switching components of the three position disconnector are located in the SF_6-filled panel module, while the operating mechanism block is easily accessible in the mechanism bay.

The three position disconnectors can be manually or motor-operated. Emergency manual operation is possible to the extent that the interlocks permit.

The mechanical controls and indicators for the operating mechanism are located in the cover of the mechanism bay and are accessible from the outside.

Manual operating mechanism
For manual operation of the switch with a lever (1) , the relevant opening for the lever (5) and (3) , for the disconnect or grounding switch is to be uncovered by turning the selector lever. The switch position is indicated mechanically (2) and (4) . In order to avoid maloperation, manual mechanisms are interlocked mechanically with the relevant circuit-breaker within the panel.

Motorized operating mechanism
Motorized mechanisms are preferably to be operated using the control unit. Manual operation as with a manual mechanism is also possible. The motorized mechanism is mechanically and electrically interlocked with the circuit-breaker.



—
Fig. 7.2.1

1 Selector lever
2 Switch position indicator earthing switch
3 Opening for operation of the earthing switch
4 Switch position indicator disconnector
5 Opening for operation of the disconnector

Operating mechanism variants and secondary equipment

The secondary equipment options for the three position disconnector mechanism variants can be found in table 7.2.2.

Table 7.2.2: Secondary equipment options for the three position disconnector operating mechanism variants in a feeder panel

			Manual-operated mechanism		Motor-operated mechanism	
IEC	**VDE**	**Equipment**	**Standard**	**Option**	**Standard**	**Option**
-MAD	-M1	Drive motor			•	
-BGI15	-S15	Microswitch to detect switch position “Disconnector OFF”			•	
-BGI16	-S16	Microswitch to detect switch position “Disconnector ON”			•	
-BGE57	-S57	Microswitch to detect switch position “Earthing switch OFF”			•	
-BGE58	-S58	Microswitch to detect switch position “Earthing switch ON”			•	
-BGI1	-S11	Auxiliary switch “Disconnector OFF”	•		•	
-BGI1	-S12	Auxiliary switch “Disconnector ON”	•		•	
-BGE5	-S51	Auxiliary switch “Earthing switch OFF”	•		•	
-BGE5	-S52	Auxiliary switch “Earthing switch ON”	•		•	
-BGL1	-S151	Microswitch on the selector lever	•		•	
-BGL2	-S152		•		•	
-RLE1	-Y1	Blocking magnet disconnector		•		•
-RLE5	-Y5	Blocking magnet earthing switch		•		•

—
Fig. 7.3.1:
Controls and indicators of a panel with switch disconnectors and fuses

7.3. Three position switch disconnector with fuse
The three position switch disconnectors with fuses are a combination of a switch disconnector, an earthing switch, an HV HRC fuse and a cable earthing switch.

Knife-type three position switch disconnectors are used. The switching elements (1) of the three position switch disconnectors are located in the SF_6-filled panel module. The disconnector contact of the three position switch disconnector is fitted with a quenching plate system. This consists of cooling plates which split the arc into short partial arcs connected in series. The reestablishment of the contact gap after extinction of the arc at the current zero is supported by the cooling of the arc.

The HV HRC fuses are located in the fuse box below the switch disconnector, in air at atmospheric pressure. A fuse flap (1.19) located in front of the insulated handles on the HV HRC fuse is blocked when the outgoing feeder is not earthed. Blown fuses can therefore only be replaced when the feeder is earthed.
The additional cable earthing switch ensures that blown HV HRC fuses are also earthed on the cable side. Operation of the cable earthing switch is effected positively when the earthing switch in the three position switch disconnector is operated.

The operating mechanism block is located in the low voltage compartment and is therefore easily accessible. The mechanism for the switch is designed as a snap action spring mechanism, and the switching velocity is therefore independent of the speed at which the mechanism is operated.

The switch disconnector is always manually operated.

The controls and indicators of the operating mechanism are shown in fig. 7.3.1.

The mechanism can be locked with a padlock at the selector slide as follows:
- Disconnector ON blocked and / or
- Opening for operating the earthing switch blocked.

Options for secondary equipment on the mechanism can be found in table 7.3.1.

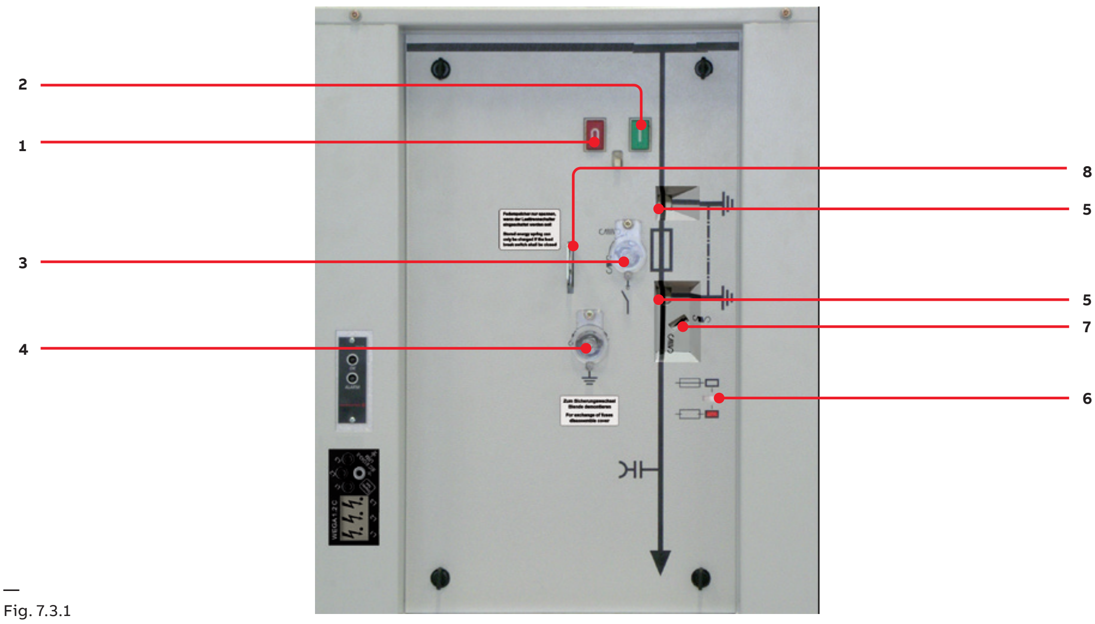


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Fig. 7.3.1

1 Mechanical OFF pushbutton switch disconnector
2 Mechanical ON pushbutton switch disconnector
3 Opening for manual charging of the switch-disconnector’s stored-energy spring
4 Opening for operation of the earthing switch
5 Mechanical indicator for “Switch disconnector ON” “Switch disconnector OFF”
6 “Fuse blown” indicator
7 Mechanical indicator “Stored-energy spring charged” “Stored-energy spring dis-charged”
8 Selector slide

—

Table 7.3.1: Secondary equipment options for the three position disconnector operating mechanism variants in a feeder panel

IEC designation	VDE designation	Equipment	Standard	Option
-BGI1	-Q0S3	Auxiliary switch “switch disconnector ON/OFF	●	
-BGI2	-Q0S4	Auxiliary switch “switch disconnector ON/OFF	●	
-BGI3	-Q0S13	Auxiliary switch “switch disconnector ON/OFF	●	
-BGI4	-Q0S14	Auxiliary switch “switch disconnector ON/OFF	●	
-BGE1	-Q8S1	Auxiliary switch “earthing switch ON/OFF“	●	
-BGE2	-Q8S2	Auxiliary switch “earthing switch ON/OFF“	●	
-MIO1	-Q0Y2	Shunt release OFF		●
-BGF	-F1S1	Auxiliary Switch “HV HRC fuse blown”		●

—
Fig. 7.4.1 :
Busbar with cross adapters

—
Fig. 7.4.2:
Busbar with end adapters

7.4. Busbar

The busbars are located within a compartment outside the gas-filled panel modules.

The insulation of the busbar is of silicone. The surfaces of the busbar components are conductive coated and are connected to earth potential after assembly.

The conductive connections between the busbars and from the busbars to the relevant cast resin bushing in the panel module are made by the cross and end adapters.

Bushing-type current transformers can be mounted between two panels in the busbar run. Voltage transformers or voltage sensors can be installed above the cross and end adapters for detection of the busbar voltage (see also fig. 6.7).

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Fig. 7.4.1

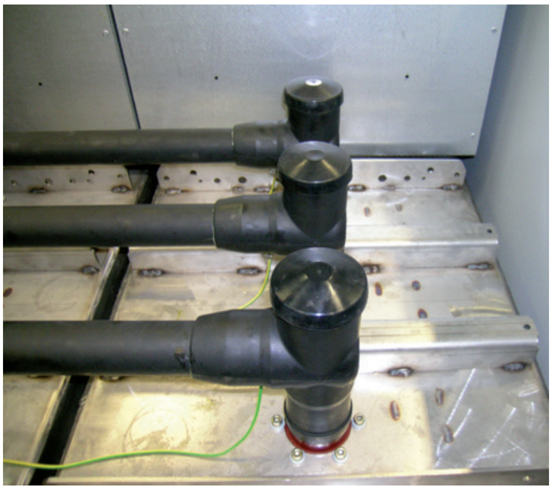

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Fig. 7.4.2

—
Fig. 7.5.1:
Cable termination area with outer cones termination type C in air, without cable connectors (during assembly at the works, without the cable termination compartment)

—
Fig. 7.5.2:
Outer cones termination type A in a panel with three position disconnector and fuses

—
Fig. 7.5.3:
Cable termination compartment in air with shockproof cable connectors (ABB type CSE-A) and cables

—
Fig. 7.5.4:
Cable termination compartment with two outer cones per phase in a 1200 mm wide panel

—
Fig. 7.5.5:
Cable termination RCAB 12 kV from Tyco, 630 A, 25 kA

7.5. Outer cone termination system

Outer cone device termination components to EN 50181, fitted gas-tight in the wall between the panel module and the cable termination compartment, facilitate connection of cables and surge arresters (figs. 7.5.1 to 7.5.4). The termination height of 700 mm provides good accessibility when installing cables. When the shutter on the cable termination compartment has been removed, the cables are accessible from the front of the system.

In panels of 1200 mm width, the two outer cones per phase must be fitted with the same number of plug connectors (fig. 7.5.4).

Furthermore, at operating voltages of up to 12 kV, operating currents of up to 630 A and short-time withstand currents of up to 25 kA, connection of plastic-insulated cables (35 mm^2 - 400 mm^2) and paper-insulated cables (50 mm^2 - 400 mm^2) is possible using an insulated cable termination (type RCAB 12 kV) from manufacturer Tyco. This cable termination (fig. 7.5.5) is not shockproof. When this termination system is used, the cover on the cable termination compartment should be lockable.

Apart from this, always use shockproof termination systems where possible. A selection of various shockproof connector systems which can be installed depending on the space available can be downloaded here. When making your selection, please observe the current and short-circuit ratings of the cables and connector systems. Please consult the manufacturers' latest catalogues for the precise ordering data and information on any couplings and termination parts required.

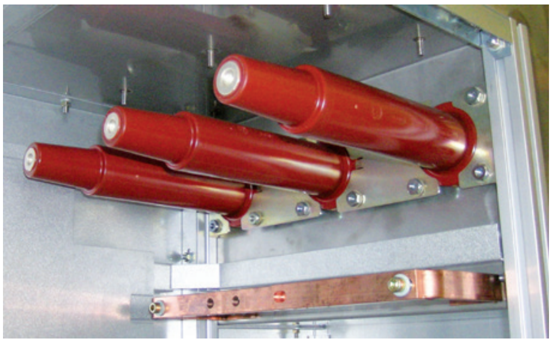

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Fig. 7.5.1

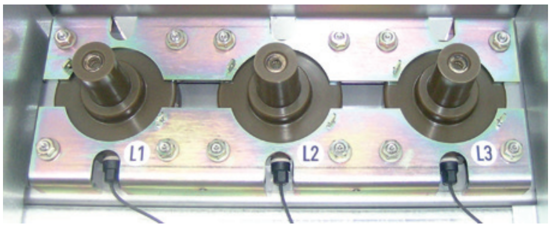

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Fig. 7.5.2

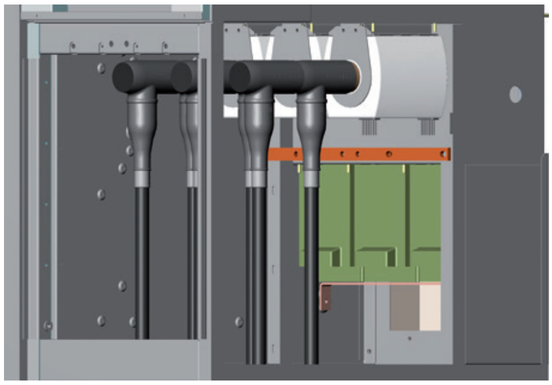

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Fig. 7.5.3

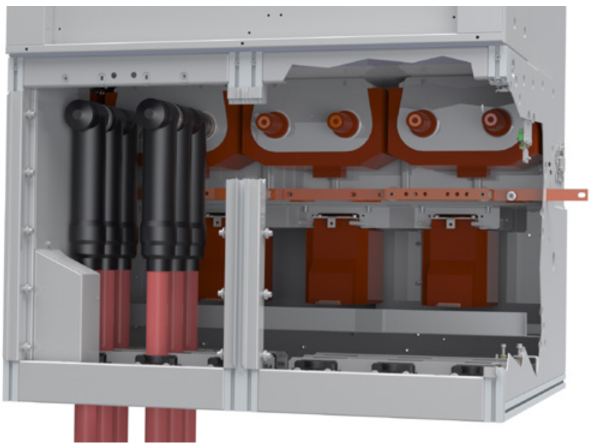

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Fig. 7.5.4

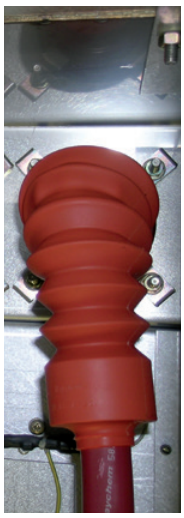

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Fig. 7.5.5

Fig. 7.8.1:
Capacitive voltage indicator system Wega 1.2 C

Fig. 7.8.2:
Capacitive voltage indicator system Wega 2.2 C

7.6. Surge arresters

Surge arresters are fitted directly with cable connectors. Fitting of several cables plus a surge arrester per phase is possible (see tables outer cone termination systems). The terminals of the surge arresters must be suitable for the type of cable connector used. Further information on surge arresters can be obtained from the relevant cable connector manufacturer.

In addition, surge arresters can be directly connected to the busbar. We will be pleased to provide information on these surge arresters on request.

7.7. Main earthing bar

The main earthing bar of the switchgear system runs through the cable termination compartments of the panels. The earthing bars in the individual panels are connected together during installation at site.

The cross-section of the main earthing bar is 300 mm^2 (ECuF30   30 mm x 10   mm).

Details on switchgear earthing can be found in chapter 10.7.

7.8. Capacitive voltage indicator systems

Two types of capacitive, low impedance voltage indicator systems are available for checking the de-energized condition of a feeder. The coupling electrode is integrated in the outer cone device termination components. The capacitive voltage indicator system is located in the cover of the mechanism bay.

Coupling electrodes can be installed on cross or end adapters in the solid insulated busbars to detect the de-energized condition of the busbars. The capacitive voltage indicator system can be integrated in the cover of the operator control area of incoming or outgoing feeder panels and in sectionalizer and riser panels.

Both systems used are voltage detection systems (VDS) according to IEC 61243-5.

The systems used permit phase comparison with the aid of an additional, compatible phase comparator.

System WEGA 1.2 C (fig 7.8.1)

LC-Display
- Three phase
- No additional indicator unit required
- Auxiliary voltage not required
- Maintenance-free with integrated self-test and built-in condition
- Phase-selective overvoltage indication
- Three phase symbolic display:
  - Voltage present/no voltage present (Threshold value for voltage presence indication: $0.1 – 0.45 \times U_N$)
  - Integrated maintenance test passed
  - Voltage signal too high (overvoltage indication)

System WEGA 2.2 C (fig 7.8.1)

As system WEGA 1.2 C, but:
- Two integrated relay contacts (changeover contacts) for signals/interlocks
- Auxiliary voltage for relay function required (LC-Display function via measuring signal)
- LED indication:
  - green for U = 0
  - red for $U \neq 0$

Fig. 7.8.1

Fig. 7.8.2

7.9. Current and voltage transformers and sensors

The areas of application for current and voltage detection devices are

- Protection applications
- Measurement
- Billing metering

The areas of application for current and voltage sensors are

- Protection applications and
- Measurement

7.9.1. Ring core current transformers

Ring core current transformers (Figure 7.9.1.1 to 7.9.1.3) are used for feeder metering in termination panels. They are located on the outer cone outside the gas compartment. Two cones per phase are used in panels for currents > 1250 A. In these cases, a ring core current transformer as shown in fig. 7.9.1.3 is to be used.

The winding of the ring core current transformer is enclosed in cast resin. The cross-section of the connecting wiring is 2.5 mm² (larger cross-sections on request). All current transformers are available with terminal boxes or molded-on connecting lines.

The possible technical data can be found in the following table.

