DISTRIBUTION SOLUTIONS

PrimeGear ZX0

Gas-insulated medium-voltage switchgear

- Greener
- Smarter
- Safer
- More reliable

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At ABB, we believe in a world in which nature and technology go hand in hand. A world in which powering your operations also means powering positive change – for your business and our planet. We strive to create products and solutions that make a difference. Our philosophy is that greener is smarter. And smarter is greener. That's the thinking behind our latest medium-voltage, primary gas insulated-switchgear (GIS): PrimeGear™ ZX0.

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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.

Since the 1990s, more than 100,000 ZX panels have been installed all over the world.

Being a pioneering technology leader over the last 30 years, we have the experience and the knowledge to prepare our customers for the Industry 4.0. PrimeGear ZX0 has been designed for our customers and reduces the impact on global warming by 99.99 percent and supports customers to enter into digitalization.

ABB is fully committed to Dry Air and AirPlus™, the green alternatives to SF_6. Eco-friendly gas and design and digital monitoring tools will make your plant and our world safer.

Characteristic of PrimeGear ZX0:

Range
- 24 kV/1250 A/25 kA
- Standard IEC, GB

Greener
- Global warming potential (GWP) < 1
- 20 percent less heat generation by innovative design

Smarter
- IEC 61850 and current and voltage sensor enabled
- Monitoring and diagnostics focusing on tracking asset health, predicting failures

Safer
- Fitted with safety interlocks
- Internal arc classification IAC AFLR according to IEC 62271-200
- Classified LSC-2, PM according to IEC 62271-200

More reliable
- Proven GIS experience
- Suitable for extreme operation conditions, -15°C

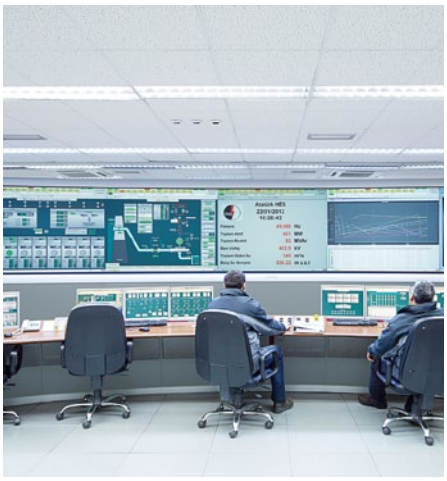
2. Applications

Utility
- Power stations
- Transformer substations
- Switching substations

Industry
- Steel works
- Paper manufacture
- Cement industry
- Textiles industry
- Chemicals industry
- Food & beverage industry
- Automobile industry
- Petrochemicals
- Raw materials industry
- Pipeline systems
- Foundries
- Rolling mills
- Mining

Transport
- Airports
- Harbours
- Railways

Infrastructure
- Supermarkets
- Shopping centres
- Hospitals
- Data Center



3. Characteristics

Basic characteristics
- Dry Air / Airplus / SF_6 gas-insulated with hermetically sealed pressure system
- Solid insulated busbar
- Rated voltage up to 24 kV
- Rated current up to 1250 A
- Rated short circuit current up to 25 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 percent per annum
- Integral leak testing of the panels at the factory
- Suitable for indoor conditions according to IEC 62271-1
- 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 as panels with circuit breaker and three position disconnector
- Outgoing feeder panels with three position switch disconnector and fuses
- Bus sectionaliser panels
- Bus riser panels
- Bus sectionaliser/riser panel

Switching devices
- Vacuum circuit-breakers with series three position disconnectors

Cable termination system
- Outer cone terminal system to EN 50181, type C for all 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 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 outside of switchgear room

Installation
- No gas work on 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, the probability of a fault during operation is extremely low
- As evidenced by arc fault testing according to IEC 62271-200, our switchgear systems are notable for maximum operator safety
- Extra safety by minimal operational pressure at 1.0 bar atmospheric pressure (applicable for 600 mm panel only)

Sustainable

- Environmental friendly switchgear by adapting Dry air and Airplus as insulating medium, with GWP < 1
- Optional eco-ready panel ensures maximum flexibility: you can choose SF_6 insulation and easily refill with Dry Air or AirPlus in the future
- Energy saving switchgear, 20 % less energy consumption by innovative design

Smart

- Online monitoring and diagnose feature
- IEC 61580 enabled switchgear supported by current and voltage sensoring
- 20 % space saving
- Easy to install and no gas work on site

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 450 mm width	Rated voltage	U_r	kV	12	24
	Rated power frequency withstand voltage	U_d	kV	28 [1)]	50 [2)]
	Rated lightning impulse withstand voltage	U_p	kV	75	125
	Rated normal current	I_r	A	...630	...630
	Rated short-time withstand current [3)]	I_k	kA	...25	...25
	Rated peak withstand current	I_p	kA	...63	...63
	Alarm level for insulation	p_{ae}	kPa	120（130 for Dry Air）	120
	Rated filling level for insulation	p_{re}	kPa	130（140 for Dry Air）	130
	Minimal functional level for operation	p_{mm}	kPa	120（130 for Dry Air）	120
Panels with 500 mm width	Rated voltage	U_r	kV	12	
	Rated power frequency withstand voltage	U_d	kV	28 [1)]	
	Rated lightning impulse withstand voltage	U_p	kV	75	
	Rated normal current	I_r	A	...1250	
	Rated short-time withstand current [3)]	I_k	kA	...25	
	Rated peak withstand current	I_p	kA	...63	
	Alarm level for insulation	p_{ae}	kPa	120（130 for Dry Air）	
	Rated filling level for insulation	p_{re}	kPa	130（140 for Dry Air）	
	Minimal functional level for operation	p_{mm}	kPa	120（130 for Dry Air）	
Panels with 600 mm width	Rated voltage	U_r	kV	12	24
	Rated power frequency withstand voltage	U_d	kV	28 [1)]	50 [2)]
	Rated lightning impulse withstand voltage	U_p	kV	75	125
	Rated normal current	I_r	A	...1250	...1250
	Rated short-time withstand current [3)]	I_k	kA	...25	...25
	Rated peak withstand current	I_p	kA	...63	...63
	Alarm level for insulation	p_{ae}	kPa	120	120
	Rated filling level for insulation	p_{re}	kPa	130（140 for dry Air）	130
	Minimal functional level for operation	p_{mm}	kPa	100	100
	Rated duration of short-circuit [4)]	t_k	s	...3	...3
	Rated frequency	f_r	Hz	50 [5)]	50 [5)]

Rated voltage		12 kV	24 kV
Insulating gas		Dry Air /SF_6	AirPlus/SF_6
Degree of protection for gas filled panel modules [6)]		IP65	IP65
Degree of protection of low voltage compartment and the mechanism bay [7)]		IP3X	IP3X
Ambient air temperature, maximum [8)]	°C	+40	+40
Ambient air temperature, maximum 24 hour averages [8)]	°C	+35	+35
Ambient air temperature, minimum	°C	-5	-5
Site altitude [9)]	m	...1000	...1000

1. 42 kV according to GB standard available.
2. 65 kV according to GB standard available.
3. 26.3 kA on request.
4. 4 second according to GB standard available.
5. 60 Hz on request
6. IP 67 on request.
7. IP4X on request.
8. Higher ambient temperature on request.
9. Higher altitude on request.

Classifications according to IEC 62271-200

Table 5.1.2: Internal arc classification of the switchgear

Internal arc classification	Wall mounting installation	Qualification IAC	AFL
		Internal arc	25 kA 1 s
	Free-standing installation	Qualification IAC	AFLR
		Internal arc	25 kA 1 s

Key to table 5.1.2

IAC Internal arc classification
AFLR
- Accessibility from the rear (R - rear)
- Accessibility from the sides (L - lateral)
- Accessibility from the front (F - front)
- Switchgear installed in closed rooms with access restricted to authorised personnel only

The IAC qualification relies on a system of at least three panels when busbar covers are used. When the system is equipped with a pressure relief duct two panels are required.

Loss of Service Continuity

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. Nevertheless, gas-insulated switchgear systems also receive a classification.

Table 5.1.3: Loss of Service Continuity of the switchgear

Loss of Service Continuity of PrimeGear ZX0	LSC2

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.

Note from IEC 62271-200:
The LSC category does not describe ranks of reliability of switchgear and controlgear.

Partition class

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

Table 5.1.4: Partition class

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	kV	12	24
Rated frequency	Hz	50 / 60	50 / 60
Rated current (40°C)	A	...1250	...1250
Rated short-time withstand current (4 s)	kA	...25	...25
Rated peak withstand current	kA	...63	...63
Rated short-circuit breaking current	kA	...25	...25
Rated short-circuit making current	kA	...63	...63
Rated operating sequence	/	O-0.3 s-CO-3 min -CO [1]	O-0.3 s-CO-3 min -CO [1]
Opening time [2]	ms	33 - 80	33 - 80
Arc duration	ms	≤ 15	≤ 15
Total breaking time	ms	33 - 95	33 - 95

1) Different operating sequence on request.
2) Based on permanent duty of shunt opening release, please consult ABB for other request.

Permissible numbers of operating cycles of the vacuum interrupters	
30000 x Ir	(Ir = Rated normal current)
50 x ISC	(ISC = Rated short-circuit breaking current)

Classification according to IEC 62271-100		
Rated voltage / kV		Classification
up to 24	All circuit-breakers	M2, E2, C2

5.3 Technical data of the three position disconnector

Table 5.3.1: Technical data of the three position disconnector

Rated voltage / maximum rated voltage	U_r	kV	12	24
Rated power frequency withstand voltage across the isolating distance		kV	32/48	60/79
Rated lightning impulse withstand voltage across the isolating distance		kV	85	145
Rated normal current	I_k		... 630, ... 1250	
Rated short-time withstand current	I_k	kA	... 25	
Rated peak withstand current	I_p	kA	... 63	
Rated duration of short-circuit	t_k	s	... 3 [3]	
Rated auxiliary voltage [1]	U_a	V DC	60, 110, 220 [2]	
Power consumption of mechanism motor		W	210 (maximum), 35 (average)	
Motor running time on opening or closing the disconnector		s	<2	
Motor running time on opening or closing the earthing switch		s	<2	

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

1) when a motor operated mechanism is used, 3000 operations available on request.
2) different auxiliary voltage on request.
3) 4 second according to GB available on request

6. Fundamental structure of the panels

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Fig.6.1: Incoming cable panel 1250 A (free-standing installation)
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Fig.6.2: Outgoing cable panel 1250 A (wall mounting installation)
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Fig.6.3: Outgoing cable panel 1250 A with optional pressure relief duct to the outside (free standing installation or wall mounting installation)

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

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.

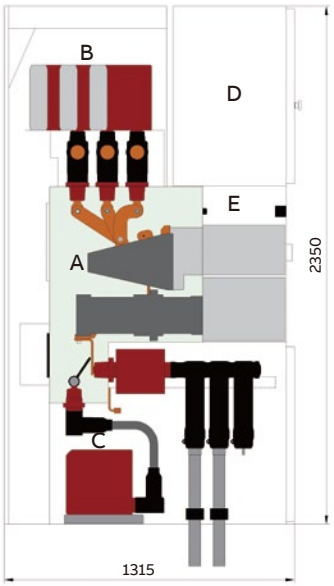

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Fig. 6.1

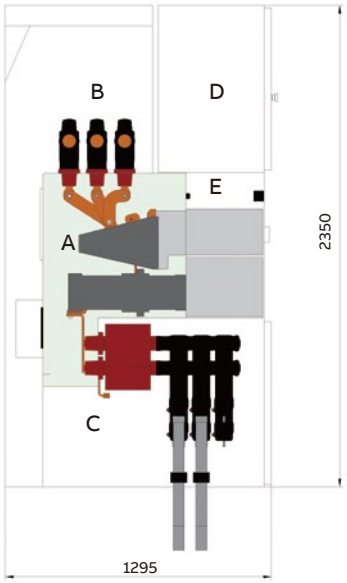

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Fig. 6.2

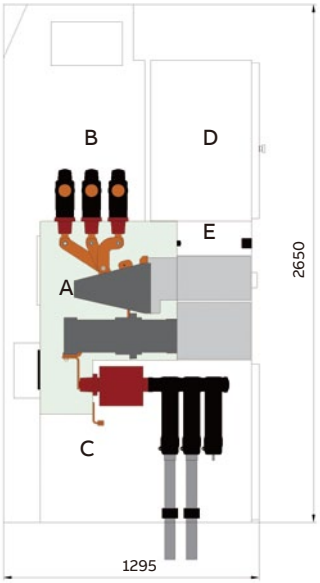

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Fig. 6.3

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

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 the panel modules.

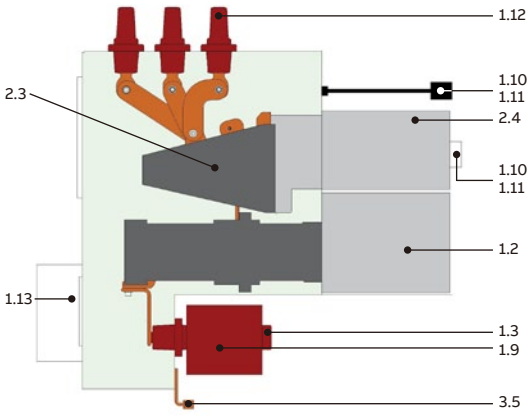
The pressure relief disk for the panel module is located in the rear wall of the enclosure.

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 (figs. 6.4)
The circuit-breaker operating mechanism, the gas density sensor and the gas filling valve are located on the circuit-breaker front plate, which is welded 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 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

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Fig. 6.4

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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.

The busbar (B)

The solid insulated busbar are 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.