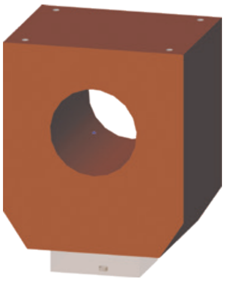

Fig. 7.9.1.1

Fig. 7.9.1.1: Ring core current transformer, I_N up to 630 A, type 1

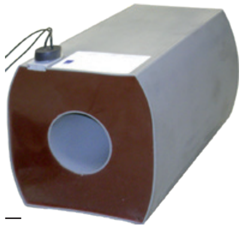

Fig. 7.9.1.2

Fig. 7.9.1.2: Ring core current transformer, I_N up to 1250 A, type 2

Fig. 7.9.1.3

Fig. 7.9.1.3: Ring core current transformer I_N up to 2500 A, type 3

Table 7.9.1.1: Technical data of the ring core current transformers

Type of current transformer			**1**	**2**	**3**
Rated voltage	U_r	kV		0.72	
Rated short duration power-frequency withstand voltage	U_d	kV		3	
Rated frequency	f_r	Hz		50 / 60	
Rated thermal short-time current	I_{therm}	kA	25	31.5	31.5
Rated impulse current	I_p	kA	62.5	80	80

Table 7.9.1.2: Core data

Panel width			**mm**	**450**	**600**	**1200**
Rated primary current		I_r	A	...630	...1250	...2500
Rated secondary current			A		1 or 5	
Max. number of cores				2	3	5
Measuring cores	Capacity (1)		VA	2.5 to 15	...20	...30
	Class (1)				0.2 / 0.5 / 1	
Protection cores	Capacity (1)		VA	2.5 to 15	...20	...20
	Class (1)			5P to 10P	5P	5P
	Overcurrent factor (1)			10 to 20	20	20

1. Depending on rated primary current

7.9.2 Dimensioning of current transformers

The stipulations and recommendations of IEC 61936, section 6.2.4.1 “Current transformers” and IEC 61869-2 are to be observed in the design of current transformers. The rated overcurrent factor and rated burden of current transformer cores are to be selected in such a way that protection devices can function correctly and measuring systems are not damaged in the event of a short-circuit.

Protection purposes

Protection cores are operated at above rated current. The function of the selected protection system is essentially determined by the connected current transformer. The requirements to be fulfilled by the current transformers for the selected protection or combination device can be found in the documentation from the protection equipment supplier. For an accurate switchgear proposal, these current transformer data are to be provided with the product inquiry and then finally agreed by the operator and manufacturer in the order.

The direct path to the right current transformers is via the technical documentation of the selected protection device. The current transformer requirements of the relay can be found there.

Measuring purposes

In order to protect measuring and metering devices from damage in the case of a fault, they should go into saturation as early as possible. The rated burden of the current transformer should be approximately the same as the operating burden consisting of the measuring instrument and cable. Further details and designations can be found in IEC 61869-2.

Recommendations

In principle, we recommend a rated secondary current of 1 A. The current transformer ratings for ABB protection devices are known. The transformer data can be selected to suit the protection application and the network parameters. If, however, third party devices are to be connected, we recommend a review by our engineers at an early stage. Taking account of the burdens and overload capacities, our experts can examine the entire current transformer requirements of the third party protection devices on request.

Further information for different protection systems

If the current transformers to be used in the network concerned (e.g. on the opposite side of the network) have already been specified, early coordination of the switchgear configuration is advisable. This requires, but is not limited to, the provision of data on the ratio, rated capacity, accuracy class, and the resistance of the secondary winding and secondary wiring. Further configurations for the particular application can then be requested.

—
Fig. 7.9.3.1:
Current sensor,
ABB Type KECA 80 C85

7.9.3. Current sensors

As an alternative to conventional current transformers, current sensors to IEC 60044-8 (fig. 7.9.3.1) can be used for outgoing feeder metering or busbar current measurement. The current sensors used are based on the Rogowski coil principle and have a distinctive linear characteristic throughout the service current range of the switchgear.

—
Fig. 7.9.3.1

Current sensors (type designation KECA 80 C85) are located on the outer cones of outgoing feeder panels or on the busbars outside the gas compartment.

In panels for currents > 1250 A one current sensor is fitted on each of the two cones per phase. The secondary wiring of the two sensors for each phase are connected in series.

The secondary connection is by a screened cable with an RJ45 plug. The technical data of the current sensors can be found in table 7.9.3.1 below.

—
Table 7.9.3.1: Technical data of the current sensors

Rated voltage	U_r	kV	0.72
Rated short duration power-frequency withstand voltage	U_d	kV	3
Rated frequency	f_r	Hz	50 / 60
Rated thermal short-time current	I_{therm}		31.5 kA - 3 s
Rated impulse current	I_p	kA	80
Rated primary current		A	2500 A
Rated ratio			80 A / 150 mV (50 Hz) 80 A / 180 mV (60 Hz)
Class			0.5 / 5P630

Fig. 7.9.4.1:
Voltage transformer for fixed mounting – up to 24 kV

Fig. 7.9.4.2:
Voltage transformer, plug-in type – up to 36 kV

7.9.4. Voltage transformers

Panels of 600 mm and 1200 mm width can be fitted with voltage transformers on the outgoing feeder. The voltage transformers are always located outside the gas compartments. They can be permanently mounted or of the plug-in type. Feeder voltage transformers are equipped with a series isolating system with optional auxiliary switches. After operation of the isolating system, the voltage transformers are earthed. Busbar voltage transformers are of the plug-in type.

The possible electrical data can be found in the table below.

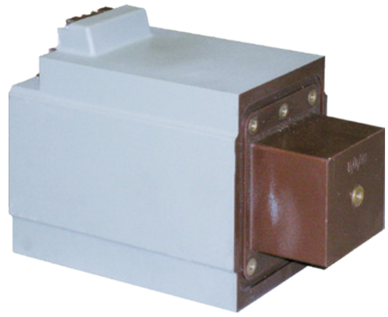

Fig. 7.9.4.1

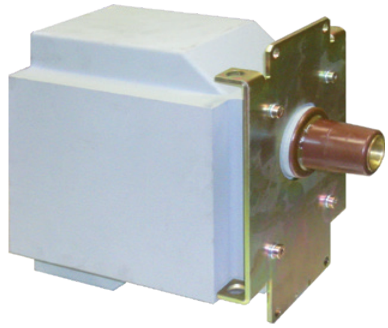

Fig. 7.9.4.2

Table 7.9.4.1: Technical data of voltage transformers

Type of voltage transformer	Rated Voltage [kV]	Max. capacity [VA]	Class	Rated secondary voltage of the metering winding [V]	Rated secondary voltage of the earth fault winding [V]	Rated thermal current limit of the metering winding with rated voltage factor 1.2 / continuous [A]	Rated thermal long duration current of the earth fault winding with rated voltage factor 1.9 / 8 h [A]
fixed mounted	up to 24	20	0.2	100 / √3 110 / √3	100 / 3 110 / 3	6	6
		50	0.5				
		100	1				
plug-in type	up to 36 (1)	25 (1)	0.2	100 / √3 110 / √3	100 / 3 110 / 3	6	6
		60 (1)	0.5				
		120 (1)	1				

1) Rated voltage > 33 kV and higher capacity on request

Table 7.9.4.2: Rated power frequency withstand voltage of voltage transformers

Rated voltage [kV]	Rated power frequency withstand voltage (1 min) [kV]
< 6	5 x U_r
6 to 12	28
> 12 to 17.5	38
> 17.5 to 24	50
> 24 to 36	70

—
Fig. 7.9.5.1:
Voltage sensor, ABB Type KEVA 36 G22 and KEVA 36 G23

7.9.5. Voltage sensors

ZX0.2 panels can be fitted with voltage sensors to IEC 60044-7 (figure 7.9.5.1) instead of conventional voltage transformers. The plug-in voltage sensors (type designation KEVA 36 G22 or KEVA 36 G23) are always located outside the gas compartments and are installed in the cable termination compartment or on the busbar. The sensors are based on an ohmic voltage divider and therefore have a linear transmission characteristic throughout the measuring range. The technical data of the voltage sensors can be found in table 7.9.5.1 below.

—
Fig. 7.9.5.1

—
Table 7.9.5.1: Technical data of the voltage sensors

Rated voltage	U_r	kV	up to 36
Rated short duration power-frequency withstand voltage	U_d	kV	70
Rated frequency	f_r	Hz	50 / 60
Rated ratio			10000 : 1
Class			0.5

7.10. Protection and control units

ABB provides the right protection and automation solution for every application.

Table 7.12.1 below provides an overview of the most important protection devices with notes on their range of applications.

Further information can be obtained in the Internet or from the responsible ABB contact for you.

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Table 7.10.1: Application of protection and control units

Unit designation	REF620	RET620	REM620	REX640	REF615	RET615	REM615	RED615
Application								
Motor operated three position switch	•	•	•	•				
Manual operated three position switch					•	•	•	•
Feeder protection	•			•	•			
Transformer protection		•		∘		•		
Motor protection			•	∘			•	
Cable differential protection				∘				•
Busbar differential protection				∘				
Communication protocols								
DNP 3.0	•	•	•	•	•	•	•	•
IEC 60870-5-103	•	•	•	•	•	•	•	•
IEC 60870-5-104				•				
IEC 61850 Ed.1	•	•	•	•	•	•	•	•
IEC 61850 Ed.2 (inc. SMV)	•	•	•	•	•	•	•	•
Modbus	•	•	•	•	•	•	•	•
Analog input (sensor channels)	•			•	•	•	•	

• Function supported
∘ Function available as option

—
Fig. 7.10.1:
Sensor test adapter (example for connection of one current sensor per phase

—
Fig. 7.10.2:
Connection of the protection tester to the sensor test adapter (example of one current sensor per phase and voltage sensors)

Sensor test adapter in panels with current and voltage sensors

Current and voltage sensors are generally connected to the protection device via a sensor test adapter which is installed in the low voltage compartment. Depending on the type and number of sensors (only current sensors, current sensors and voltage sensors, 2 x current sensors and voltage sensors) appropriate sensor test adapter are used. The sensor test adapter (figure. 7.10.1) provides one socket for each phase for connection of a protection tester or protection testing apparatus by network cables (RJ45 interface) (see single line diagram in figure 7.10.2). In case of performing a protection test, changing of the existing wiring is not necessary.

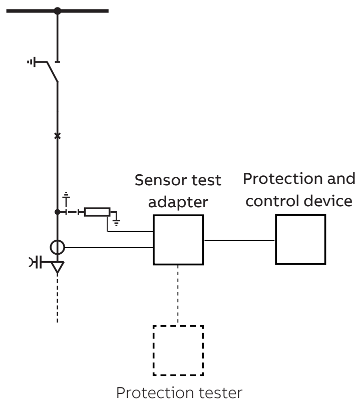

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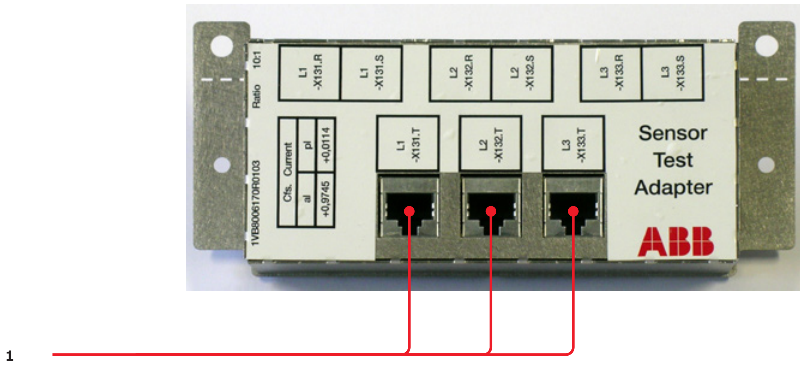
Fig. 7.10.2



1 Connections for the protection tester

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Fig. 7.10.1

7.11. Sulfur Hexafluoride

This product contains sulfur hexafluoride (SF_6) ([1]).

SF_6 is a non-toxic, inert insulating gas with high dielectric strength and thermal stability.
Its unique electrical and thermal properties have made the design of new, more efficient switchgear possible. The change from conventional insulation to the non-flammable, chemically inactive and non-toxic heavy gas sulfur hexafluoride has led to significant savings in space and materials, and to greater safety of the installations. Switchgear systems insulated with sulfur hexafluoride have become highly successful especially in applications where space is constricted and compact design is required. On account of their insensitivity to air pollution, enclosed SF_6 systems are also used in the chemicals industry, in desert areas and at coastal locations. Thanks to SF_6 technology, new substations can also be erected at load centers in densely populated areas where high land prices prohibit other solutions.

SF_6 has been used in HV-switchgear since 1960.

1. SF_6 is a fluorinated greenhouse gas with a GWP of 22800. The maximum quantity per panel is 9 kg.
   That corresponds to a CO_2 equivalent of 205 t.
   Each gas compartment has a gas leakage monitor, and therefore regular leakage testing (to Fluorinated Gas Regulation 517/2014) is not required.

—
Fig. 7.12.1:
Gas filling connector

—
Fig. 7.12.2:
Density sensor

—
Fig. 7.12.3:
Signal lamp for gas density (used when the signal is not integrated in the protection device)

7.12. Gas system in the panels

SF_6 is used as the insulation medium. Furthermore, SF_6 is used as the quenching gas in panels with switch disconnector and fuses for interruption of operating currents.

The gas compartments are designed as hermetically sealed pressure systems. As they are filled with SF_6, constant ambient conditions are permanently ensured for the entire high voltage area of the panel. It is not necessary to top up the insulating gas during the expected service life of the system. Under normal operating conditions, no checks on the insulating gas are necessary. The insulating gas is maintenance-free.

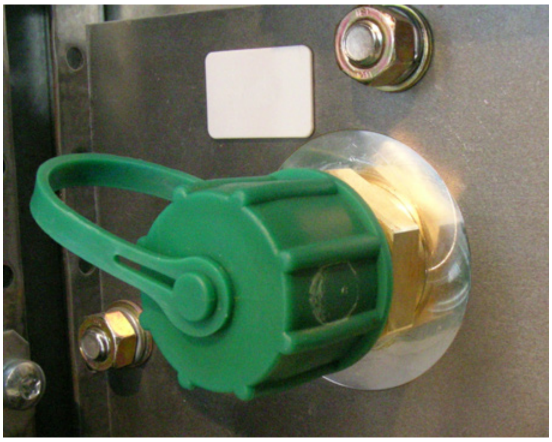
Each panel module has a gas filling connector (fig. 7.12.1 - see also section 6), through which the panel modules can be filled with gas, for instance in the case of repairs.

The service pressure of the individual gas compartments is monitored by separate density sensors (temperature-compensated pressure sensors, fig. 7.12.2). A shortfall below the alarm signal level for insulation (120 kPa) or below the minimum filling pressure for switching (140 kPa) in a panel with three position switch disconnector and fuses is indicated on the protection and control unit or by signal lamp (fig. 7.12.3). Temporary operation of the panel at atmospheric pressure (> 100 kPa) is in principle possible if the SF_6 content of the insulating gas is at least 95 %.

(Caution: A panel with three position switch disconnector and fuses may not be operated at less than the minimum filling pressure for switching (140 kPa), as the blowing of fuses leads to the tripping of the three position switch disconnector).

Leakage testing of the gas compartments during manufacturing process

The leakage rate of the gas compartments is determined by integral leakage testing:
Inside a pressure test cabin, following evacuation of the gas compartments, the panel is filled with helium. The leakage rate of the gas compartments is determined by measurement of the proportion of helium in the test cabin. The helium is then recovered as the gas compartments in the panel are evacuated again. Thereafter, the gas compartments are filled with insulating gas at the rated filling pressure.
A successful leakage test is therefore the necessary condition for filling of the systems with insulating gas.



—
Fig. 7.12.1

—
Fig. 7.12.2

—
Fig. 7.12.3

—
Fig. 7.13.1:
Schematic diagram of the function of the gas density sensor

—
Fig. 7.13.2:
Version 1 of the gas density sensor

—
Fig. 7.13.3:
Version 2 of the gas density sensor

7.13. Gas density sensor

Fig. 7.13.1 shows the function of the gas density sensor. Between the measuring chamber and a reference chamber there is a moving mounting plate which operates electrical contacts.

Temperature compensation

The pressure in the monitored gas compartment rises with increasing temperature. As, however, the temperature in the reference chamber and thus the pressure of the reference volume increases to the same extent, this does not lead to any movement of the mounting plate.

Self-supervision

A drop in pressure of the reference volume results in a movement of the mounting plate (to the right in fig. 7.15.1). The self-supervision contact is operated. As the system is designed as a closed circuit, both wire breakages and defective plug and terminal connections are signaled as faults.

Gas losses

A loss of gas in the monitored gas compartment results in a drop in pressure in the measuring volume and thus a movement of the mounting plate (to the left in fig. 7.13.1). The contact for the pressure loss signal is operated.

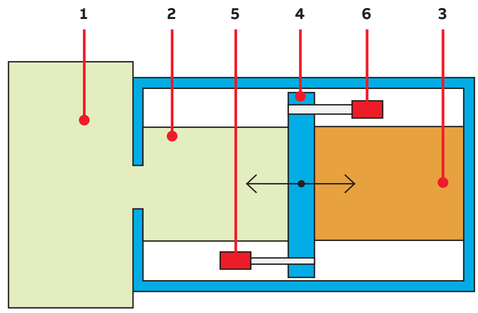
Two versions of gas density sensors

Two versions of the density sensors (figs. 7.13.2 and 7.13.3) are used.

1. A common indication for gas loss, wire breakage, defective plug connection and defective pressure sensor for the reference volume.

2. Separate indications for
a) Gas loss, wire breakage and defective plug connection, and
b) Defective pressure sensor for the reference volume, wire breakage and defective plug connection.

1. 170 kPa at a rated voltage of 36 kV and for panels with three position switch disconnector and fuses
2. 140 kPa at a rated voltage of 36 kV and for panels with three position switch disconnector and fuses



—
Fig. 7.13.1

1 Monitored gas compartment
2 Measuring volume
3 Enclosed volume for temperature compensation (reference volume)
4 Mounting plate moved by interaction of forces (pressure of measuring volume against pressure of reference volume)
5 Contact for self-supervision (p > 150 kPa) ([1])
6 Contact for gas loss (p < 120 kPa) ([2])

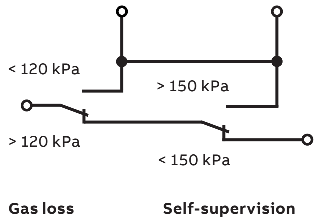


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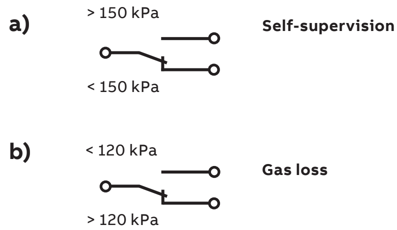
Fig. 7.13.2



—
Fig. 7.13.3

—
Fig. 7.14.1:
Pressure relief of the switchgear

—
Fig. 7.14.2:
Pressure relief to the outside

7.14. Pressure relief systems

In the unlikely event of an internal arc fault in a gas compartment, the relevant pressure relief disk opens. The pressure is then relieved as described below.