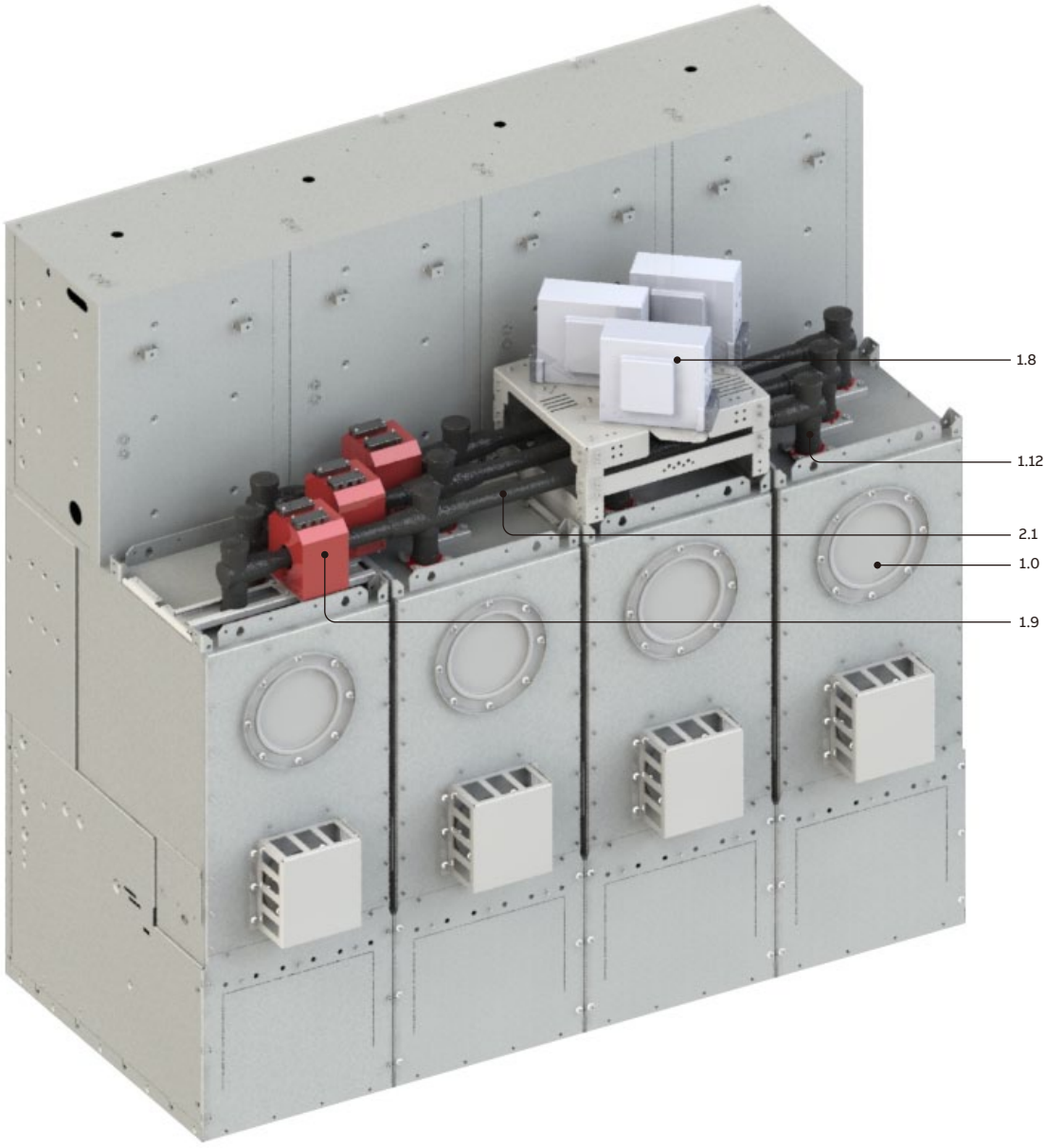

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Fig. 6.8

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

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Fig. 6.9.1: Cable termination compartment (C), example configuration with removable cable connected voltage transformers and two cables per phase

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Fig. 6.9.2: Cable termination compartment (C) example configuration with plug in voltage transformers.

The cable termination compartment (C)
The cable termination compartment (6.9) represents a supporting frame for the panel, manufactured from aluminium sections and galvanised 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 applicable for 500 mm and 600 mm feeder (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.

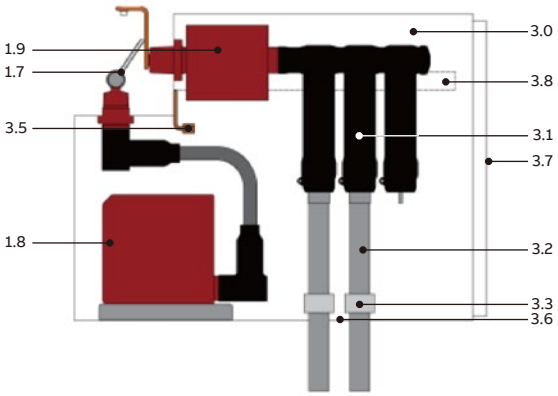

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Fig. 6.9.1

1.7	Voltage transformer disconnecting device
1.8	Voltage transformers, in this case fixed mounted
1.9	Current transformers
3.0	Cable termination compartment (C)
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)

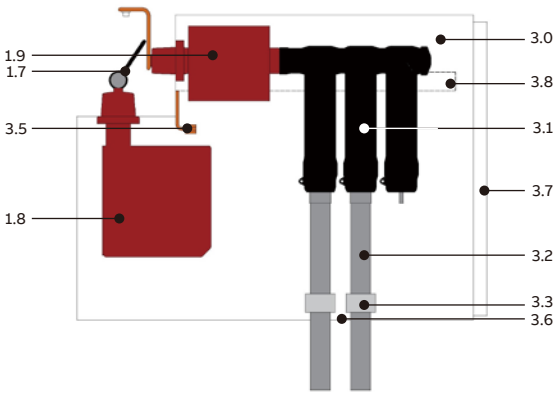

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Fig. 6.9.2

1.7	Voltage transformer disconnecting device
1.8	Voltage transformers, in this case fixed mounted
1.9	Current transformers
3.0	Cable termination compartment (C)
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

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 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), and the sensor for gas density monitoring (1.10) and the gas filling valve (1.11) of the gas compartment.

The sockets for the capacitive 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.