Use of busbar covers

In the case of wall mounting, the pressure from a fault in the panel module or in the cable termination compartment is discharged upwards behind the switchgear, and in the case of free-standing installation upwards through the pressure relief duct at the rear (figure 7.14.1).

The internal arc classification requires a system length of at least 1800 mm plus lateral end covers or a system length of minimum 1500 mm plus lateral end covers when using at least one 450 mm wide panel.

Use of a pressure relief duct for pressure relief to the outside

It is possible to fit a pressure relief duct with a maximum busbar current of 2000 A.

The pressure is discharged upwards in a duct behind the switchgear and to the outside through the pressure relief duct at the top of the switchgear (figure 7.14.2).

The building wall through which the pressure relief duct is led to the outside must not contain any combustible materials. The area outside below the pressure relief discharge opening is to be fenced off and marked with warning signs. There must not be any accessible areas such as stairs or walkways above the pressure relief opening. Storage of combustible materials in the areas mentioned is prohibited. The dimensions of the hazardous area can be found in the section entitled "Hazardous area for pressure relief to the outside".

The internal arc classification requires a switchgear length of at least 1200 mm (without end covers) in the case of pressure relief to the outside.

7.15. Surfaces

The gas-tight enclosures of the panel modules consist of stainless steel sheets. The cable termination compartments and low voltage compartments mechanism bays and busbar covers are manufactured from galvanized sheet steel. The low voltage compartment doors, the covers on the operator control areas, the cable termination compartment covers and end covers are coated with a powder stove enamel in RAL 7035 (light gray).

The rear duct required for free-standing installation is galvanized as standard. Optional the cover can be coated with a powder stove enamel in RAL 7035 (light gray).

Other colours for the painted parts are available on request.

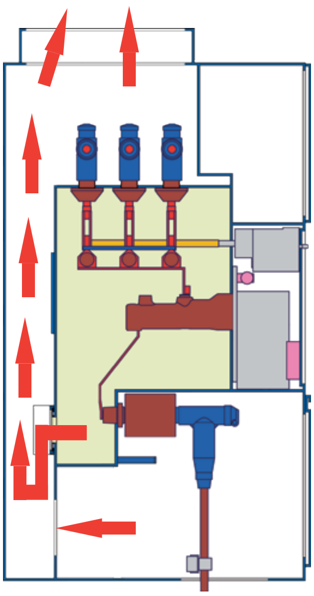


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Fig. 7.14.1

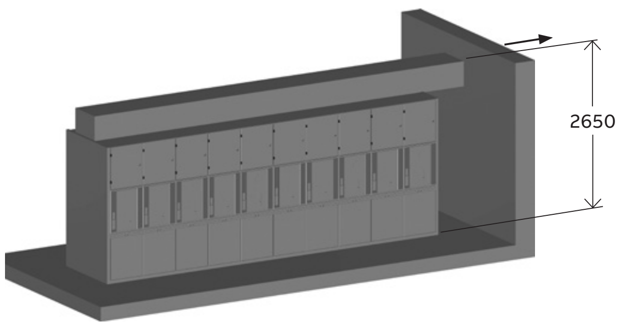

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Fig. 7.14.2

8. Range of panels

The following panel variants are available:
- Feeder panels
  - Panels with circuit-breaker and three position disconnector
  - Panels with three position switch disconnector and fuses
  - Cable termination panels
- Sectionalizer
- Riser
- Design to order panels

All the panels shown in section 8 are available as versions for free-standing and wall mounting installation. All the illustrations show the free-standing versions.

The assignment of the panel variants to the relevant panel widths can be found in table 8.1.

Table 8.1: Panel widths

Panel variant	Panel normal current [A]	Panel width [mm]
Feeder panel with three position switch disconnector and fuses	Dependent on the fuses	600
Feeder panel	... 630	450, 600
	...1250	600
Sectionalizer panel	... 1250	600
Riser panel	... 1250	600
Transfer panel	... 1250	600
Incomer panel	... 2500	1200
Sectionalizer panel	... 2500	900
Riser panel	... 2500	900

8.1. Feeder Panels

8.1.1. Incoming and outgoing feeder panels with circuit-breaker

—
Fig. 8.1.1.1:
Feeder panel with circuit-breaker, 24 kV, 630 A, width 450 mm

—
Fig. 8.1.1.2:
Feeder panel with circuit-breaker 630 A, width 600 mm

—
Fig. 8.1.1.3:
Feeder panel with circuit-breaker 1250 A, voltage transformers (isolatable in the de-energized condition) on the cables and plug-in voltage transformers on the busbars, width 600 mm

—
Fig. 8.1.1.4:
Feeder panel with circuit-breaker 2500 A, voltage transformers (isolatable in the de-energized condition) on the cables and plug-in voltage transformers on the busbars, 1200 mm

—
Fig. 8.1.1.5:
Feeder panel with circuit-breaker 1250 A, with current and voltage sensors (isolatable in the de-energized condition) panel width 600 mm

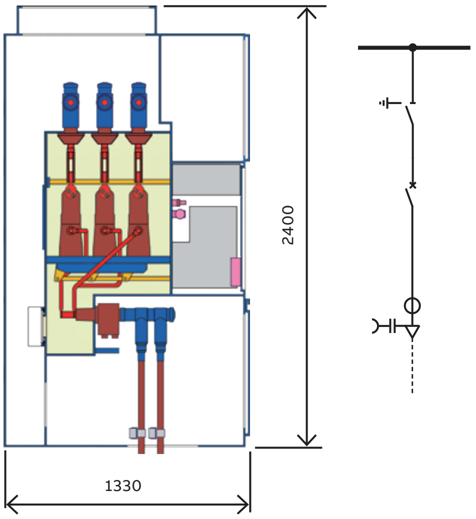

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Fig. 8.1.1.1

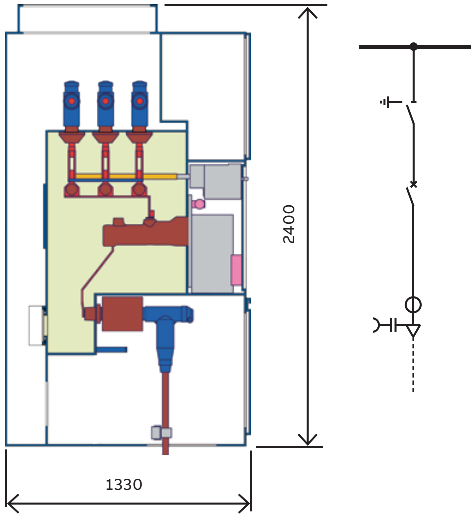

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Fig. 8.1.1.2

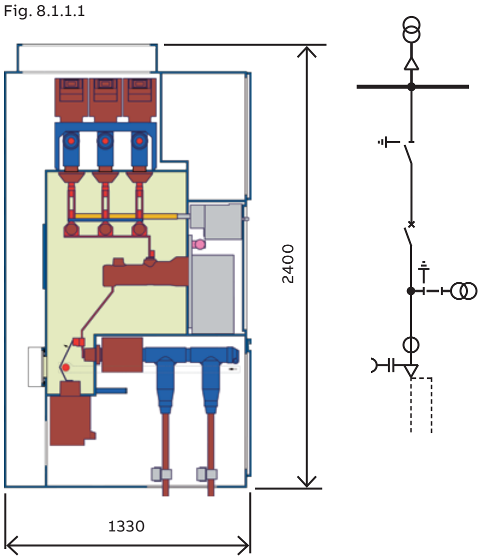

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Fig. 8.1.1.3

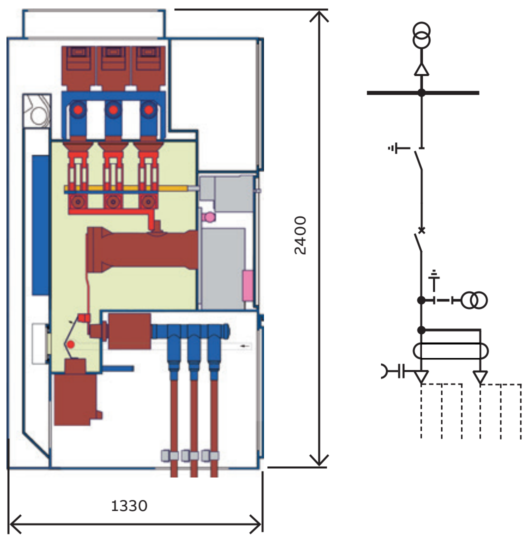

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Fig. 8.1.1.4

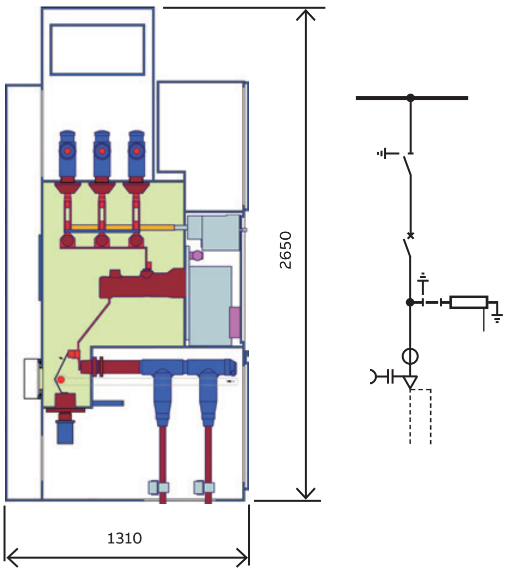

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Fig. 8.1.1.5

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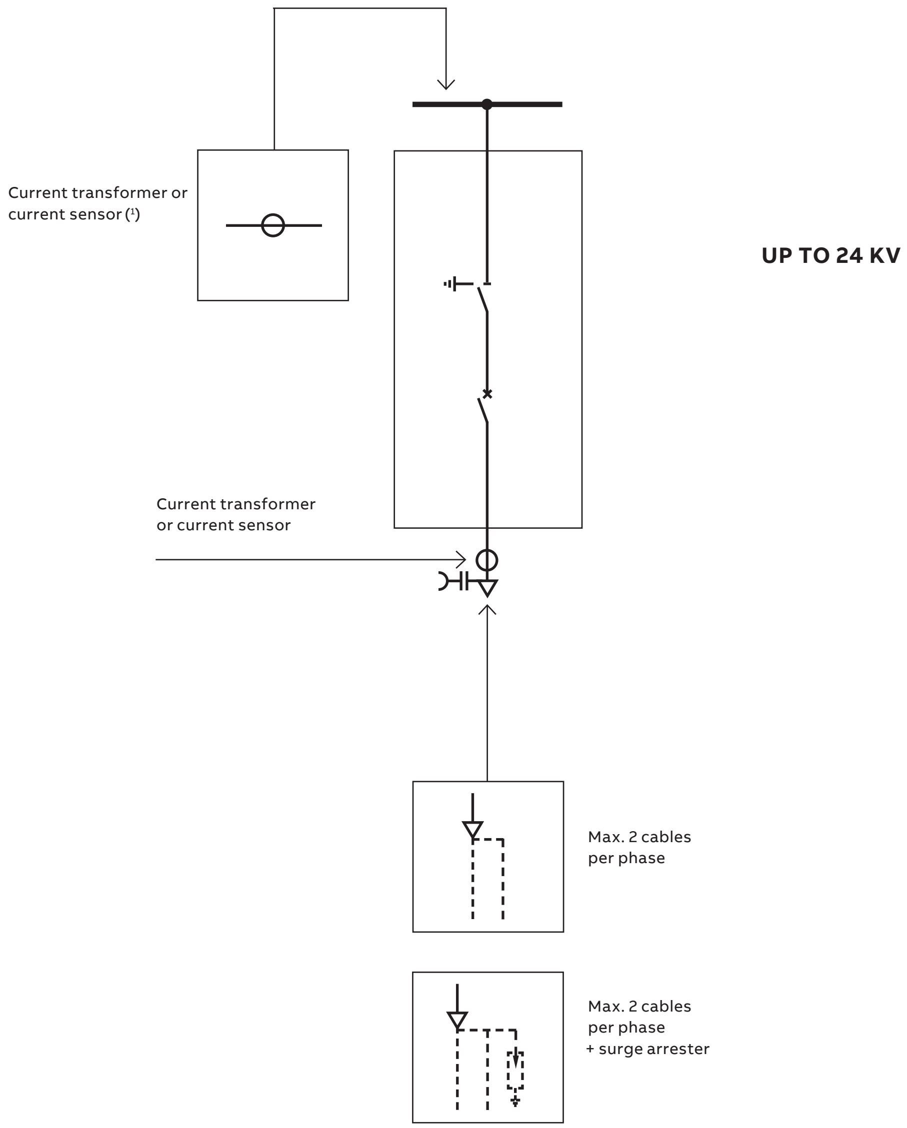
Fig. 8.1.1.6:
Schematic of variants for incoming and outgoing feeder panels I_r up to 630 A, width 450 mm



—
Table 8.1.1.1: Overview of variants for incoming and outgoing feeder panels with circuit breaker, I_r up to 630 A

Panel width: 450 mm	U_r:	...24 kV
	I_r:	…630 A
	I_p:	…25 kA

1. No current transformer possible when the adjacent panel is 450 mm wide or, with a busbar current of 2500 A, the adjacent panel on the left is 600 mm wide.

—
Fig. 8.1.1.7
Schematic of variants for incoming and outgoing feeder panels, I_r up to 1250 A, width 600 mm

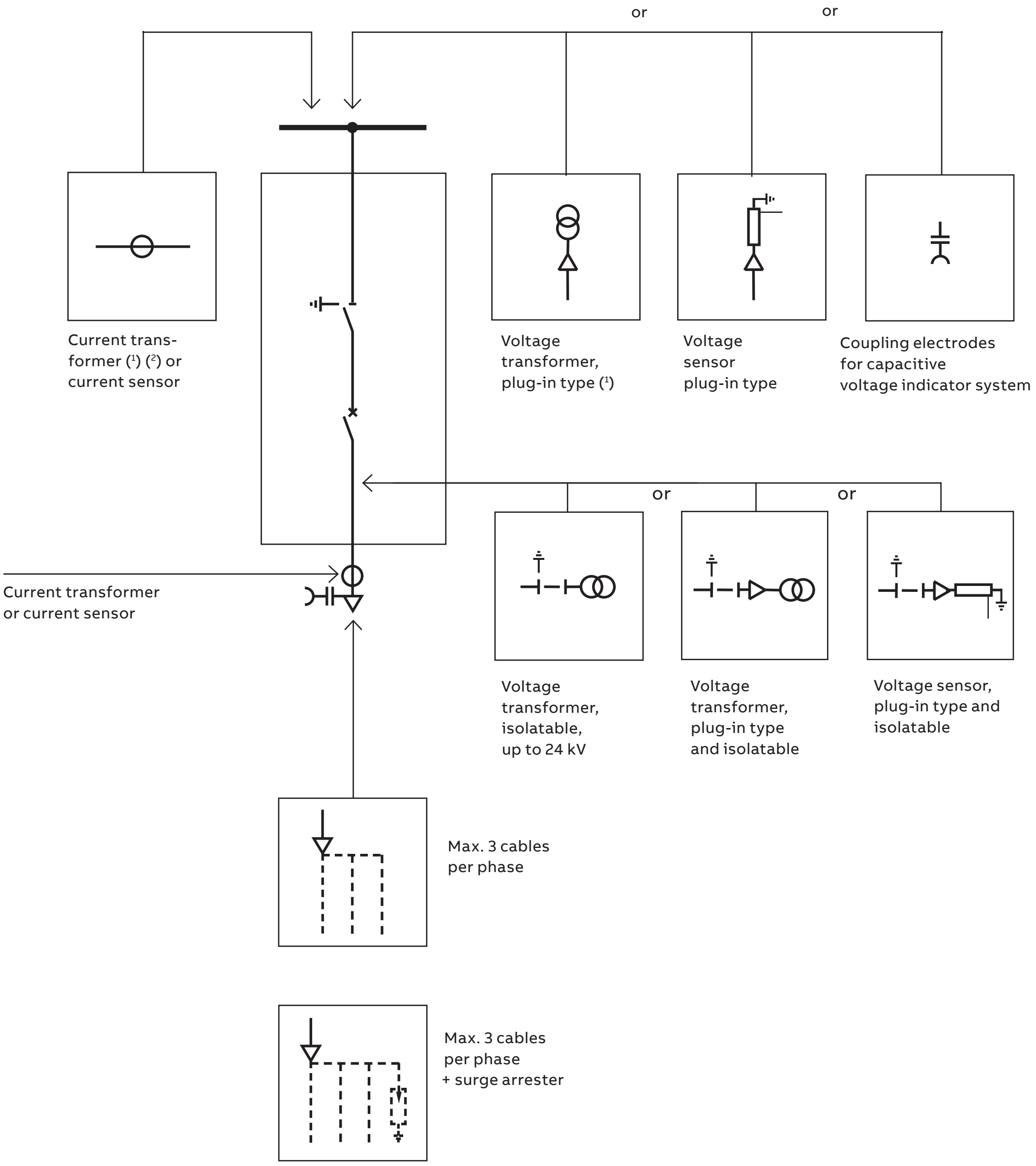


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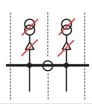
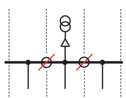
Table 8.1.1.2: Overview of variants for incoming and outgoing feeder panels with circuit-breaker, I_r up to 1250 A

Panel width: 600 mm	U_r: I_r: I_p:	...36 kV ...630 A, ...1250 A ...25 kA, ...31.5 kA

Explanatory note on footnote “1) Either current or voltage transformer”	
	If current transformer then no voltage transformer on the left or right
	If voltage transformer then no current transformer on the left or right

1. (See explanatory note above) Either current or voltage transformer
2. No current transformer possible when the adjacent panel is 450 mm wide

Fig. 8.1.1.8
Schematic of variants for incoming and outgoing feeder panels, I_r up to 2500 A, width 1200 mm

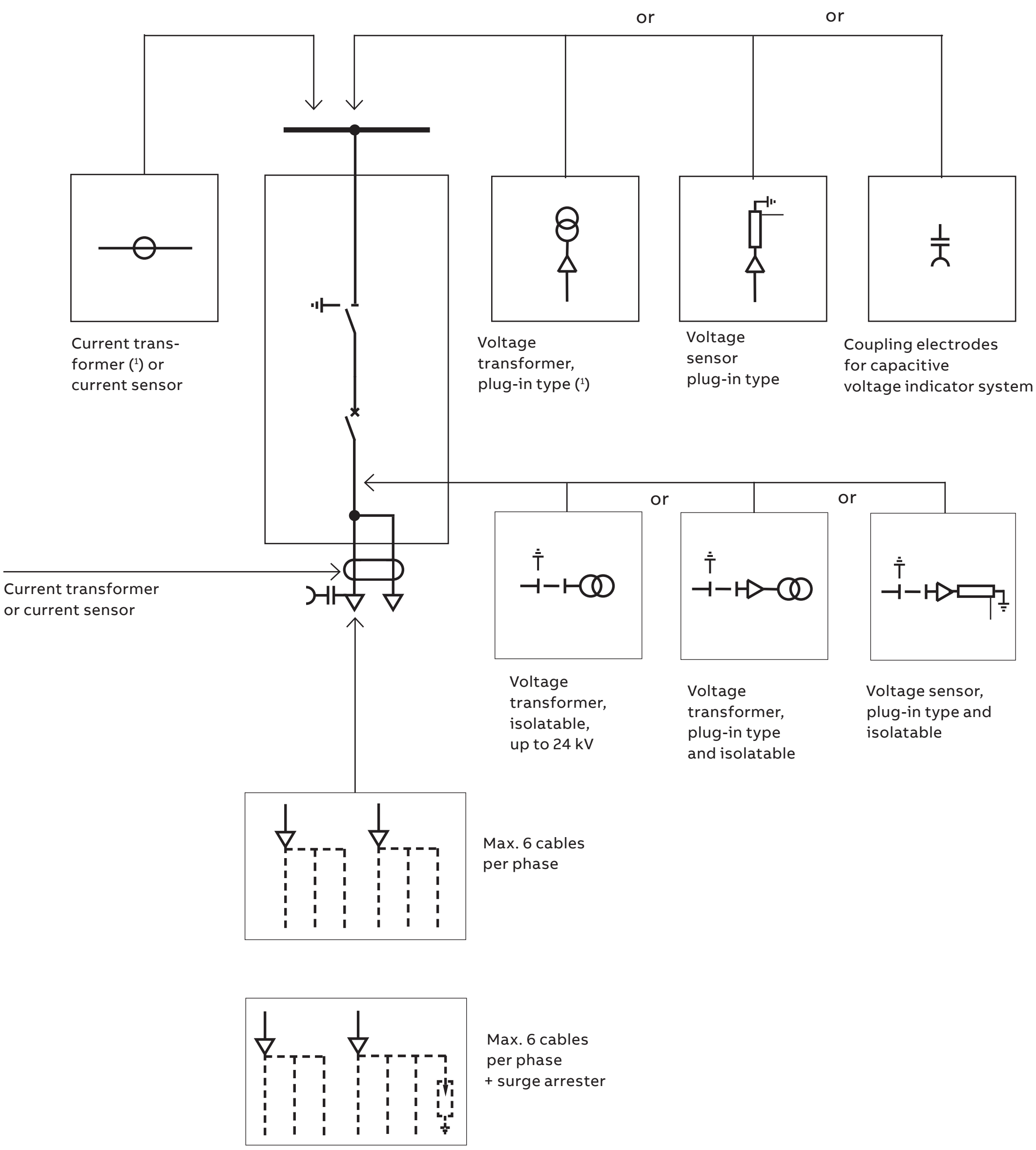


Table 8.1.1.3: Overview of variants for incoming and outgoing feeder panels with circuit-breaker, I_r over 1250 A and up to 2500 A

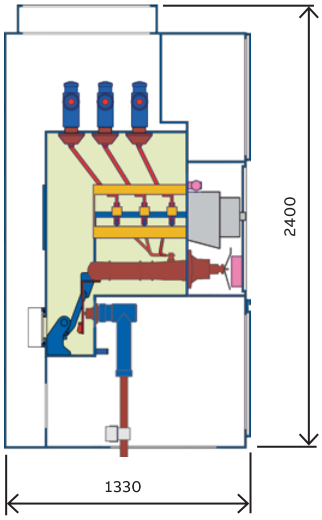
Panel width: 1200 mm	U_r:	...36 kV
	I_r:	...1600 A, ...2000 A, ...2500 A
	I_p:	...25 kA, ...31.5 kA

1. (See explanatory note on page 54) Either current or voltage transformer

Fig. 8.1.2.1:
Feeder panel with three position switch disconnector and fuses

Fig. 8.1.2.1:
Schematic of variants for feeder panels with three position switch disconnector and fuses

8.1.2.Feeder panels with three position switch disconnector and fuses



UP TO 24 KV

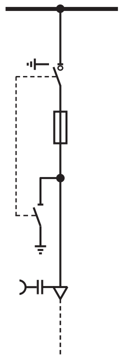


Fig. 8.1.2.1

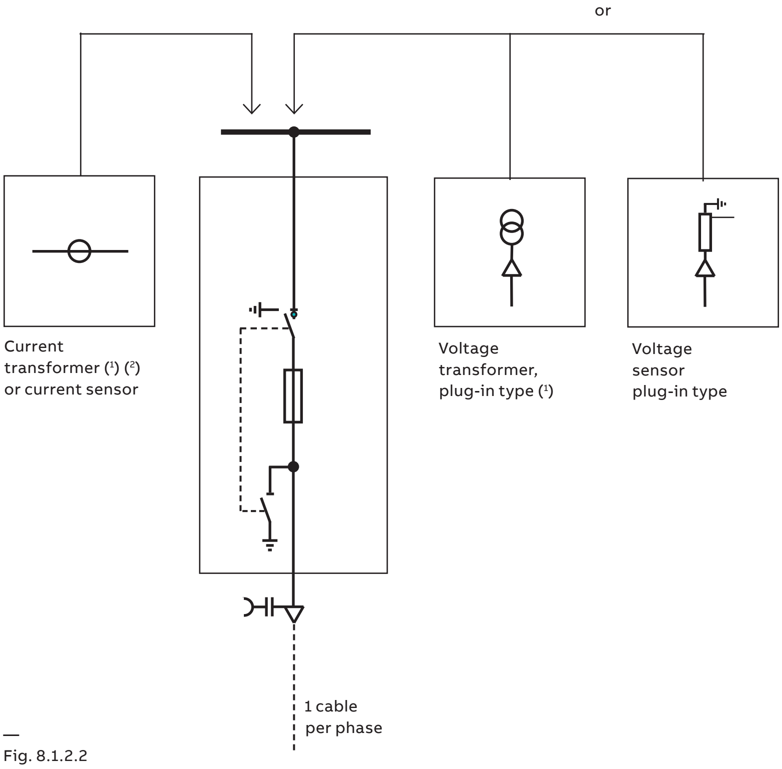


Fig. 8.1.2.2

Table 8.1.2.1: Overview of variants for incoming and outgoing feeder panels with three position switch disconnector

Panel width: 600 mm	U_r: I_r:	...12 kV ...100 A
	U_r: I_r:	...24 kV ...63 A

1. (See explanatory note on page 54) Either current or voltage transformer
2. No current transformer possible when the adjacent panel is 450 mm wide

—
Fig. 8.1.3.1:
Cable termination panel, I_r up to 1250 A, width 600 mm

—
Fig. 8.1.3.2:
Schematic of variants for cable termination panels, I_r up to 1250 A, width 600 mm

8.1.3. Cable termination panels

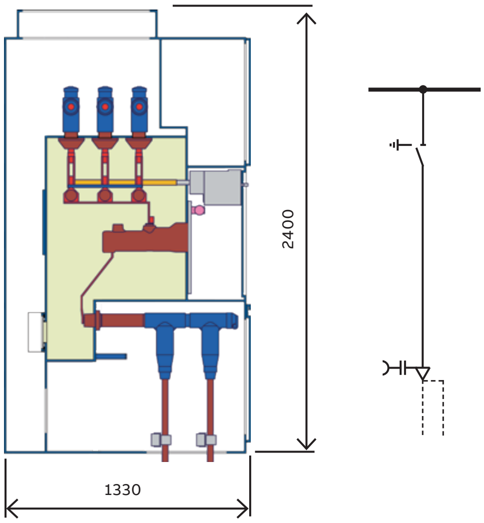


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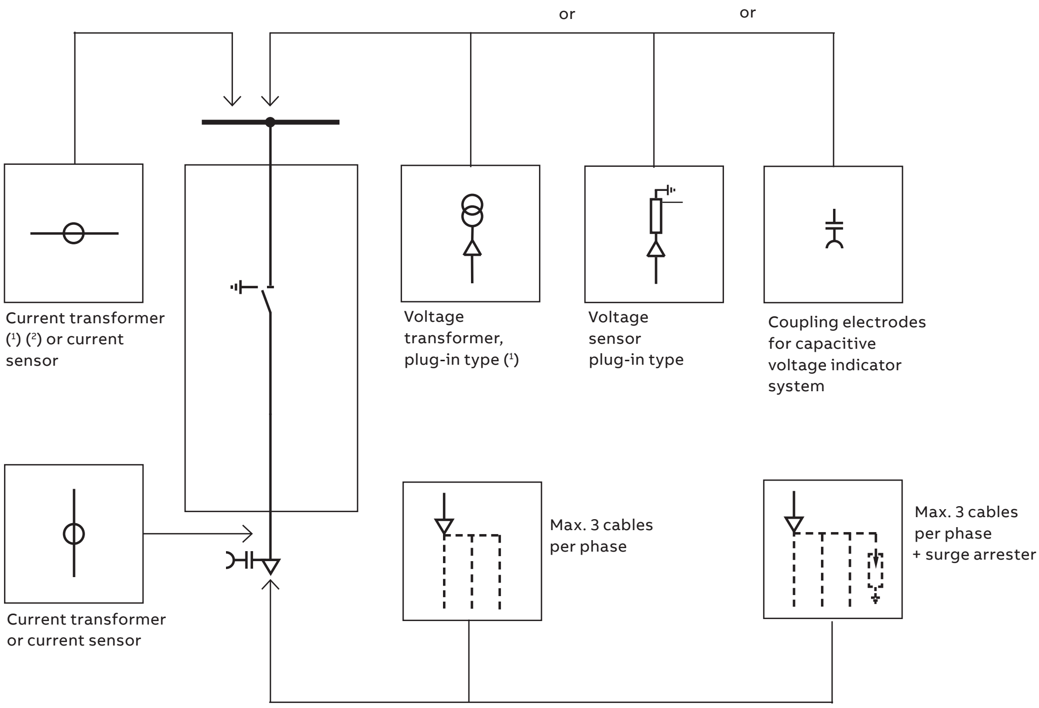
Fig. 8.1.3.1



—
Fig. 8.1.3.2

—
Table 8.1.3.1: Overview of variants for cable termination panels, I_r up to 1250 A

Panel width: 600 mm	U_r: I_r: I_p:	...36 kV ...1250 A ...25 kA, ...31.5 kA

1. (See explanatory note on page 54) Either current or voltage transformer
2. No current transformer possible when the adjacent panel is 450 mm wide

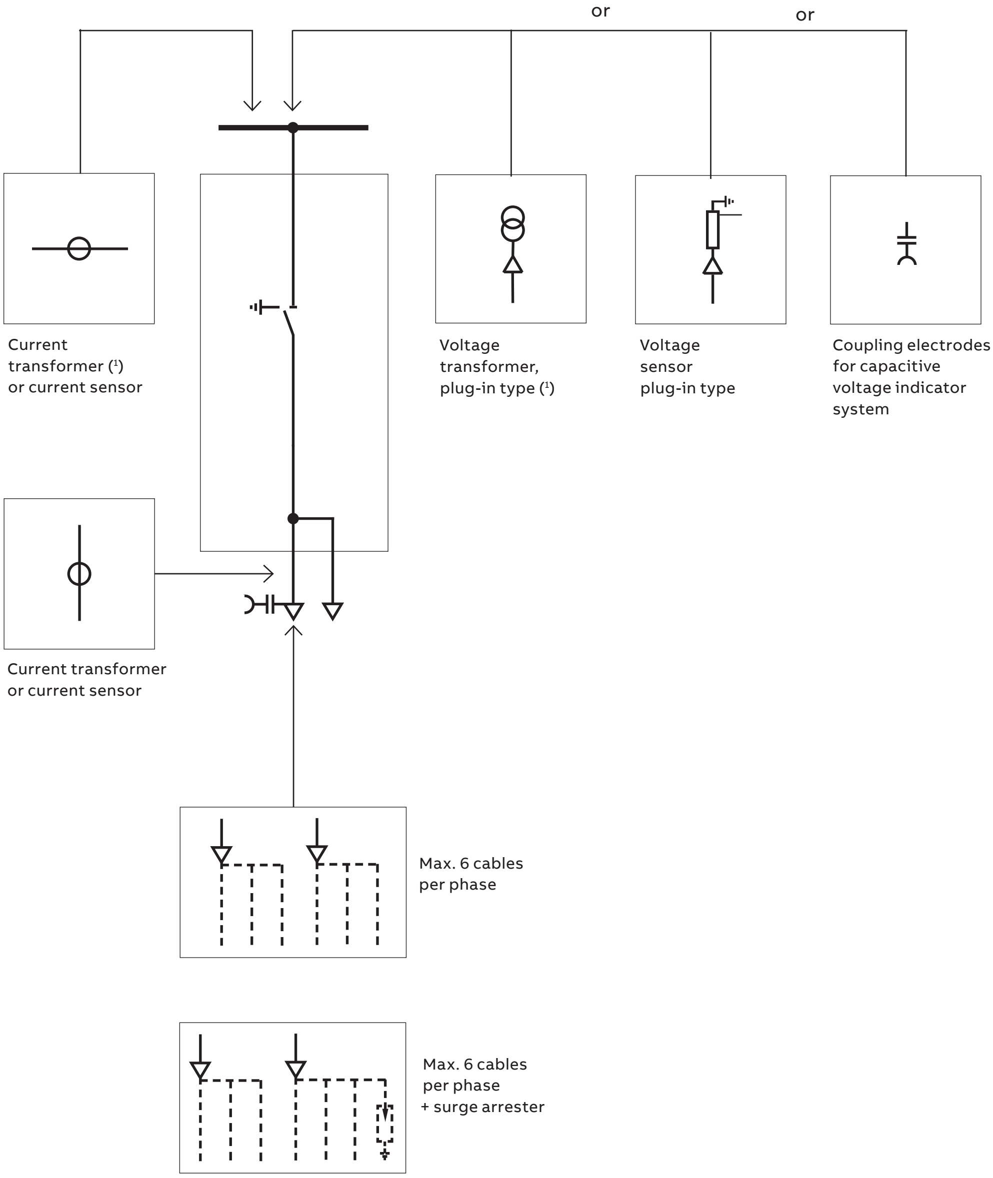


Fig. 8.1.3.3: Schematic of variants for cable termination panels, I_r up to 2500 A, width 1200 mm

Table 8.1.3.2: Overview of variants for cable termination panels, I_r up to 2500 A

Panel width: 1200 mm	U_r:	...36 kV
	I_r:	...2500 A
	I_p:	...31.5 kA

1. (See explanatory note on page 54) Either current or voltage transformer

—
Fig. 8.2.1.1:
Sectionalizer panel,
I_r up to 1250 A,
width 600 mm

—
Fig. 8.2.1.2:
Riser panel,
I_r up to 1250 A,
width 600 mm

—
Fig. 8.2.1.3:
Sectionalizer panel,
I_r up to 2500 A,
width 900 mm

—
Fig. 8.2.1.4:
Riser panel,
I_r up to 2500 A,
width 900 mm

8.2. Busbar sectionalizer and riser panels

A sectionalizer and a riser panel are required for the implementation of bus couplings. In addition, a transfer panel containing a circuit-breaker and a three position disconnector is also available.

Bus couplings can be integrated in a switchgear block. The riser and sectionalizer panels are connected by a solid insulated bar below the panel module.
Couplings between two system blocks can be effected by means of cables.

8.2.1. Couplings within a switchgear block

Sectionalizer panels are equipped with a combination of circuit-breaker and three position disconnector. Riser panels contain a three position disconnector. The current transformer is located on the solid insulated bar below the panel module.
Sectionalizer and riser panels can be fitted with voltage transformers for busbar measurement.
The installation variants “sectionalizer left – riser right” and vice versa are possible.
For future extension a riser panel can be installed at the end of the switchgear system.