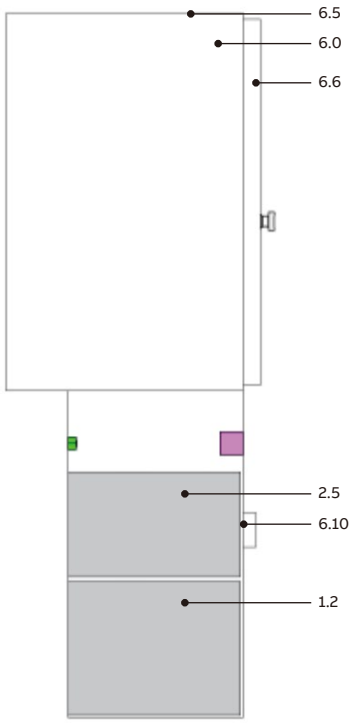

Fig. 6.10

1.2	Circuit-breaker operating mechanism
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

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

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

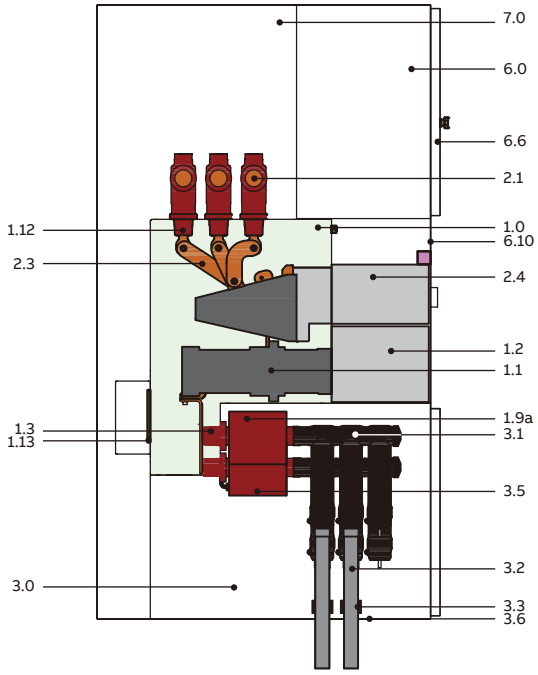

Fig. 7.1

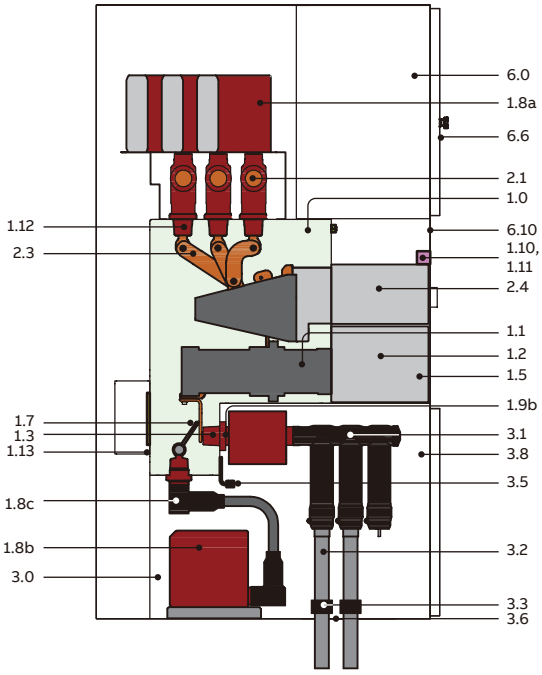

Fig. 7.2

1.0	Panel module
1.1	Circuit-breaker pole
1.2	Circuit-breaker operating mechanism
1.3	Outer cone
1.7	Isolating system for voltage transformer or sensors
1.8a	Voltage transformer for busbar measurement (optional)
1.8b	Voltage transformer for feeder measurement (optional)
1.8c	Voltage transformer cable
1.9	Current transformer
1.9b	Current sensor
1.10	Gas density sensor
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 transformers or sensors
6.0	Low voltage compartment
6.6	Low voltage compartment door
6.10	Mechanism bay
7.0	Busbar cover (pressure relief into the switchgear room)
	Insulating Gas SF_6

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

7.1 Vacuum circuit-breaker

The circuit breaker used in Primegear ZX0 are VD4X0

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 VD4X0

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

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 insulated medium, 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

Fig. 7.1.1

Secondary equipment for the circuit-breaker operating mechanism

The secondary equipment options for the circuit-breaker operating mechanism can be found in table 7.1.1.

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Table 7.1.1: Secondary equipment options for the operating mechanism of circuit breaker type VD4X

IEC designation	VDE designation	Equipment	Standard	Option
-MAS	-M0	Charging motor for spring mechanism	●	
-BGS2 [1)]	-S1.1	Auxiliary switch “Spring charged”	●	
-MBO1	-Y2	Shunt release OFF	●	
-MBC	-Y3	Shunt release ON	●	
-BGB0		Auxiliary switch “CB ON / OFF”	●	
-BGB7	-S10	Auxiliary switch at the mechanical “C.B. ON” push-button		●
-RLE1	-Y1	Blocking magnet “CB ON”	●	
-MBU [3)]	-Y4	Undervoltage release		●
-MBO3 [3)]	-Y7	Indirect overcurrent release		●
-MBO2	-Y9	2nd shunt release OFF		●

1) For certain versions of the circuit-breaker, auxiliary switches BGS2.1...2.2 are used.
2) Combination of -MU with -MO3 is not possible

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Fig. 7.1.2: Securing to prevent operation of the OFF button and securing to prevent cancellation of earthing (version 1)
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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 padlock (locking of both buttons shown here)
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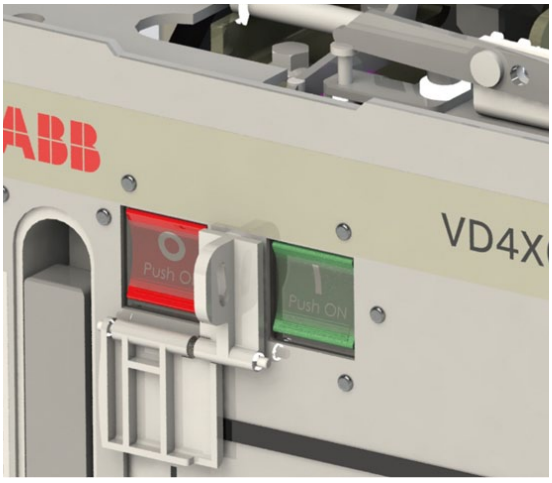
Fig. 7.1.5: Locking by lock switch: locking of the OFF button

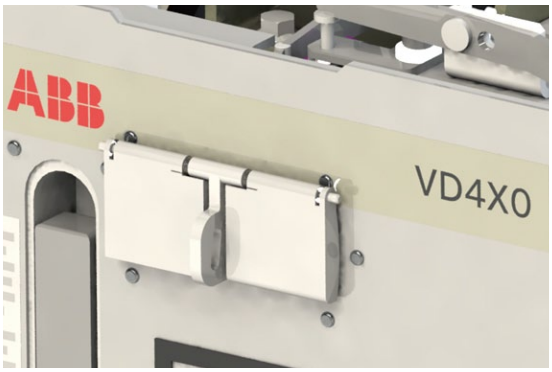
Locking of the mechanical pushbuttons
The following methods of locking the mechanical pushbuttons for the circuit-breaker are available.

- 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 then not possible. The pressed OFF button can be released locally with the key

—
Fig. 7.1.2



—
Fig. 7.1.3



—
Fig. 7.1.4

—
Fig. 7.1.5

—
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 gas 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.

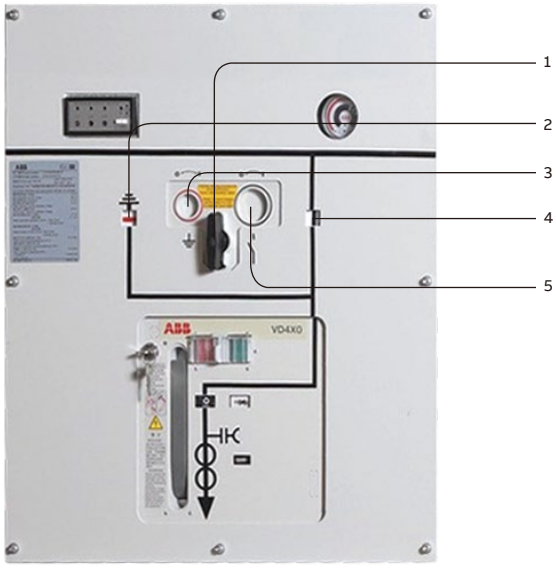
The mechanical controls and indicators for the operating mechanism are located in the cover of the mechanism bay and are accessible from the outside.

Manual operating mechanism

For manual operation of the switch with a lever (1), the relevant opening for the lever (5 and 3, for the disconnector or earthing 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.

Motorised operating mechanism

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



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

—
Fig. 7.2.1

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

IEC designation	VDE designation	Equipment	Manual mechanism		Motor-operated mechanism	
			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		●		●

1) When shunt release ON –MC1 is used in the circuit-breaker operating mechanism.

—
Fig. 7.4.1: Busbar with cross and end adapters

7.4 Busbar

The busbars are located within a compartment outside the gasfilled 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 can be installed above the cross and end adapters for detection of the busbar voltage (see also fig. 6.8).