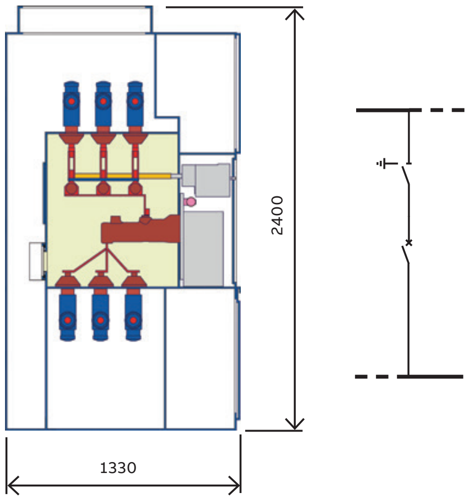


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Fig. 8.2.1.1

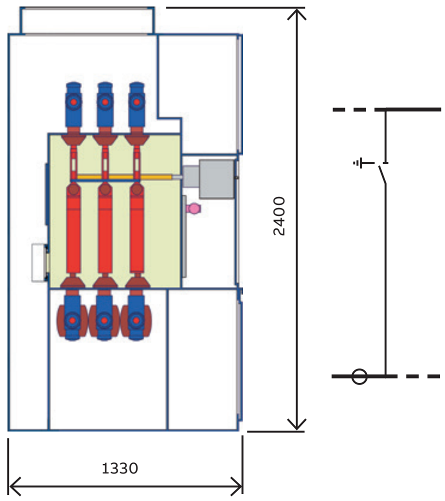

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Fig. 8.2.1.2

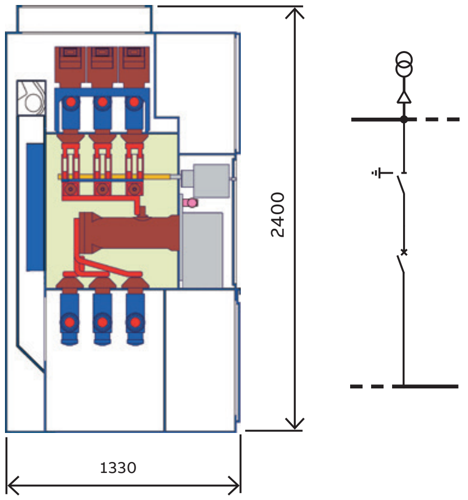

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Fig. 8.2.1.3

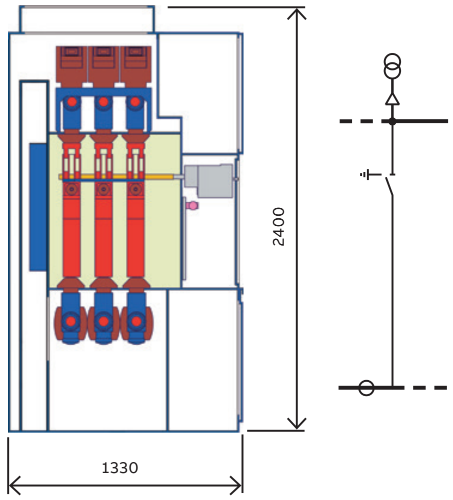

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Fig. 8.2.1.4

Fig. 8.2.1.5: Overview of variants for sectionalizer and riser panels for installation within a switchgear block

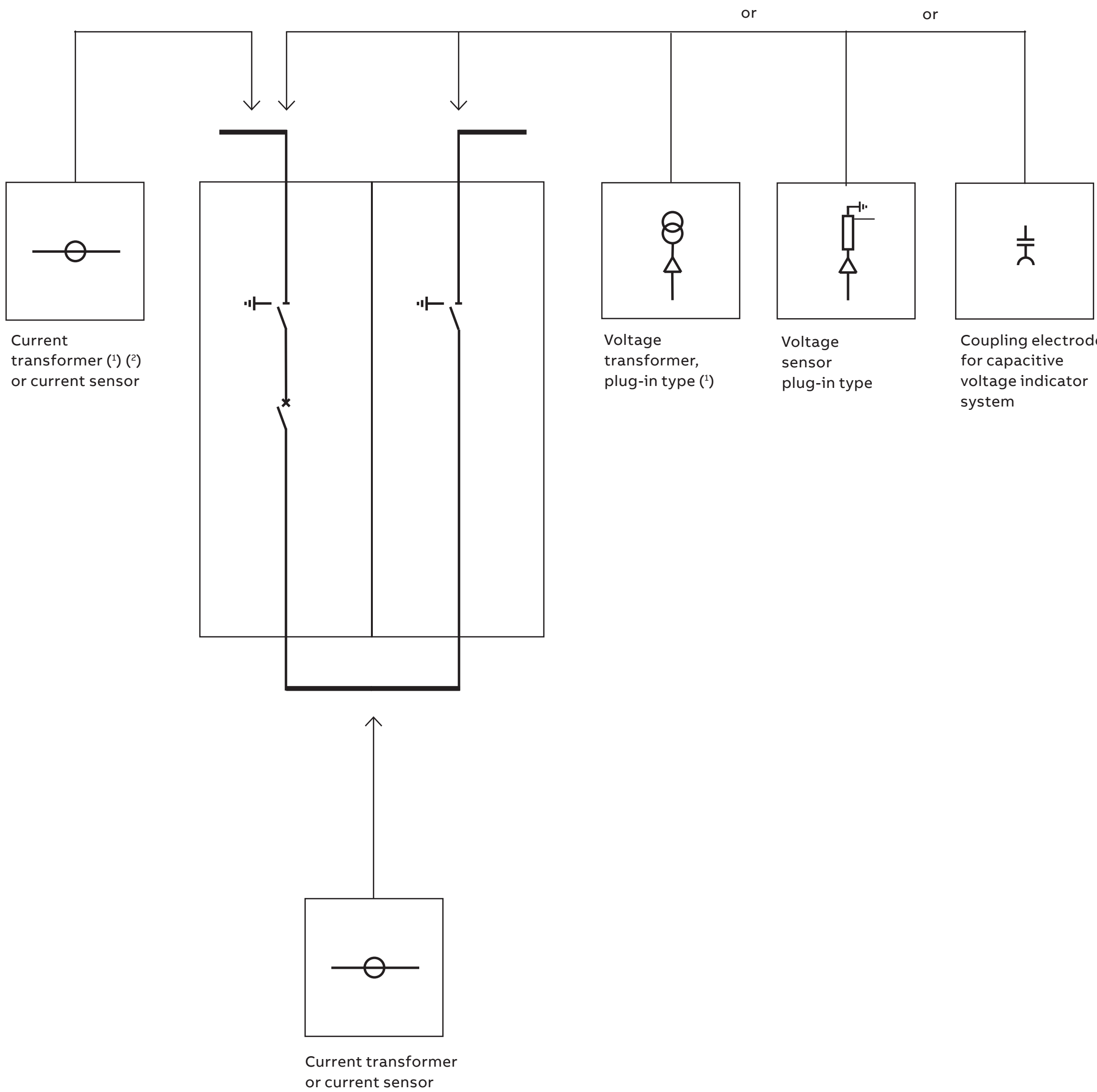


Table 8.2.1.1: Overview of variants for sectionalizer and riser panels for installation within a switchgear block

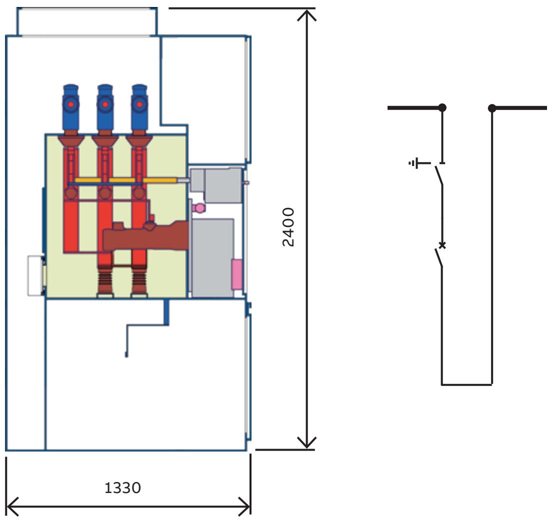
Panel width: 2 x 600 mm	U_r: I_r: I_p:	...36 kV ...1250 A ...25 kA, ...31.5 kA
Panel width: 2 x 900 mm	U_r: I_r: I_p:	...36 kV ...1600 A, ...2000 A, ...2500 A ...25 kA, ...31.5 kA

1. (See explanatory note on page 54) Either current or voltage transformer
2. No current transformer possible when the adjacent panel is 450 mm wide

Fig. 8.2.1.5:
Overview of variants
for transfer panel

8.2.2. Transfer panel

The transfer panel contains a circuit-breaker and a three position disconnector. In this panel variant, the three position disconnector is located between the left-hand busbar section and the circuit-breaker. The bushings on the left-hand busbar section can be fitted with voltage sensors. Current transformers can be positioned under certain circumstances (1) (2) on the busbars of the adjacent panels.



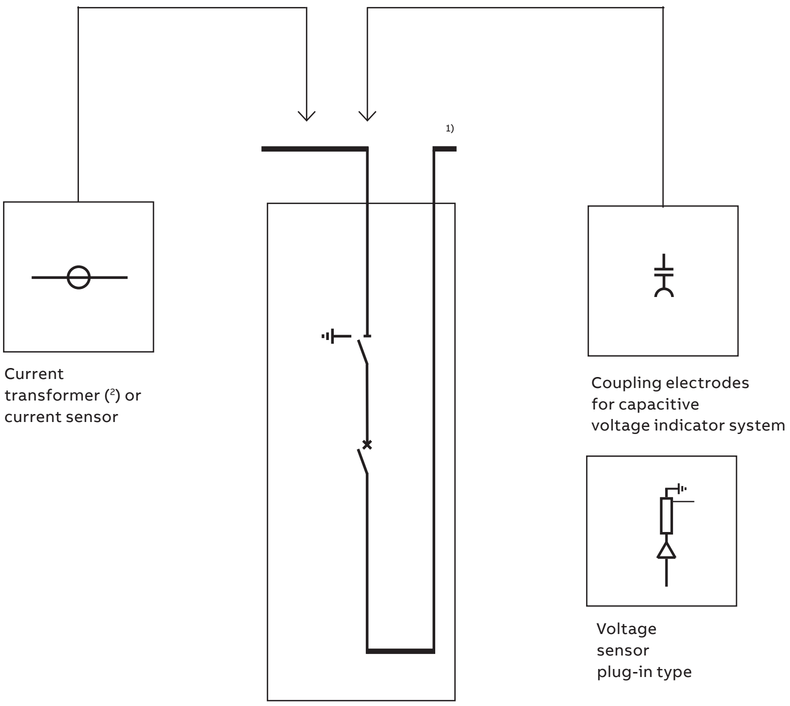


Table 8.2.2.1: Transfer panel

Panel width: 600 mm	U_r:	...17.5 kV	...24 kV
	I_r:	...1250 A	...1250 A
	I_p:	...31.5 kA	...25 kA

1. No current transformers can be installed between the transfer panel and the adjacent panel on the right.
2. No current transformer when the adjacent panel is 450 mm wide

8.2.3. Coupling (Connection of two blocks via cables)

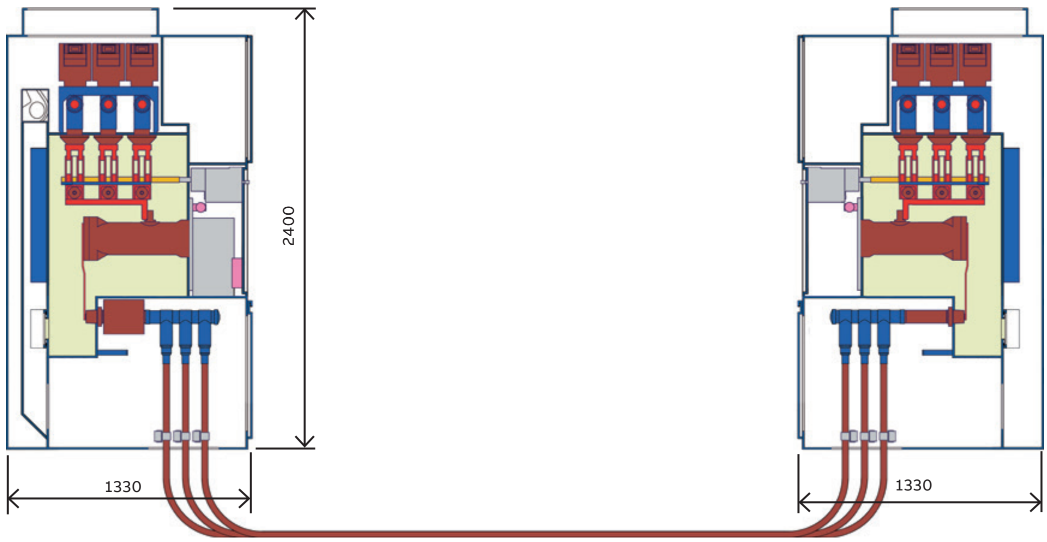
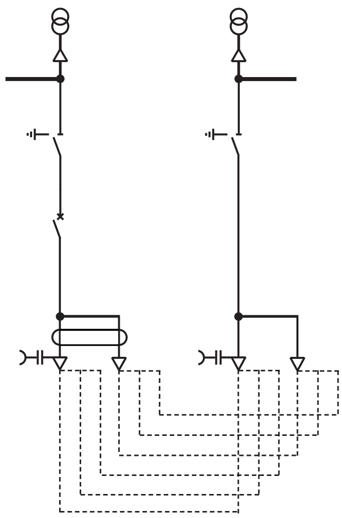


Fig. 8.2.3.1: Couplings by cables, example configuration with circuit-breaker, three position disconnectors and integrated busbar voltage measurement, 2500 A



The overview of variants can be found in section 8.1.

Table 8.2.1.1: Overview of variants for sectionalizer and riser panels for installation within a switchgear block

Panel width: 600 mm	U_r: I_r: I_p:	...36 kV ...1250 A ...25 kA, ...31.5 kA
Panel width: 1200 mm	U_r: I_r: I_p:	...36 kV ...1600 A, ...2000 A, ...2500 A ...25 kA, ...31.5 kA

9. Busbar earthing

—
Fig. 9.1.1:
Busbar earthing
by earthing set

—
Fig. 9.2.1:
Busbar earthing
by sectionalizer and riser

This section outlines the ways in which the busbar can be earthed. The details of these operations can be found in the relevant instruction manuals.

9.1. Earthing the busbar by means of an earthing set
With the feeder earthed, the cable connectors can be fitted with an earthing set connected to the main earthing bar. The earthing sets considered suitable by the cable connector manufacturer for the type of connector concerned are to be used. The busbar is earthed via the closed feeder disconnector and closed circuit-breaker downstream (see fig. 9.1.1). Earthing can also be effected similarly via a switch disconnector panel with cable termination.

9.2. Earthing the busbar by means of a sectionalizer and riser or bus coupler
Earthing is effected by the three position disconnector and the circuit-breaker in a bus sectionalizer (see fig. 9.2.1).

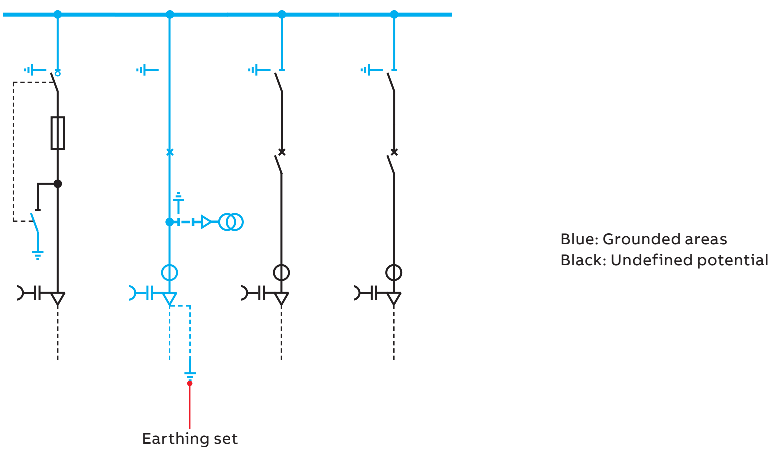


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Fig. 9.1.1

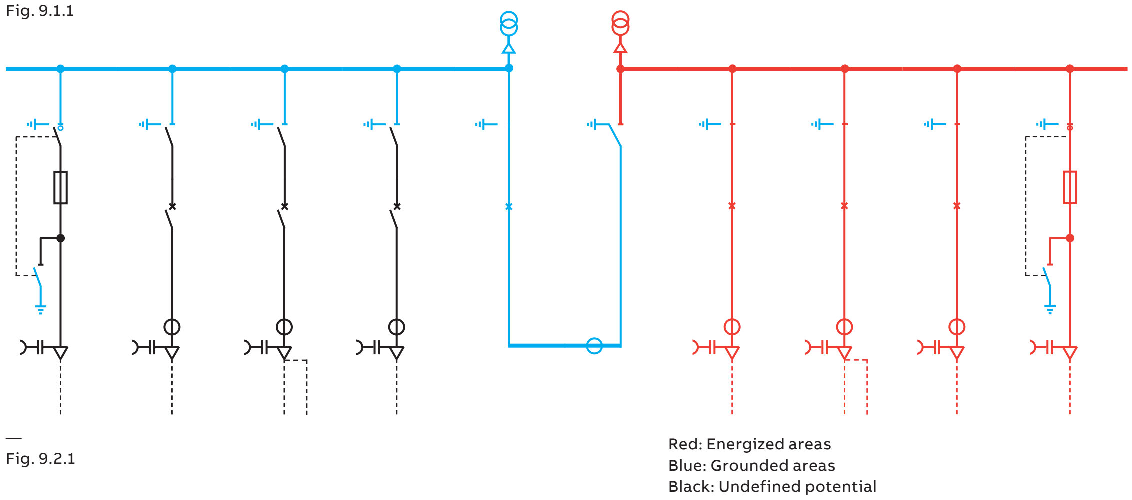

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Fig. 9.2.1

10. Building planning

10.1. Site requirements
The switchgear can be installed:
- On a concrete floor, or
- On a raised false floor

Concrete floor
A concrete floor requires a foundation frame set into the floor topping. The evenness and straightness tolerances for the base of the switchgear system are ensured by the foundation frame. The foundation frame can be supplied by ABB. Floor openings for power and control cables can be configured as cutouts for each panel or as continuous cutouts (one each for power and control cables). The floor openings are to be free from eddy currents.

False floor
Below the switchgear, the supporting sections of the raised false floor serve as a base for the panels. A foundation frame is not as a rule necessary.

Pressure stress on the switchgear room
With pressure relief inside the switchgear room, a pressure rise in the room can be expected in the – highly unlikely – event of an internal arc fault. This is to be taken into account when planning the building. The pressure rise can be calculated by ABB on request. Pressure relief openings in the switchgear room may be necessary.

Ventilation of the switchgear room
Lateral ventilation of the switchgear room is recommended.

Service conditions
The service conditions according to IEC 62271-1 for indoor switchgear are to be ensured.

The ambient air is not significantly polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt.