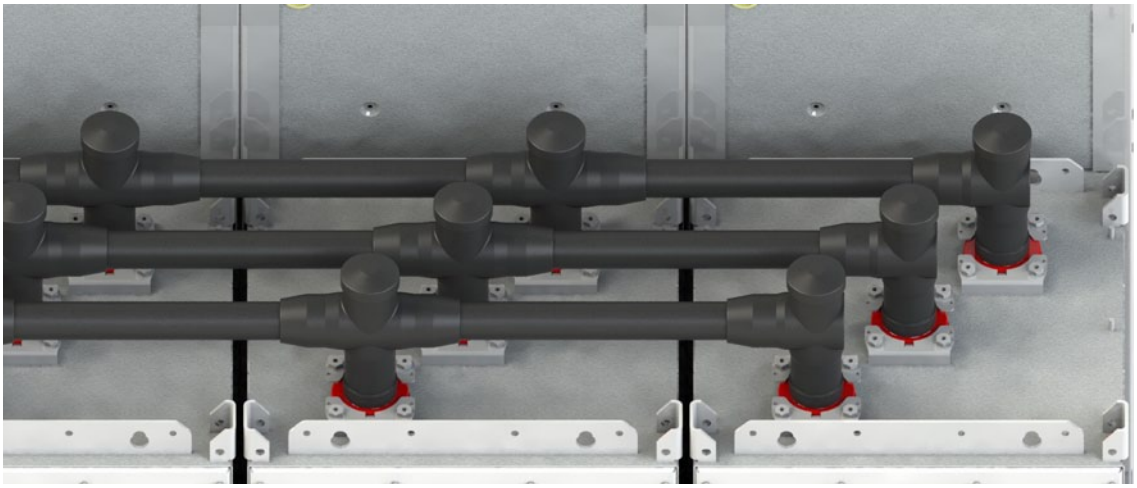


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Fig. 7.4.1

—
Fig. 7.5.1: View into the 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: View into the cable termination area with outer cones termination type C in air, 630 A 450 mm wide panel
—
Fig. 7.5.3: View into the cable termination compartment in air with shockproof cable connectors (ABB type CSE-A) and cables
—
Fig. 7.5.4: Cable termination RCAB 12 kV from Tyco, 630 A, 25 kA

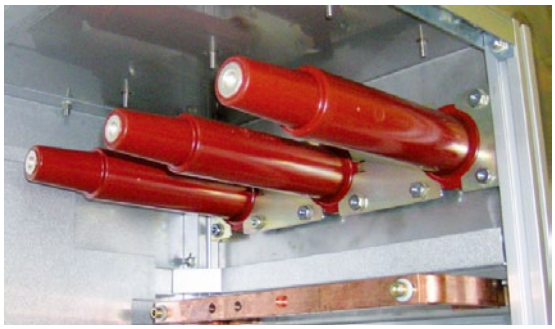
7.5 Outer cone termination system

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 7.5.3). The termination height of 700 mm provides for 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.

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. 7.5.4) 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 is presented in tables 7.5.1 to 7.5.10. 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 required.



—
Fig. 7.5.1

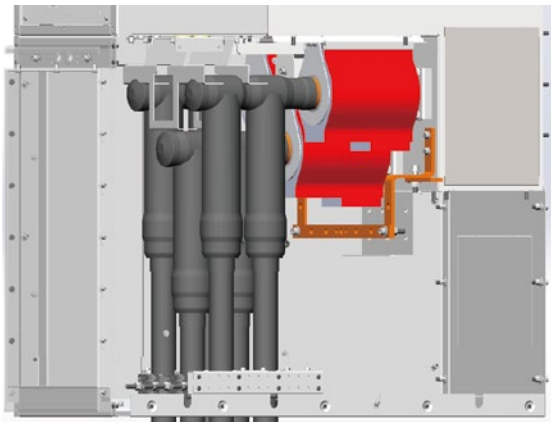


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Fig. 7.5.2

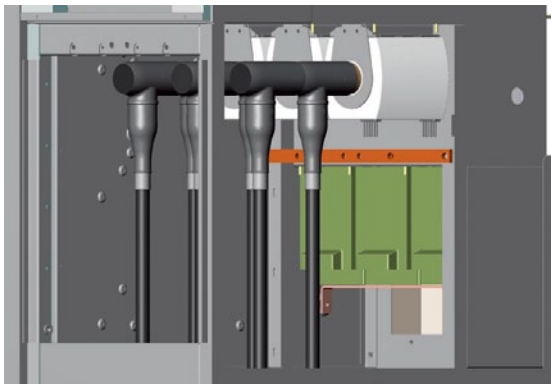

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Fig. 7.5.3

—
Fig. 7.5.4

—

Table 7.5.2 a: Selection of cable connectors, panel width 450 mm, outer cone termination type C, 12 kV

Maximum operating voltage	Cable cross section	Cables fitted			
[kV]	[mm²]	One cable	Two cables	One cable + Surge arrester	Two cables + Surge arrester
12	25 - 70	●			
			●		
				●	
					●
	25 - 240	●			
			●		
				●	
					●
	25 - 300	●			
			●		
				●	
					●
	35 - 300	●			
			●		
				●	
					●
	50 - 300				

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
CSE-A 12630-01					
CSE-A 12630-01					
CSEP-A 12630-01					
CSE-A 12630-01					
CSAP-A 12xx					
CSE-A 12630-01					
CSEP-A 12630-01					
CSAP-A 12xx					
					CTS 630 A 24 kV
					CTS 630 A 24 kV
					CTKS 630 A 24 kV
					CTS 630 A 24 kV
					CTKSA
					CTS 630 A 24 kV
					CTKS 630 A 36 kV
					CTKSA
		CB12-630		RSTI-58xx	
		CB12-630		RSTI-58xx	
		CC12-630		RSTI-CC-58xx	
		CB12-630		RSTI-58xx	
		CSA12-...		RSTI-CC-58SA	
		CB12-630		RSTI-58xx	
		CC12-630		RSTI-CC-58xx	
		CSA12-...		RSTI-CC-58SA	
	430TB				
	430TBM-P2				
	430TB				
	300SA				
	430TBM-P2				
	300SA				
			SET12		
			SET12		
			SEHDK13.1		
			SET12		
			MUT13		
			SET12		
			SEHDK13.1		
			MUT13		

—

Table 7.5.2 b: Selection of cable connectors, panel width 450 mm, outer cone termination type C, 12 kV

Maximum operating voltage	Cable cross section	Cables fitted			
[kV]	[mm²]	One cable	Two cables	One cable + Surge arrester	Two cables + Surge arrester
12	50 - 630				
	95 - 300	●			
			●		
				●	
					●
	185 - 500	●			
			●		
				●	
	300 - 500	●			
	400	●			
	500		●		
	630				
				●	
	400 - 630	●			
			●		
				●	
	400 - 800				
	500 - 630	●			
			●		
				●	

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
	484TB/G				
	484TB/G				
	804PB/G				
	484TB/G				
	800SA				
	484TB/G				
	804PB/G				
	800SA				
CSE-A 12630-02					
CSE-A 12630-02					
CSEP-A 12630-02					
CSE-A 12630-02					
CSAP-A 12xx					
CSE-A 12630-02					
CSEP-A 12630-02					
CSAP-A 12xx					
		CB24-1250/2			
		CB24-1250/2			
		CC24-1250/2			
		CB24-1250/2			
		CSA12			
			SEHDT13		
		CB36-630 (1250)			
		CB36-630 (1250)			
		CC36-630 (1250)			
		CB36-630 (1250)			
		CSA12			
CSE-A 12630-03					
CSE-A 12630-03					
CSEP-A 12630-03					
CSE-A 12630-03					
CSAP-A 12xx					
				RSTI-x95x	
				RSTI-x95x	
				RSTI-CC-68SA	
					CTS 1250 A 24 kV
					2x CTS 1250 A 24 kV
					CTS 1250 A 24 kV
					CTKSA

—

Table 7.5.3 a: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 12 kV

Maximum operating voltage [kV]	Cable cross section [mm²]	Cables fitted					
		One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
12	25 - 70	●					
			●				
					●		
						●	
	25 - 240	●					
			●				
					●		
						●	
	25 - 300	●					
			●				
				●			
					●		
						●	
	35 - 300	●					
			●				
				●			
					●		
						●	
							●
	50- 300	●					
			●				
					●		
						●	