The conditions of humidity are as follows:
- the average value of the relative humidity, measures over a period of 24 h, does not exceed 95%
- the average value of the water vapor pressure, over a period of 24 h, does not exceed 2.2 kPa
- the average value of the relative humidity, over a period of one month, does not exceed 90%
- the average value of the water vapor pressure, over a period of one month, does not exceed 1.8 kPa

Heaters are to be fitted in the low voltage compartments to preclude condensation phenomena (outside the gas-tight enclosures) resulting from major rapid temperature fluctuations and corresponding humidity.
The specified temperature conditions according to IEC 62271-1 (> -5 °C) are also to be ensured by means of room heating.

10.2. Space required
The opportunities to install the switchgear at a small distance from the switchgear room wall at the rear or as a free-standing unit must be considered together with the two options for pressure relief of the switchgear. Pressure relief can be into the switchgear room or to the outside via a pressure relief duct. This results in four variants:

1. Pressure relief into the switchgear room / Wall installation

2. Pressure relief into the switchgear room / Free-standing

3. Pressure relief to the outside through a duct / Wall installation

4. Pressure relief to the outside through a duct / Freestanding

The following conditions are to be fulfilled in planning the position of a switchgear installation in the switchgear room:

a) Fulfillment of IEC 61936 standard in connection with an escape route width of no less than 500 mm behind and to the side of the switchgear system.

b) Fulfillment of IEC 61936 standard in connection with an aisle width of no less than 800 mm in front of the switch gear system. Under certain conditions, the aisle width has to be increased as set out in Table 10.3.2.

c) Fulfillment of IEC 62271-200 standard in connection with a minimum distance of 800 mm between the rear of the switchgear system and the wall of the building behind it in the case of free-standing installation, and a distance of 800 mm at one side of switchgear system and 100 ± 30 mm at the other side.

Explanatory note:
The distance between the switchgear system and the building wall may be 100 ± 30 mm on one side, either right or left. For reasons concerning installation methods, a distance of 100 ± 30 mm on both sides is not possible.
The distances of 800 mm for free-standing installation mentioned above at the rear and side of the switchgear system result from the requirement in the standard for 500 mm deep mounting racks with indicators 300 mm from the test specimen (the switchgear system). If the dimension on installation of the system is less than 800 mm, no statement may be made as to the safe accessibility of the system in the areas concerned. The standardized designation IAC-AFLR does not then include the L (for lateral arc fault testing) and/or R (for arc fault testing at the rear).

d) Conditions imposed by the design.

Re 1: Pressure relief into the switchgear room / Wall installation

The switchgear system must be designed to be positioned at a small distance from the wall of the switchgear room. A specified dimension of 1310 mm + 15 mm from the front edge of the switchgear system to the wall of the switchgear room behind the system is the result. Greater dimensions are not permissible, as the end covers at the sides of the switchgear system will then not be flushed with the building wall – and the conditions for safety in the case of internal arc faults are not fulfilled.

Re 2. Pressure relief into the switchgear room / Free-standing

For an internal arc classification of IAC-AFLR, the switchgear system must have a distance of at least 800 mm between the rear walls of the panels and the wall of the switchgear room. If the distance is reduced to one which merely fulfills the condition for an escape route (escape route width no less than 500 mm), it cannot be stated that the switchgear system is safe at the rear in the case of internal arc faults.

Re 3. Pressure relief to the outside through a duct / Wall installation

With pressure relief to the outside via a plenum, the switchgear system must have a distance of 1400 mm from the front edge of the switchgear system to the wall of the switchgear room behind the system.

Re 4. Pressure relief to the outside through a duct / Free-standing

The escape route condition (escape route width min. 500 mm) behind the switchgear must be observed.

The following illustrations show examples of installation dimensions for ZX0.2 switchgear systems.

—
Fig. 10.2.1.1: Wall mounting installation, example of a single row installation (top view, dimensions in mm)

—
Fig. 10.2.1.2: Wall mounting installation, example of a double row installation (top view, dimensions in mm)

10.2.1 Space required when busbar covers are fitted

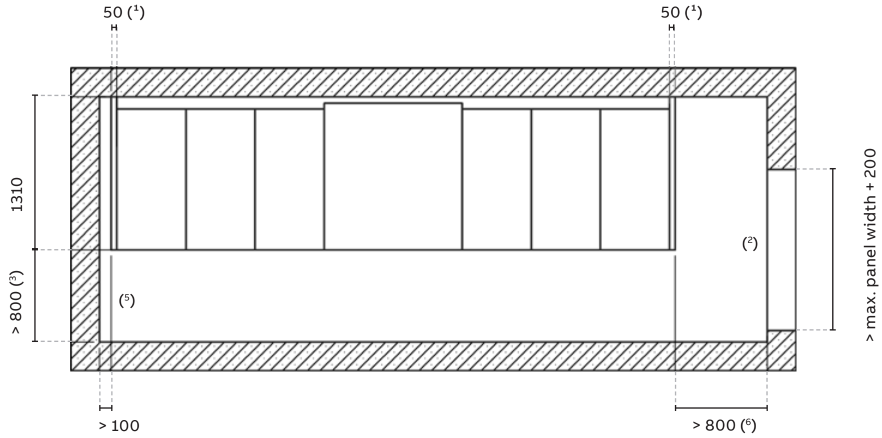

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Fig. 10.2.1.1

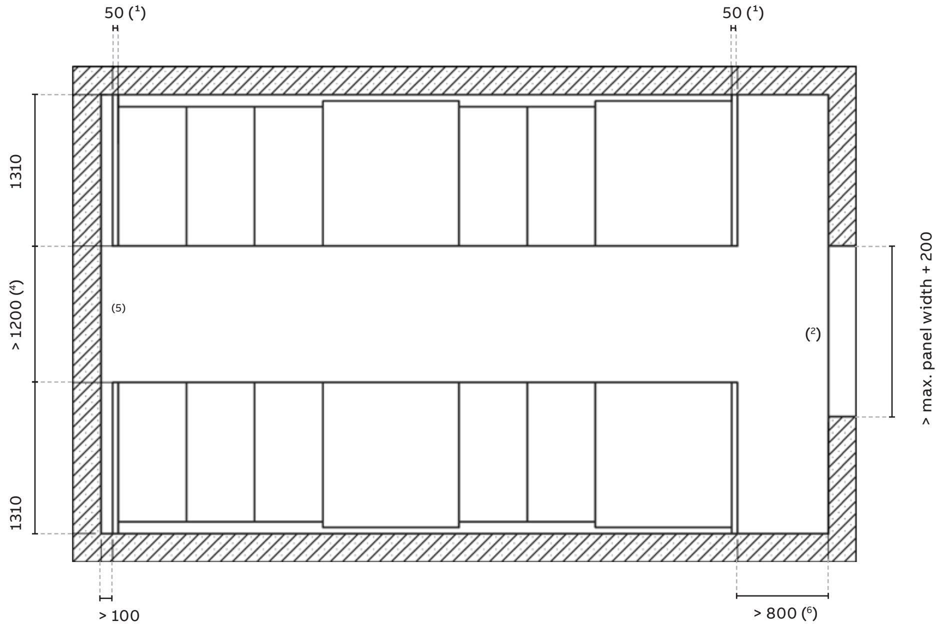

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Fig. 10.2.1.2

1. End cover
2. Recommended minimum door height: 2550 mm, for handling of panels with tall low voltage compartments fitted (figure 6.11): minimum 2900 mm.
3. Conditions for a minimum clearance of 800 mm in front of the system:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm in front of the panel is required for installation of a panel in an existing row.
4. Conditions for a minimum clearance of 1200 mm between the system blocks:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm between the system blocks is required for installation of panels in an existing row. If escape routes are provided at both ends of the system, we recommend a minimum clearance of 1700 mm between the system blocks.
5. Observe IEC 61936 with regard to the necessity to provide escape routes and emergency exits at both ends of the system when the system exceeds a certain length.
6. The width of the escape route can be reduced to 500 mm with a corresponding reduction in the IAC qualification as per table 10.3.1. IEC 62271-200 provides for a distance of 300 mm between the indicators and the panel for arc fault testing. According to the standard, the frame with the mountings for the indicators has a depth of 500 mm, resulting in a minimum distance of 800 mm between the panels and the wall. With smaller distances, therefore, no statements can be made on accessibility at the side of the switchgear system. A minimum escape route width of 500 mm is recommended in IEC 61936.

—
Fig. 10.2.1.3:
Free-standing installation, example of a single row installation (top view, dimensions in mm)

—
Fig. 10.2.1.4:
Free-standing installation, example of a double row installation (top view, dimensions in mm)

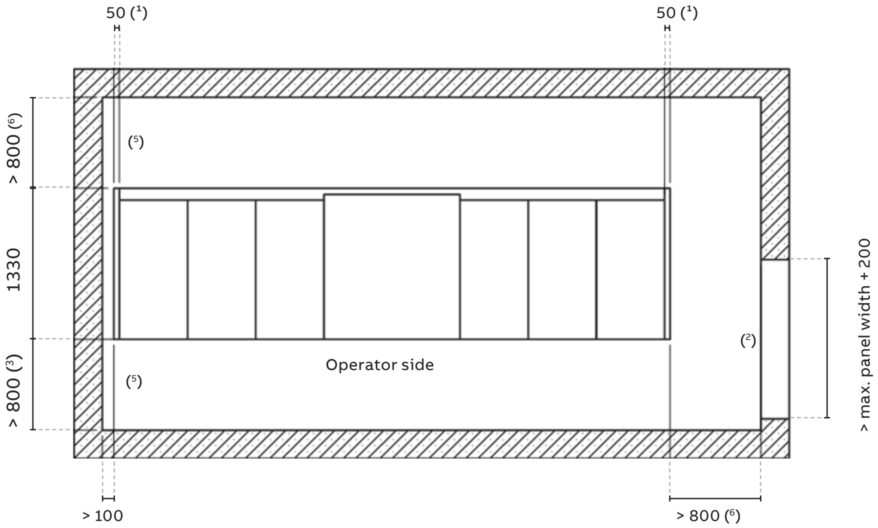

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Fig. 10.2.1.3

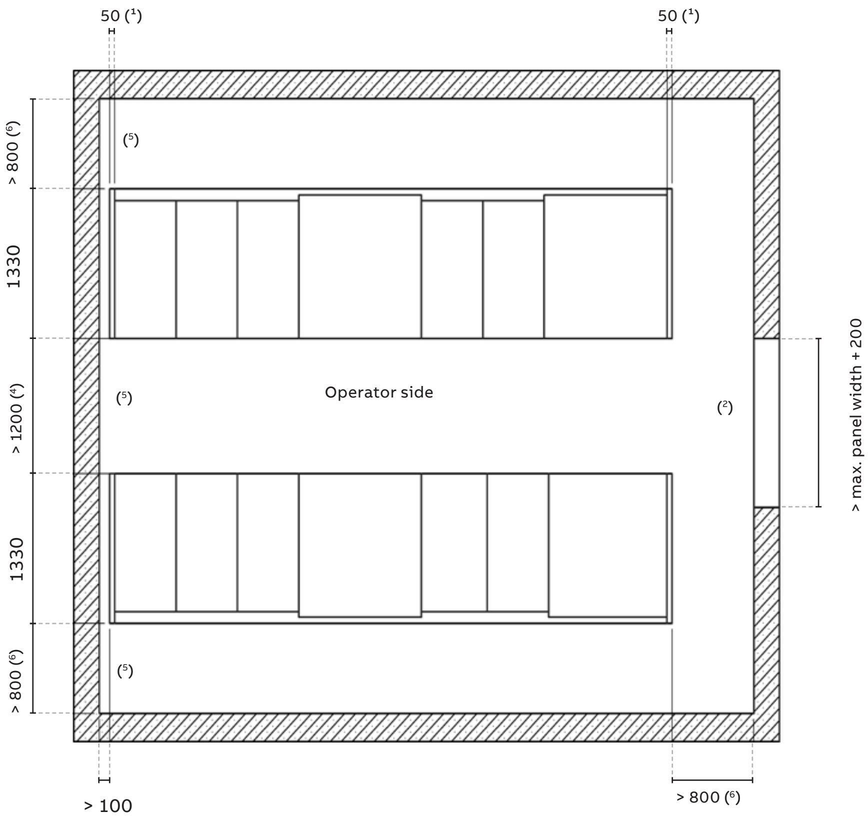

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Fig. 10.2.1.4

1. End cover
2. Recommended minimum door height: 2550 mm, for handling of panels with tall low voltage compartments fitted (figure 6.11): minimum 2900 mm.
3. Conditions for a minimum clearance of 800 mm in front of the system:
   a) The low voltage compartment doors close in the direction of the emergency exit.
   b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm in front of the panel is required for installation of a panel in an existing row.
4. Conditions for a minimum clearance of 1200 mm between the system blocks:
   a) The low voltage compartment doors close in the direction of the emergency exit.
   b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm between the system blocks is required for installation of panels in an existing row. If escape routes are provided at both ends of the system, we recommend a minimum clearance of 1700 mm between the system blocks.
5. Observe IEC 61936 with regard to the necessity to provide escape routes and emergency exits at both ends of the system when the system exceeds a certain length.
6. The width of the escape route can be reduced to 500 mm with a corresponding reduction in the IAC qualification as per table 10.3.1. IEC 62271-200 provides for a distance of 300 mm between the indicators and the panel for arc fault testing. According to the standard, the frame with the mountings for the indicators has a depth of 500 mm, resulting in a minimum distance of 800 mm between the panels and the wall. With smaller distances, therefore, no statements can be made on accessibility at the side of the switchgear system. A minimum escape route width of 500 mm is recommended in IEC 61936.

—
Fig. 10.2.2.1:
Wall mounting installation, example of a single row installation (top view, dimensions in mm)

—
Fig. 10.2.2.2:
Wall mounting installation, example of a double row installation (top view, dimensions in mm)

10.2.2 Space required when a pressure relief duct is fitted

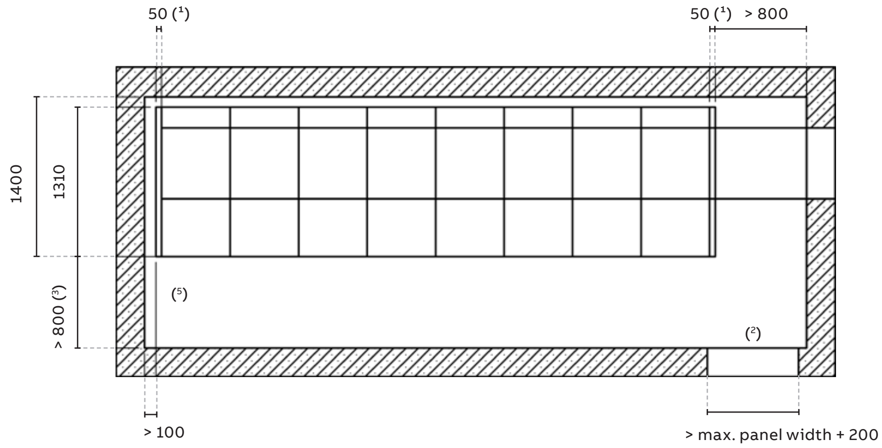

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Fig. 10.2.2.1

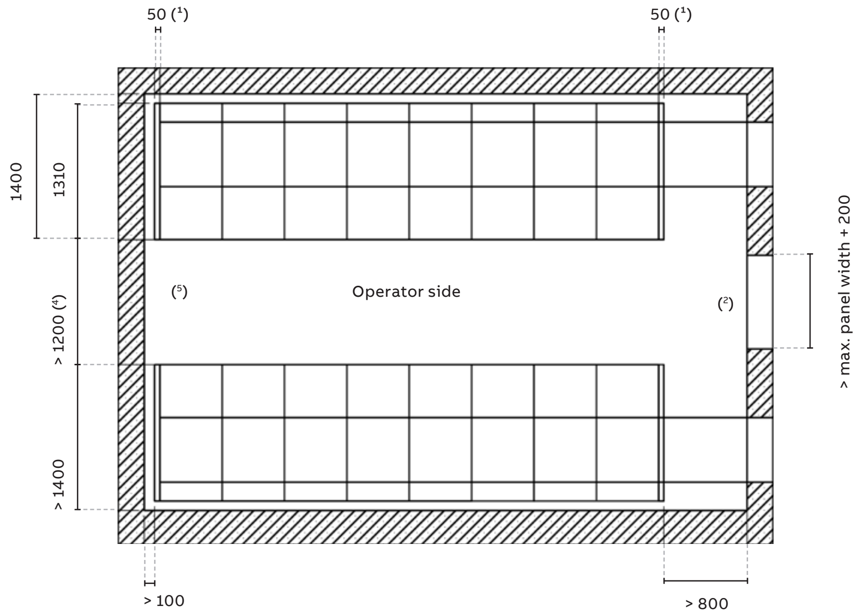

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Fig. 10.2.2.2

1. End cover
2. Recommended minimum door height: 2550 mm, for handling of panels with tall low voltage compartments fitted (figure 6.11): minimum 2900 mm.
3. Conditions for a minimum clearance of 800 mm in front of the system:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm in front of the panel is required for installation of a panel in an existing row.
4. Conditions for a minimum clearance of 1200 mm between the system blocks:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm between the system blocks is required for installation of panels in an existing row. If escape routes are provided at both ends of the system, we recommend a minimum clearance of 1700 mm between the system blocks.
5. Observe IEC 61936 with regard to the necessity to provide escape routes and emergency exits at both ends of the system when the system exceeds a certain length.
6. The width of the escape route can be reduced to 500 mm with a corresponding reduction in the IAC qualification as per table 10.3.1. IEC 62271-200 provides for a distance of 300 mm between the indicators and the panel for arc fault testing. According to the standard, the frame with the mountings for the indicators has a depth of 500 mm, resulting in a minimum distance of 800 mm between the panels and the wall. With smaller distances, therefore, no statements can be made on accessibility at the side of the switchgear system. A minimum escape route width of 500 mm is recommended in IEC 61936.

—
Fig. 10.2.2.3:
Free-standing installation, example of a single row installation (top view, dimensions in mm)

—
Fig. 10.2.2.4:
Free-standing installation, example of a double row installation (top view, dimensions in mm)

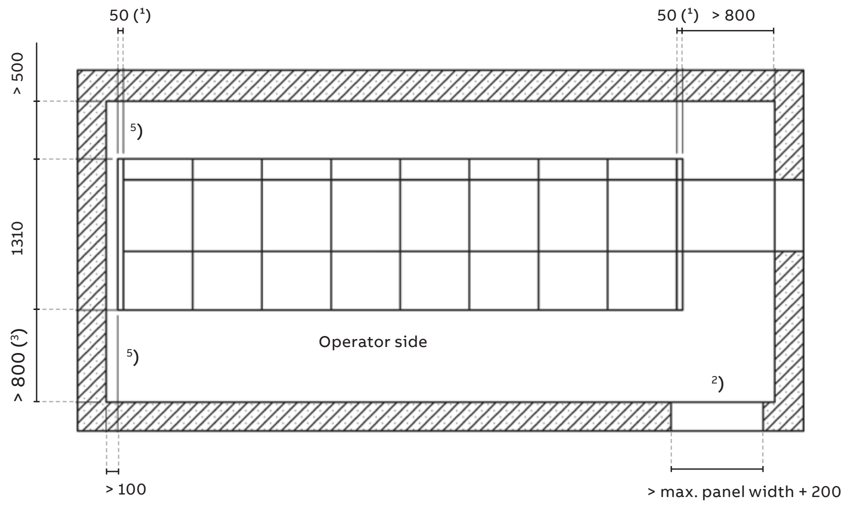

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Fig. 10.2.2.3

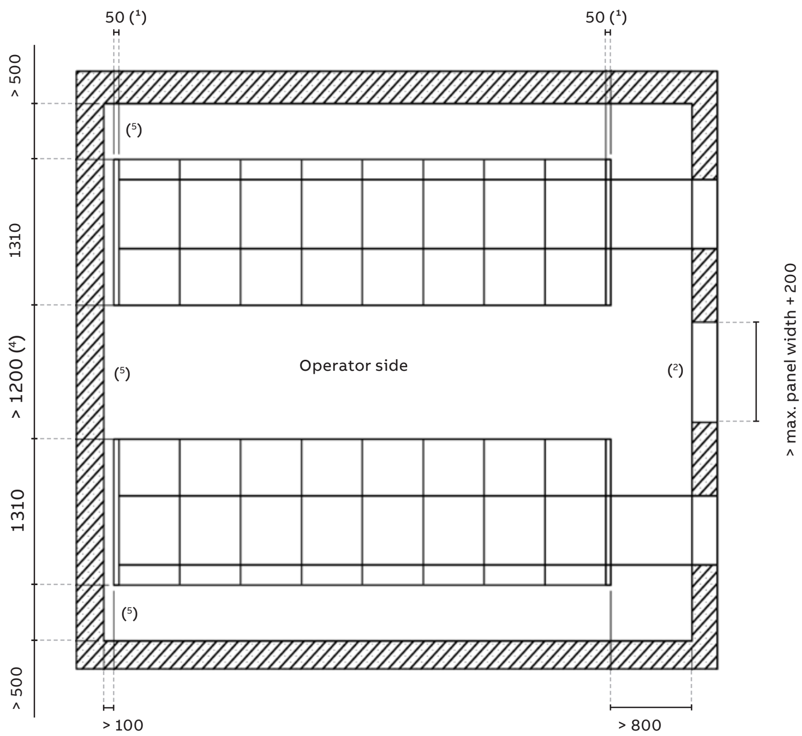

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Fig. 10.2.2.4

1. End cover
2. Recommended minimum door height: 2550 mm, for handling of panels with tall low voltage compartments fitted (figure 6.11): minimum 2900 mm.
3. Conditions for a minimum clearance of 800 mm in front of the system:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm in front of the panel is required for installation of a panel in an existing row.
4. Conditions for a minimum clearance of 1200 mm between the system blocks:
a) The low voltage compartment doors close in the direction of the emergency exit.
b) No door holders are used, (see also IEC 61936). A minimum clearance of 1500 mm between the system blocks is required for installation of panels in an existing row. If escape routes are provided at both ends of the system, we recommend a minimum clearance of 1700 mm between the system blocks.
5. Observe IEC 61936 with regard to the necessity to provide escape routes and emergency exits at both ends of the system when the system exceeds a certain length.
6. The width of the escape route can be reduced to 500 mm with a corresponding reduction in the IAC qualification as per table 10.3.1. IEC 62271-200 provides for a distance of 300 mm between the indicators and the panel for arc fault testing. According to the standard, the frame with the mountings for the indicators has a depth of 500 mm, resulting in a minimum distance of 800 mm between the panels and the wall. With smaller distances, therefore, no statements can be made on accessibility at the side of the switchgear system. A minimum escape route width of 500 mm is recommended in IEC 61936.

Fig. 10.2.2.1.1: Dimensions of the hazardous area for pressure relief to the outside

10.2.2.1. Hazardous area for pressure relief to the outside

In the case of an internal arc fault, hot gases can suddenly emerge from the outlet of the pressure relief duct. The area around the outlet of a pressure relief duct for relief to the outside constitutes a hazardous area which must be fenced off by the switchgear operator to prevent persons from entering that area.

The size of the hazardous area depends on the level of the expected short-circuit current. Please consult fig. 11.5.1 and table 11.5.1 for the dimensions of the hazardous area.

Table 10.2.2.1.1: Dimensions of the hazardous area

Short-circuit current [kA]	A (distance to the side) [m]	R (distance to the front) [m]	H (distance to the top) [m]
20/25	1.0	2.0	2.0
31.5	1.5	2.5	2.5

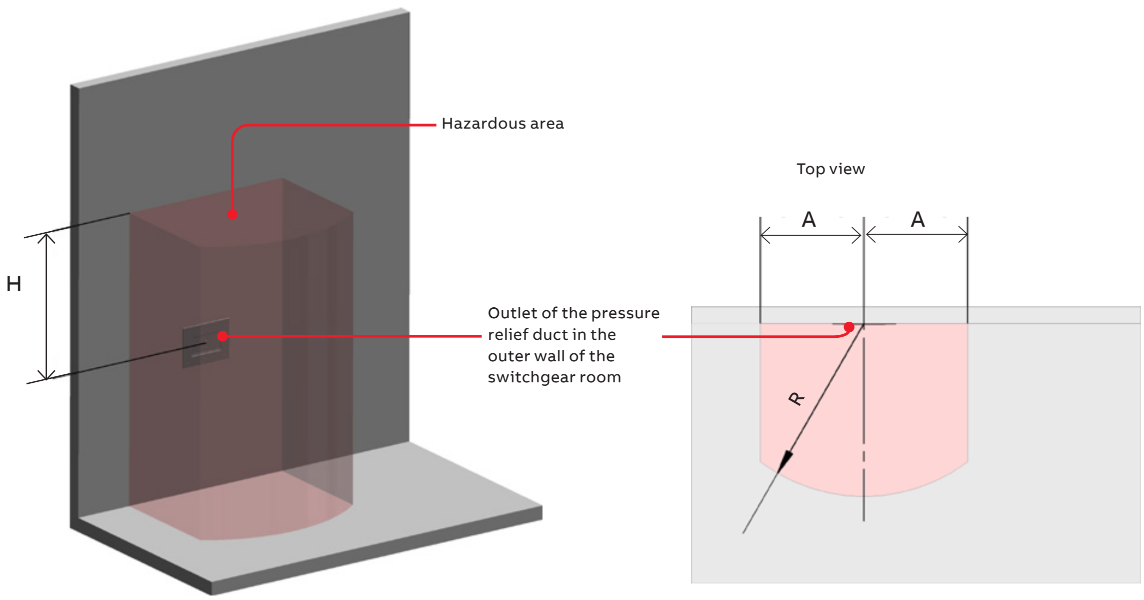

Fig. 10.2.2.1.1

10.3. Minimum aisle widths and emergency exits

The aisle width in front of the switchgear is to be planned with attention to the need to remove panels from or insert panels into existing rows, and to the requirements of the relevant standards (see IEC 61936 and IEC 62271-200). The minimum and recommended minimum aisle widths can be found in tables below.

"Aisles shall be at least 800 mm wide [...] Space for evacuation shall always be at least 500 mm, even when removable parts or open doors, which are blocked in the direction of escape, intrude into the escape routes [...] Exits shall be arranged so that the length of the escape route within the room...does not exceed [...] 20 m [...] If an operating aisle does not exceed 10 m, one exit is enough.
An exit or emergency possibilities shall be provided at both ends of the escape route if its length exceeds 10 m [...] The minimum height of an emergency door [possibly the 2nd door] shall be 2000 mm [clear height] and the minimum clear opening 750 mm." ([1])

—

Table 10.3.1: IAC qualification on reduction of escape route widths to the minimum of 500 mm

		Escape route width at the side of the switchgear system [mm]	Escape route width behind the switchgear system [mm]	IAC classification
Busbar covers fitted	Wall mounting installation	> 800	-	AFL
		> 500	-	AF
	Free-standing installation	> 800	> 800	AFLR
		> 800	> 500	AFL
		> 500	> 800	AFR
		> 500	> 500	AF
Pressure relief duct fitted for discharge to the outside	Wall mounting installation	> 500 (3)	-	AFL
	Free-standing installation	> 500 (3)	> 500	AFLR

—

Table 10.3.2: Recommended aisle width (in front of the system) ([2])

Aisle width in front of the switchgear system, single row installation [mm]	Aisle width between the system blocks, two row installation [mm]
> 800 (without door holders, doors close in the direction of the emergency exit)	> 1200 (without door holders, doors close in the direction of the emergency exit)
> 1100 (escape route width 500 mm with doors open)	> 1500 (for installation of panels in an existing row)
> 1500 (for installation of panels in an existing row)	> 1700 (escape route width 500 mm with doors open on both sides

1. IEC 61936, section 7.5.4

10.4. Minimum room heights

—

Table 10.4.1: Minimum room heights ([2])

Busbar covers fitted [mm]	Pressure relief duct fitted for discharge to the outside [mm]	Tall low voltage compartment fitted [mm]
> 3000 ([3])	> 2900	> 3000

2. Enlarging the aisle width might be required due to the area defined in section "Hazardous area for pressure relief to the outside"
3. Length of the standard pressure relief duct: 800 - 1000 mm

—
Fig. 10.5.1.1:
Opening for cables, panel width 450 mm

—
Fig. 10.5.1.2:
Opening for cables, panel width 600 mm

—
Fig. 10.5.1.3:
Opening for cables, panel width 1200 mm

10.5. Concrete floor

10.5.1. Floor openings

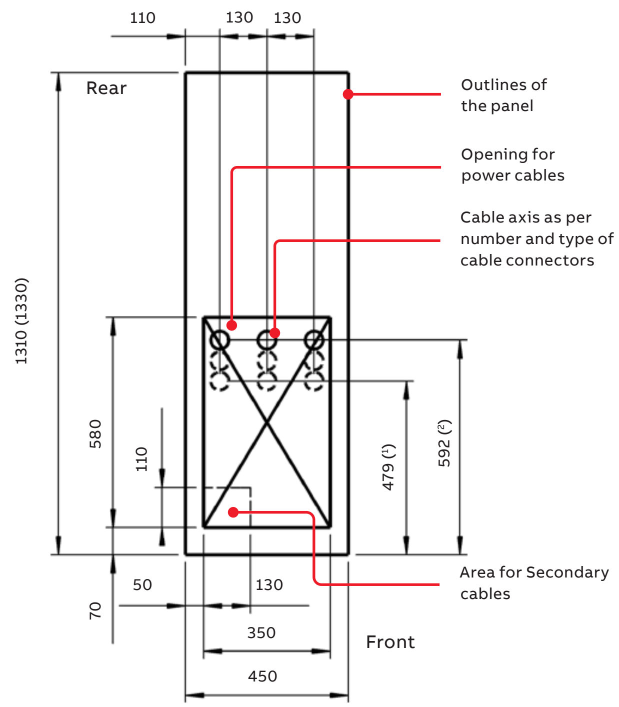

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Fig. 10.5.1.1

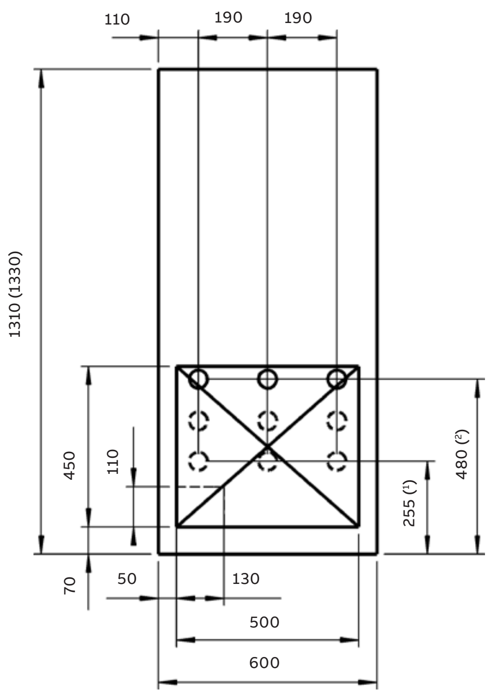

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Fig. 10.5.1.2

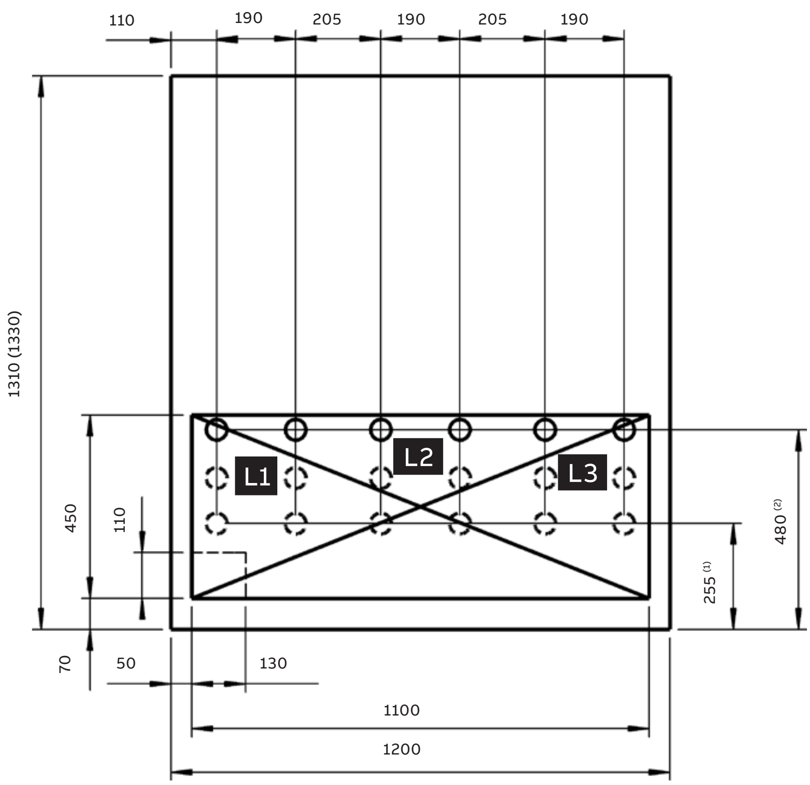

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Fig. 10.5.1.3

1. Minimum dimension for the front cables
2. Maximum dimension for the rear cables

—
Fig. 10.5.1.4:
Floor openings for entry of secondary cables from below (optional) in sectionalizer and riser panels (panel width 600 mm or 900 mm) and in the transfer panel (panel width 600 mm)

—
Fig. 10.5.1.5:
Floor openings for power cables and secondary cables, panel with switch disconnector and fuses

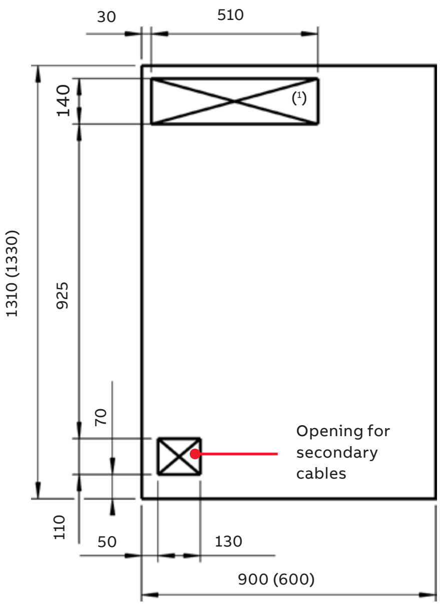

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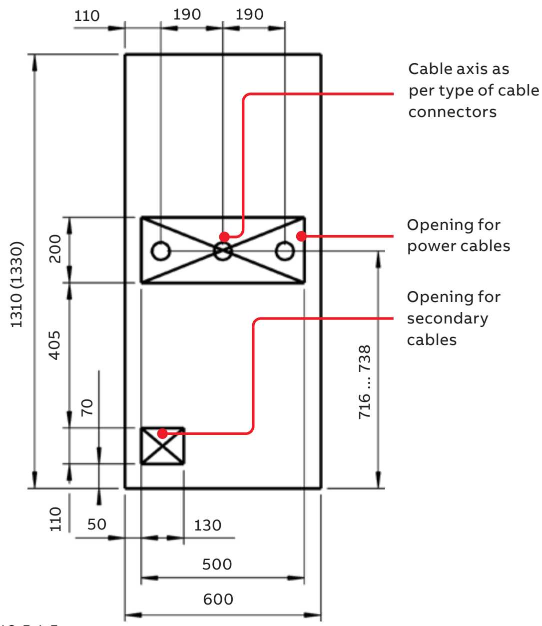
Fig. 10.5.1.4



—
Fig. 10.5.1.5

1. The opening is only necessary for cooling in sectionalizer panels for currents > 1600 A to 2000 A (panel width 900 mm) if a pressure relief duct to the outside is used. No opening is needed for the corresponding riser panel.