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
CSE-A 12630-01					
CSE-A 12630-01					
CSEP-A 12630-01					
CSE-A 12630-01					
CSAP-A 12xx					
CSE-A 12630-01					
CSEP-A 12630-01					
CSAP-A 12xx					
					CTS 630 A 24 kV
					CTS 630 A 24 kV
					CTKS 630 A 24 kV
					CTS 630 A 24 kV
					CTKSA
					CTS 630 A 24 kV
					CTKS 630 A 36 kV
					CTKSA
		CB12-630		RSTI-58xx	
		CB12-630		RSTI-58xx	
		CC12-630		RSTI-CC-58xx	
		CB12-630		RSTI-58xx	
		2x CC12-630		2x RSTI-CC-58xx	
		CB12-630		RSTI-58xx	
		CSA12-...		RSTI-CC-58SA	
		CB12-630		RSTI-58xx	
		CC12-630		RSTI-CC-58xx	
		CSA12-...		RSTI-CC-58SA	
	430TB				
	430TBM-P2				
	430TBM-P3				
	430TB				
	300SA				
	430TBM-P2				
	300SA				
	430TBM-P3				
	300SA				
			SET12		
			SET12		
			SEHDK13.1		
			SET12		
			MUT13		
			SET12		
			SEHDK13.1		
			MUT13		

—

Table 7.5.3 b: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 12 kV

Maximum operating voltage	Cable cross section	Cables fitted					
[kV]	[mm²]	One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
12	50 - 630	●					
			●				
				●			
					●		
						●	
							●
	95 - 300	●					
			●				
				●			
					●		
						●	
	185 - 500	●					
			●				
				●			
					●		
						●	
	300 - 500	●					
	400	●					
	500		●				
	630						
				●			
						●	

Cable connector manufacturer / connector type			
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH
	484TB/G		
	484TB/G		
	804PB/G		
	484TB/G		
	2x 804PB/G		
	484TB/G		
	800SA		
	484TB/G		
	804PB/G		
	800SA		
	484TB/G		
	2x 804PB/G		
	800SA		
CSE-A 12630-02			
CSE-A 12630-02			
CSEP-A 12630-02			
CSE-A 12630-02			
2x CSEP-A 12630-02			
CSE-A 12630-02			
CSAP-A 12xx			
CSE-A 12630-02			
CSEP-A 12630-02			
CSAP-A 12xx			
		CB24-1250/2	
		CB24-1250/2	
		CC24-1250/2	
		CB24-1250/2	
		2x CC24-1250/2	
		CB24-1250/2	
		CSA12	
		CB24-1250/2	
		CC24-1250/2	
		CSA12	
			SEHDT13
		CB36-630 (1250)	
		CB36-630 (1250)	
		CC36-630 (1250)	
		CB36-630 (1250)	
		2x CC36-630 (1250)	
		CB36-630 (1250)	
		CC36-630 (1250)	
		CSA12	

Table 7.5.3 c: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 12 kV

Maximum operating voltage [kV]	Cable cross section [mm²]	Cables fitted					
		One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
12	400 - 630	●					
			●				
					●		
						●	
	400 - 800	●					
			●				
					●		
						●	
	500 - 630	●					
					●		
	630 - 1000	●					
			●				
					●		
						●	
	800 - 1200	●					
			●				
					●		
						●	

Cable connector manufacturer / connector type				
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Tyco	Cellpack
CSE-A 12630-03				
CSE-A 12630-03				
CSEP-A 12630-03				
CSE-A 12630-03				
CSAP-A 12xx				
CSE-A 12630-03				
CSEP-A 12630-03				
CSAP-A 12xx				
			RSTI-x95x	
			RSTI-x95x	
			RSTI-CC-x95x	
			RSTI-x95x	
			RSTI-CC-68SA	
			RSTI-x95x	
			RSTI-CC-x95x	
			RSTI-CC-68SA	
				CTS 1250 A 24 kV
				CTS 1250 A 24 kV
				CTKSA
		CB42-1250/3		
		CB42-1250/3		
		CC42-2500/3		
		CB42-1250/3		
		CSA12		
		CB42-1250/3		
		CC42-2500/3		
		CSA12		
	489TB/G			
	489TB/G			
	809PB			
	489TB/G			
	800SA			
	489TB/G			
	809PB			
	800SA			

—

Table 7.5.6 a: Selection of cable connectors, panel width 450 mm, outer cone termination type C, 24 kV

Maximum operating voltage	Cable cross section	Cables fitted			
[kV]	[mm²]	One cable	Two cables	One cable + Surge arrester	Two cables + Surge arrester
24	25 - 70	●			
			●		
				●	
					●
	25 - 240	●			
			●		
				●	
					●
	25 - 300	●			
			●		
				●	
					●
	35 - 300	●			
			●		
				●	
					●
	35 - 630	●			
			●		
				●	
					●

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
CSE-A 24630-01					
CSE-A 24630-01					
CSEP-A 24630-01					
CSE-A 24630-01					
CSAP-A 24xx					
CSE-A 24630-01					
CSEP-A 24630-01					
CSAP-A 24xx					
			SET24		CTS 630 A 24 kV
			SET24		CTS 630 A 24 kV
			SEHDK23.1		CTKS 630 A 24 kV
			SET24		CTS 630 A 24 kV
			MUT23		CTKSA
			SET24		CTS 630 A 24 kV
			SEHDK23.1		CTKS 630 A 24 kV
			MUT23		CTKSA
		CB24-630		RSTI-58xx	
		CB24-630		RSTI-58xx	
		CC24-630		RSTI-CC-58xx	
		CB24-630		RSTI-58xx	
		CSA24-...		RSTI-CC-58SA	
		CB24-630		RSTI-58xx	
		CC24-630		RSTI-CC-58xx	
		CSA24-...		RSTI-CC-58SA	
	K430TB				
	K430TBM-P2				
	K430TB				
	300SA				
	K430TBM-P2				
	300SA				
	K484TB/G				
	K484TB/G				
	K804PB/G				
	K484TB/G				
	800SA				
	K484TB/G				
	K804PB/G				
	800SA				

Table 7.5.6 b: Selection of cable connectors, panel width 450 mm, outer cone termination type C, 24 kV

Maximum operating voltage	Cable cross section	Cables fitted			
[kV]	[mm²]	One cable	Two cables	One cable + Surge arrester	Two cables + Surge arrester
24	95 - 300	●			
			●		
				●	
					●
	95 - 500	●			
			●		
				●	
	300 - 500	●			
	400	●			
	500		●		
	630				
				●	
	400 - 630	●			
			●		
				●	
	400 - 800	●			
				●	
	630 - 1000	●			
				●	
	800 - 1200	●			
				●	

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
CSE-A 24630-02					
CSE-A 24630-02					
CSEP-A 24630-02					
CSE-A 24630-02					
CSAP-A 24xx					
CSE-A 24630-02					
CSEP-A 24630-02					
CSAP-A 24xx					
		CB24-1250/2			
		CB24-1250/2			
		CC24-1250/2			
		CB24-1250/2			
		CSA24			
			SEHDT23		
		CB36-630 (1250)			
		CB36-630 (1250)			
		CC36-630 (1250)			
		CB36-630 (1250)			
		CSA24			
CSE-A 24630-03					CTS 1250 A 24 kV
CSE-A 24630-03					2x CTS 1250 A 24 kV
CSEP-A 24630-03					
CSE-A 24630-03					CTS 1250 A 24 kV
CSAP-A 24xx					CTKSA
				RSTI-x95x	
				RSTI-x95x	
				RSTI-CC-68SA	
		CB42-1250/3			
		CB42-1250/3			
		CSA24			
	K489TB/G				
	K489TB/G				
	800SA				

—

Table 7.5.7 a: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 24 kV

Maximum operating voltage	Cable cross section	Cables fitted					
[kV]	[mm²]	One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
24	25 - 70	●					
			●				
					●		
						●	
	25 - 240	●					
			●				
					●		
						●	
	25 - 300	●					
			●				
				●			
					●		
						●	
	35 - 300	●					
			●				
				●			
					●		
						●	
							●

Cable connector manufacturer / connector type					
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Südkabel GmbH	Tyco	Cellpack
CSE-A 24630-01					
CSE-A 24630-01					
CSEP-A 24630-01					
CSE-A 24630-01					
CSAP-A 242xx					
CSE-A 24630-01					
CSEP-A 24630-01					
CSAP-A 24xx					
			SET24		CTS 630 A 24 kV
			SET24		CTS 630 A 24 kV
			SEHDK23.1		CTKS 630 A 24 kV
			SET24		CTS 630 A 24 kV
			MUT23		CTKSA
			SET24		CTS 630 A 24 kV
			SEHDK23.1		CTKS 630 A 24 kV
			MUT23		CTKSA
		CB24-630		RSTI-58xx	
		CB24-630		RSTI-58xx	
		CC24-630		RSTI-CC-58xx	
		CB24-630		RSTI-58xx	
		2x CC24-630		2x RSTI-CC-58xx	
		CB24-630		RSTI-58xx	
		CSA24-...		RSTI-CC-58SA	
		CB24-630		RSTI-58xx	
		CC24-630		RSTI-CC-58xx	
		CSA24-...		RSTI-CC-58SA	
	K430TB				
	K430TBM-P2				
	K430TBM-P3				
	K430TB				
	300SA				
	K430TBM-P2				
	300SA				
	K430TBM-P3				
	300SA				

Table 7.5.7 b: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 24 kV

Maximum operating voltage	Cable cross section	Cables fitted					
[kV]	[mm²]	One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
24	35 - 630	●					
			●				
				●			
					●		
						●	
							●
	95 - 300	●					
			●				
				●			
					●		
						●	
	95 - 500	●					
			●				
				●			
					●		
						●	
	300 - 500	●					

Cable connector manufacturer / connector type			
ABB Kabeldon	EUROMOLD	Nkt cables GmbH	Südkabel GmbH
	K484TB/G		
	K484TB/G		
	K804PB/G		
	K484TB/G		
	2x K804PB/G		
	K484TB/G		
	800SA		
	K484TB/G		
	K804PB/G		
	800SA		
	K484TB/G		
	2x K804PB/G		
	800SA		
CSE-A 24630-02			
CSE-A 24630-02			
CSEP-A 24630-02			
CSE-A 24630-02			
2x CSEP-A 24630-02			
CSE-A 24630-02			
CSAP-A 24xx			
CSE-A 24630-02			
CSEP-A 24630-02			
CSAP-A 24xx			
		CB24-1250/2	
		CB24-1250/2	
		CC24-1250/2	
		CB24-1250/2	
		2xCC24-1250/2	
		CB24-1250/2	
		CSA24	
		CB24-1250/2	
		CC24-1250/2	
		CSA24	
			SEHDT23

Table 7.5.7 c: Selection of cable connectors, panel width 600 mm, outer cone termination type C, 24 kV

Maximum operating voltage	Cable cross section	Cables fitted					
[kV]	[mm²]	One cable	Two cables	Three cables	One cable + Surge arrester	Two cables + Surge arrester	Three cables + Surge arrester
24	400	●					
	500		●				
	630				●		
						●	
	400 - 630	●					
			●				
					●		
						●	
	400 - 800	●					
			●				
					●		
						●	
	630 - 1000	●					
			●				
					●		
						●	
	800 - 1200	●					
			●				
					●		
						●	

Cable connector manufacturer / connector type				
ABB Kabeldon	EUROMOLD	nkt cables GmbH	Tyco	Cellpack
		CB36-630 (1250)		
		CB36-630 (1250)		
		CC36-630 (1250)		
		CB36-630 (1250)		
		CSA24		
		CB36-630 (1250)		
		CC36-630 (1250)		
		CSA24		
CSE-A 24630-03				CTS 1250 A 24 kV
CSE-A 24630-03				
CSEP-A 24630-03				
CSE-A 24630-03				CTS 1250 A 24 kV
CSAP-A 24xx				CTKSA
CSE-A 24630-03				
CSEP-A 24630-03				
CSAP-A 24xx				
			RSTI-x95x	
			RSTI-x95x	
			RSTI-CC-x95x	
			RSTI-x95x	
			RSTI-CC-68SA	
			RSTI-x95x	
			RSTI-CC-x95x	
			RSTI-CC-68SA	
		CB42-1250/3		
		CB42-1250/3		
		CC42-2500/3		
		CB42-1250/3		
		CSA24		
		CB42-1250/3		
		CC42-2500/3		
		CSA24		
	K489TB/G			
	K489TB/G			
	K809PB			
	K489TB/G			
	800SA			
	K489TB/G			
	K809PB			
	800SA			

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 7.5.2.1 to 7.5.2.6). 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 240 mm^2 (ECuF30 30 mm x 8 mm).

7.8 Capacitive voltage indicator systems
Two types of capacitive, low impedance voltage indicator systems are available for checking of the off-circuit 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 mechanical bay.

—
Fig. 7.8.1: System WEGA 1.2 C

—
Fig. 7.8.2: System WEGA 2.2 C

Coupling electrodes can be installed on cross or end adapters in the solid insulated busbars to detect the off-circuit 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 sectionaliser 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 in 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 x UN)
  - Integrated maintenence test passed
  - Voltage signal too high (Overvoltage indication)

System WEGA 2.2 C (Fig. 7.8.2)
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 ≠ 0

System CVD (Fig. 7.8.3)
- LED display
- Three phase
- No additional indicate unit required maintenance free with integrated self-test build-in solution

—
Fig. 7.8.3: System CVD

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Fig. 7.9.1.1: Ring core current transformer up to 630 A
—
Fig. 7.9.1.2: Ring core current transformer up to 1250 A

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 (Fig. 7.9.1.1 to 7.9.1.2) are used for feeder metering in termination panels. They are located on the outer cone outside the gas compartment. 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.

Panels with one cable per phase can also be fitted with straight-through current transformers on request.

—
Table 7.9.1.1: Technical data of the ring core current transformers

Current transformer type				LMZ6-226x155	LMZ6-228x188
Rated voltage		U_r	kV	0.72	0.72
Rated short duration power-frequency withstand voltage		U_d	kV	3	3
Rated frequency		f_r	Hz	50/60	50 / 60
Rated thermal short-time current		I_{therm}		31.5 kA-4 s	31.5 kA-4 s
Rated impulse current		I_p	kA	82	82
Rated primary current		I_r	A	...630	...1250
Rated secondary current			A	1/5	1/5
Max number of cores				5	5
Core data [1]					
Measuring cores	Capacity		VA	2.5 to 15	...20
	Class			0.2S / 0.2 / 0.5	0.2S / 0.2 / 0.5
Protection cores	Capacity		VA	2.5 to 15	...20
	Class			5P to 10P	5P/10P
	Overcurrent factor			10 to 20	10 to 20

1) Dependent on rated primary current.

—
Fig. 7.9.1.1 LMZ6-266X155

—
Fig. 7.9.1.2 LMZ6-228X188

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

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 logically 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 enquiry 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.