— Fig. 10.5.2.1: Foundation frame for panel width 450 mm

— Fig. 10.5.2.2: Foundation frame for panel width 600 mm

— Fig. 10.5.2.3: Foundation frame for panel width 1200 mm

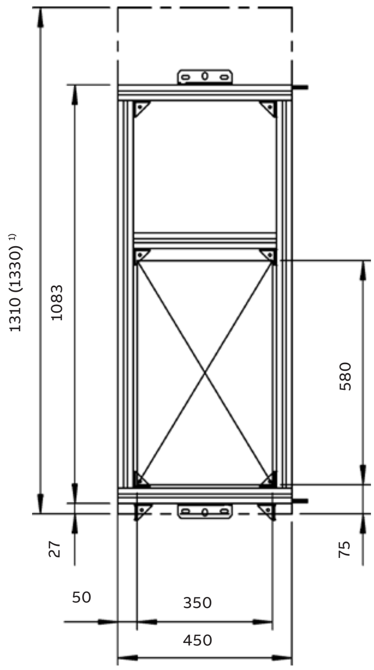
— Fig. 10.5.2.4: Foundation frame

10.5.2. Foundation frames
Standard foundation frames are available in a width of 450 mm for 450 mm wide panels, and in a width of 600 mm for 600 mm, 900 mm and 1200 mm wide panels.

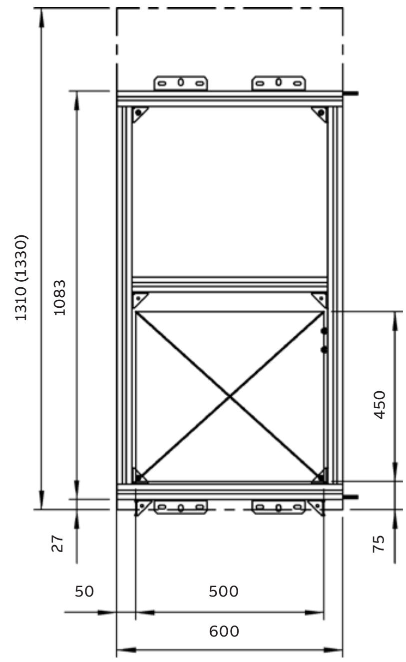
Two frames with a width of 600 mm are to be provided for panels of width 1200 mm, and three frames with a width of 600 mm for panel width 2 x 900 mm (sectionalizer and riser > 1250 A).

The foundation frames are fastened to the concrete floor and embedded in the floor topping.

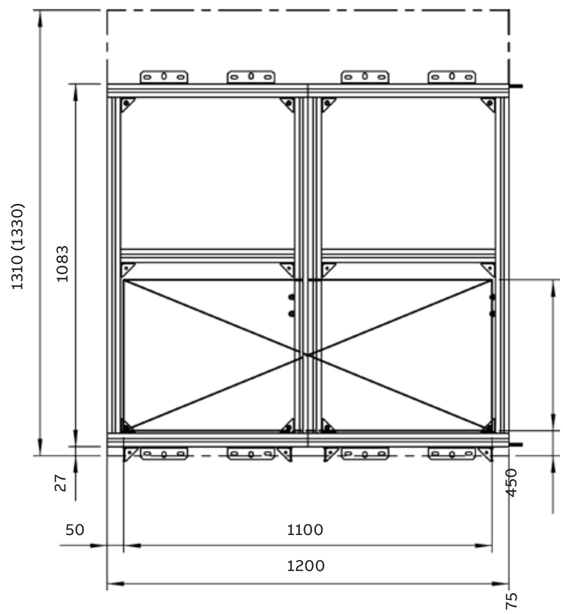
When installing the foundation frame at site, observe the form and position tolerances stated in the order documents.



— Fig. 10.5.2.1



— Fig. 10.5.2.2



— Fig. 10.5.2.3

— Fig. 10.5.2.4

10.6. False floor

Fig. 10.6.1 is an aid to planning of the false floor.

The floor plates of the panels have L13 x 14 slots for fastening the panels to the frame sections. Provide M 8 threads or bore holes for screws M 8 in the frame sections at the positions of the slots.

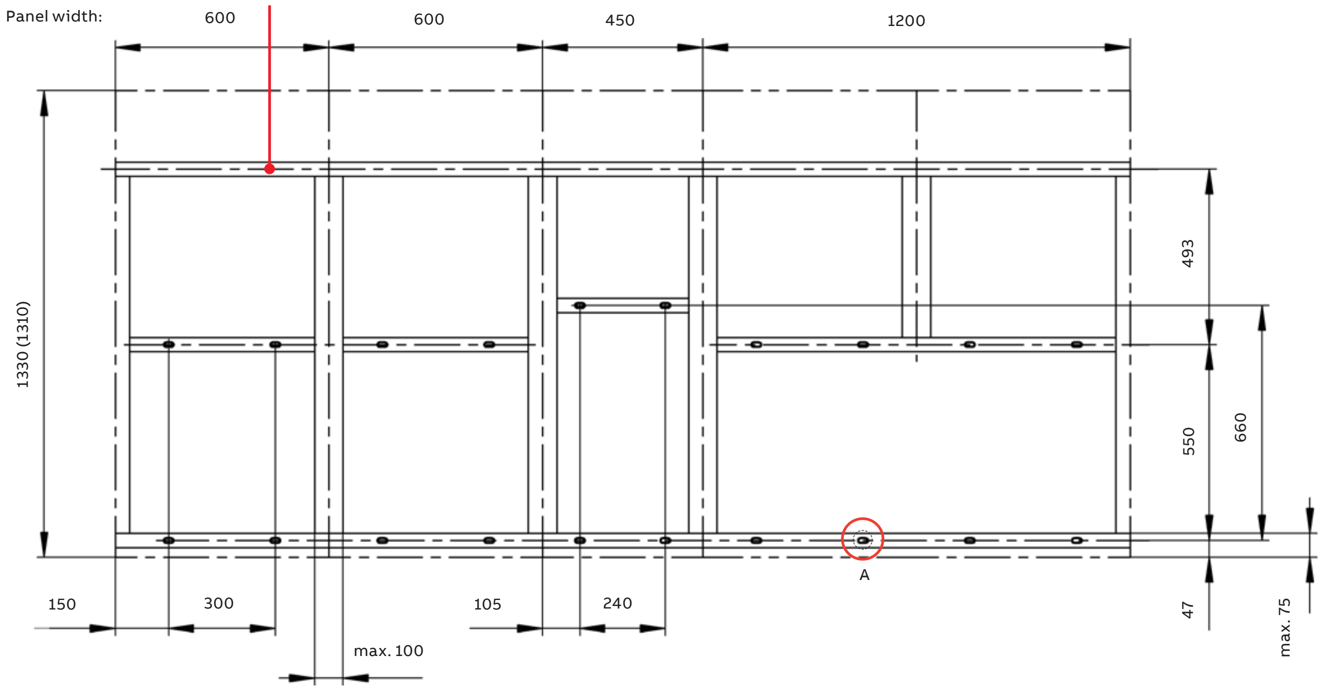
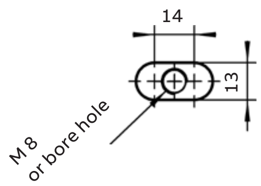


Fig. 10.6.1: Example of a false floor in the area of a five-panel ZX0.2 switchgear system as an aid to planning (plan view, dimensions in mm).

Detail A



- L13 x 14 slot in the floor plate of the panel
- M 8 thread or bore hole for screw M 8 in the frame section of the false floor

—
Fig. 10.7.3.1: Earthing recommendation, schematic diagram showing the concrete floor

10.7. Earthing of the switchgear

10.7.1. Design of earthing systems with regard to touch voltage and thermal stress

The earthing system for the station building and the earthing system for the switchgear are to be designed in accordance with IEC 61936.

The switchgear system is to be fitted with a continuous copper earthing bar with a cross-section of 300 mm² (ECuF30, 30 mm x 10 mm). The connection of this earthing bar to the station earthing system is to be effected in accordance with the above standards.

10.7.2. EMC-compliant earthing of the switchgear

Observe IEC 61000-5-2 and IEC 61000-6-5 to project the earthing system for the station building and the design, laying and connection of external control cables.

Establish the switchgear earthing due to the guidelines in the following section.

10.7.3. Recommendations on configuration of the switchgear earthing

We recommend that the switchgear be earthed as shown in figures 10.7.3.1 and 10.7.3.2.
A ring consisting of 80 mm x 5 mm copper strip is to be located beneath the switchgear and connected at several points with a maximum spacing of 5 m to the earthing system of the building. The foundation frame, the main earthing bar in the panels and the earthing bar in the low voltage compartments are to be connected at multiple points to the ring located beneath the switchgear. Details on the use of materials and the number of connections can be found in figure 10.7.3.1 and 10.7.3.2.

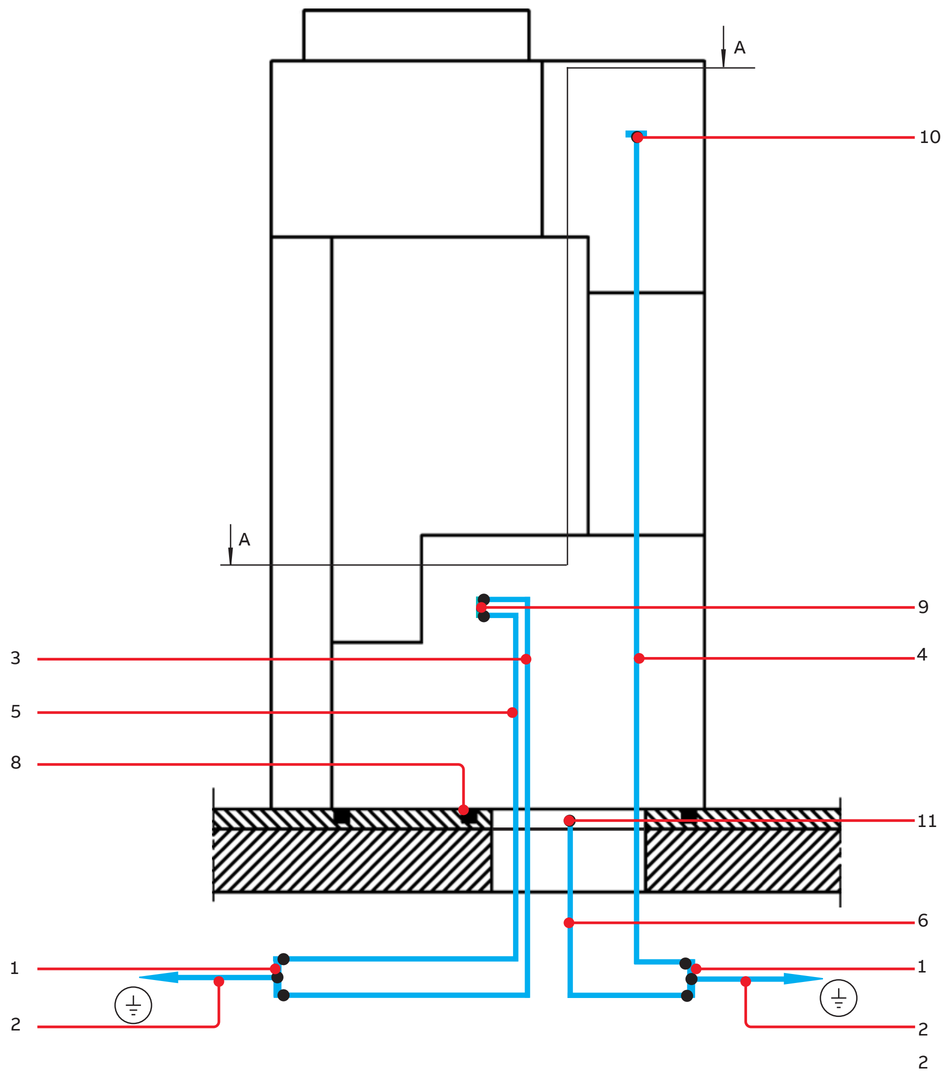


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Fig. 10.7.3.1

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Fig. 10.7.3.2: Earthing recommendation, plan view (section A-A of figure 10.7.3.1)

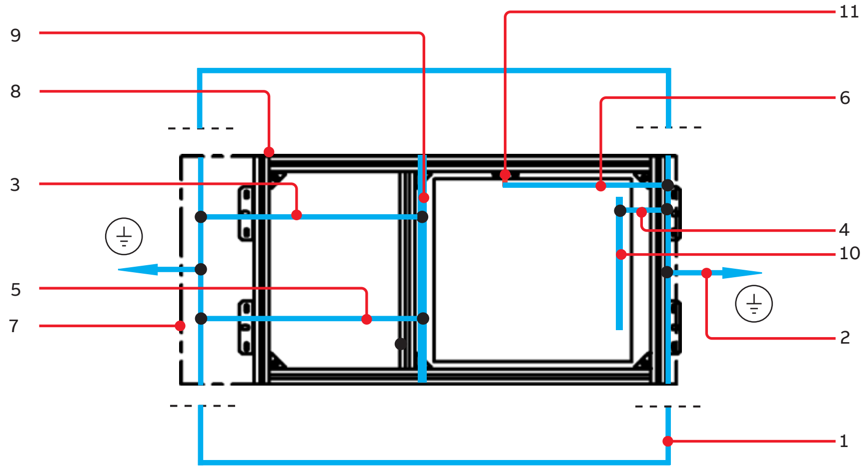

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Fig. 10.7.3.2

1 Ring below the switchgear, material ECuF30, cross-section, 80 mm x 5 mm
2 Several connections from (1) to the building earth at distances of max. 5 m, material ECuF30, cross-section 80 mm x 5 mm
3 Short-circuit proof earthing of the switchgear in both end panels and at least every third panel, material: ECuF30, cross-section: 30 mm x 10 mm
4 Low impedance earthing of the earthing bar in each low voltage compartment, material: tinned copper braid, cross-section: 20 mm x 3 mm
5 Low impedance earthing of the switchgear in each panel, material: tinned copper braid, cross-section: 20 mm x 3 mm,
6 Earthing of the foundation frame, at least every third foundation frame, material: galvanized steel strip, cross-section: 30 mm x 3.5 mm
7 Outline of the panel
8 Foundation frame
9 Main earthing bar
10 Earthing bar in the low voltage compartment
11 Earthing point on the foundation frame

—
Legend to figs. 10.7.3.1 and 10.7.3.2

10.8. Panel weights

—
Table 10.8.1: Panel weights

Panel variants	Panel width [mm]	Rated normal current [A]	Weight, max [kg]
Feeder panel with three position switch disconnector and fuses	600	Dependent on the fuses	600
Feeder panel	450	... 630	450
	600	... 1250	900
Sectionalizer panel	600	... 1250	900
Riser panel	600	... 1250	700
Transfer panel	600	... 1000 (...1250)	800
Incomer panel	1200	... 2500	2200
Sectionalizer panel	900	... 2500	1600
Riser panel	900	... 2500	1200

11. Non-standard operating conditions

Fig. 11.1: Relationship between ambient air temperature and current carrying capacity

Non-standard operating conditions may require special action. A number of non-standard requirements and the measures which may be necessary are listed below. Over and above this, our design team will be pleased to make a technical proposal to meet your specific requirements.

Rated frequency 60 Hz, site altitudes up to 1000 m
In principle, at an operating frequency of 60 Hz, a reduction factor of 0.97 is to be applied to the permissible current to determine a thermal equivalent to a 50 Hz load current. In individual cases, an evaluation of the type test can indicate that a reduction is not or only partially required.

Seismic withstand capability
Seismic-proof switch panels according to IEEE Std. 693 are available on request.

Climate
With high humidity and / or major rapid temperature fluctuations, electrical heaters must be fitted in the low voltage compartments.

Site altitudes > 1000 m above sea level
The panels are suitable for site altitudes > 1000 m above sea level with the following exceptions.

- All panels with test voltages > 50 / 125 kV
- Panels with switch-disconnector and fuses
- Transfer panels

At site altitudes > 1000 m, a reduction of the permissible operating current and/or the ambient temperature may be necessary. An individual examination can be made on request.

The non-standard operating conditions include in particular
- Higher ambient air temperature (maximum > 40 °C and maximum 24 h average > 35 °C) see fig. 11.1
- Ambient air contaminated by dust, smoke, corrosive or flammable gases or salt

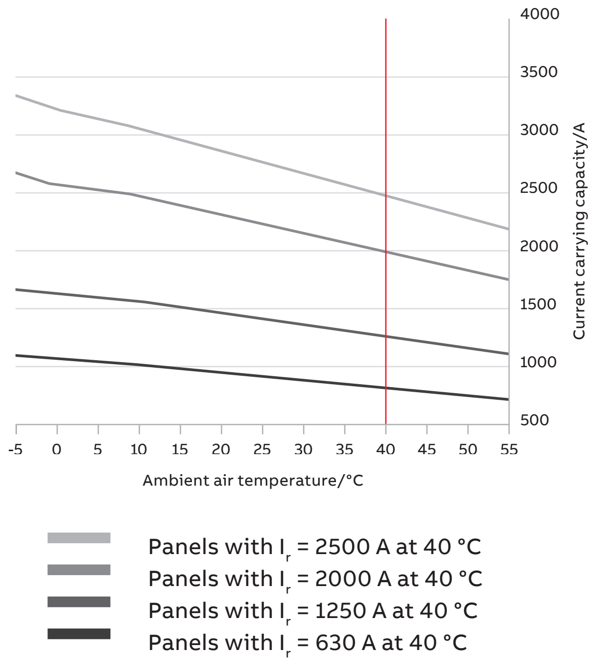

Fig. 11.1

Table 11.1: Correction factors for permissible operating current at site altitudes > 1000 m

Max. ambient air temp. / ° C	20		30		35		40	
Frequency / Hz	50	60	50	60	50	60	50	60
	Correction factors for the permissible operating current							
Site altitude > 1000 m up to 2000 m	1	1	1	1	1	0.98	0.97	0.94
Site altitude up to 3000 m	1	1	1	1	1	0.97	0.96	0.94
Site altitude up to 4000 m	1	1	0.98	0.95	0.90	0.88	-	-
Site altitude up to 5000 m	0.81	0.79	0.62	0,60	-	-	-	-

Notes

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1VBA680503P0102 REV 17– May 2021