7.9.3 Current sensors

As an alternative to conventional current transformers, current sensors according to IEC 60044-8 (Fig. 7.9.3.1) can be used for 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.

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.

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.

Fig. 7.9.3.1

Table 7.9.3.1

Parameters for Application	Value
Rated primary current of application	up to 4000 A

Sensor Parameters	Value
Highest voltage for equipment, U_m	0.72 kV
Rated primary current, I_{pr}	80 A
Rated continuous thermal current, I_{cth}	4000 A
Rated transformation ratio, K_{ra}	80 A / 150 mV at 50 Hz 180 mV at 60 Hz
Current accuracy class	0.5 / 5P630

Fig. 7.9.4.2: Voltage transformer, plug-in type

7.9.4 Voltage transformers

Voltage transformer can be installed in 500 mm and 600 mm panel, fuse solution are available for these voltage transformer with voltage transformers on feeder panel. The voltage transformers are always located outside the gas compartments. They can be directly plug in to gas compartment or connected via cable.

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. 7.9.4.2

Table 7.9.4.1 Technical data of voltage transformers

Type of voltage transformer	Rated voltage	Max. capacity	Class	Rated secondary voltage of the metering winding	Rated secondary voltage of the earth fault winding	Rated thermal current limit of the metering winding with rated voltage factor 1.2 / continuous	Rated thermal long duration current of the earth fault winding with rated voltage factor 1.9 / 8 h
	[kV]	[VA]		[V]	[V]	[A]	[A]
plug-in type	up to 24 [1)]	25 [1)]	0,2	100 / √3 110 / √3	100 / 3 110 / 3	6	6
		60 [1)]	0,5				
		120 [1)]	1				

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 - 12	28
> 12 - 17.5	38
> 17.5 - 24	50

—
Fig. 7.9.5.1: Voltage sensor, ABB Type KEVA 24 C22

7.9.5 Voltage sensors

Primegear ZX0 panels can be fitted with voltage sensors according to IEC 60044-7 (Fig. 7.9.5.1) instead of conventional voltage transformers. The plug-in voltage sensors (type designation KEVA 24 C22c) 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

Highest voltage for equipment	Um	kV	up to 24 kV
Rated power frequency test voltage		kV	50 kV
Rated frequency	f_r	Hz	50 / 60
Rated transformation ratio			10000 : 1
Voltage accuracy class			0.5 / 3P

7.9.6 installation of instrument transformer and sensor

The current transformer and sensor could be mounted at either busbar or cable side, the detailed mapping are as below:

—
Table 7.9.6.1: Current measurement position in switchgea

Location	Feeder 450 cable bushing	Feeder 500 cable bushing	Feeder 600 cable bushing	Solid busbar at bottom of bus couplier and riser	Solid busbar IF600+450/500/600
LMZ6-226x155/220-75	Yes	Yes	Yes	Not available	Not available
LMZ6-228x188/220-75	Not available	Not available	Yes	Yes	Not available
LMZ6-226x185/145-65	Not available	Not available	Not available	Not available	Yes
KECA 80 C85	Yes	Yes	Yes	Yes	Yes

The voltage transformer and sensor could be mounted at cable side or busbar side, the detailed mapping are as below:

—
Table 7.9.6.2: Voltage measurement position in switchgear

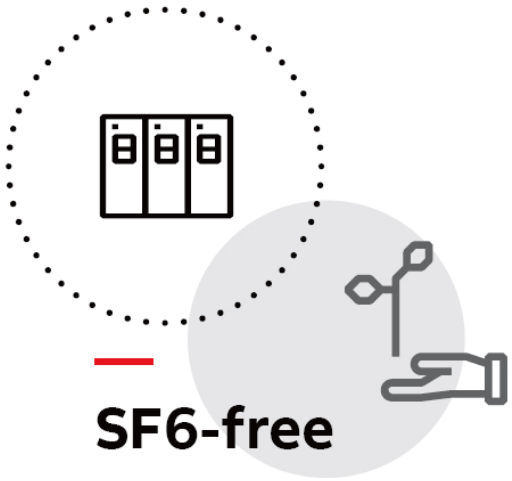
Type	Fuse solution	Voltage level (kV)	Cable side			Busbar side
			Cable connection		Plug in	600 mm, 500 mm, 450 mm (except the end panel)
			Feeder 500	Feeder 600	Feeder 600	
JDZXR27G-10C	Fuse solution available	12	Yes	Yes	Not available	Not available
JDZXR27G-10B	Fuse solution available	12	Not available	Not available	Yes	Yes
JDZX27G-20C	Without fuse solution	24	Not available	Yes	Not available	Not available
JDZX27G-20B	Without fuse solution	24	Not available	Not available	Yes	Yes
JDZXR27G-20B	Fuse solution available	24	Not available	Not available	Yes	Yes
JDZXR27G-10C1	Fuse solution available	12	Not available	Yes	Not available	Not available
KEVA 24C22	Fuse solution available	24	Not available	Not available	Yes	Yes

7.11 Insulation gas

To enhance eco-efficiency and reduce environmental impact, ABB has developed alternatives to SF_6.

Since more than five years ABB offers medium-voltage gas insulated switchgear (GIS) with AirPlus™, a groundbreaking eco-efficient gas mixture with 99.99% lower global warming potential (GWP).

In addition to AirPlus, the eco-efficient portfolio also includes Dry Air, which is a natural gas and suitable for lower voltage applications up to 12 kV.



Three pillars to make your switchgear greener

1. Dry Air Up to 12 kV
- Low-pressure design with similar footprint like SF6
- Common product platform with SF6 which makes our products eco-ready
- Meeting the similar performance and safety expectations like SF_6
- No Greenhouse gas effect
  Reduces the impact on global warming by 99.99%

2. AirPlus For 24 kV
- Most safest and compact SF_6-free low-pressure design..
- Common product platform with SF_6 which makes our products eco-ready
- Meeting the similar performance and safety expectations like SF_6
- No Greenhouse gas effect
  Reduces the impact on global warming by 99.99%

3. Eco-ready
- Plan and purchase an eco-ready GIS
- Energize the eco-ready GIS with SF_6
- During GIS lifetime, evacuate SF_6 and fill in DryAir / AirPlus
- Energize your green GIS and be happy about your reduced carbon footprint

—
Fig. 7.12.1: Gas density manometer
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Fig. 7.12.2 gas density manometer with triple joint
—
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

The gas compartments are designed as hermetically sealed pressure systems. 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, through which the panel modules can be filled with gas. It can also be used to exchange the gas or to remove it completely - for example when the end of life of the switchgear is eventually reached. In standard operation mode, this filling valve is used to connect a manometer that is monitoring the service pressure of the gas compartment.

The service pressure of the individual gas compartments is monitored by separate manometer (temperature-compensated pressure sensors, fig. 7.12.1). A shortfall below the alarm signal level for insulation 120 kPa for AirPlus and SF_6 / 130kPa for Dry Air 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 for 600mm panel if the gas in the gas compartment are still according to standard requirement.

In exceptional cases, on site refill is possible via triple joint gas density manometer, fig 7.12.2.

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: Pressure relief of the switchgear

Fig. 7.13.2: Pressure relief to the outside

7.13 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 7.13.1).

Use of a pressure relief duct for pressure relief to the outside
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 7.13.2).

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”.

7.14 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 galvanised 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 grey).

The rear cover which is necessary in case if a free-standing installation is galvanised. Optional the cover can be coated with a powder stove enamel in RAL 7035 (light grey).

Other colors for the painted parts are available on request.

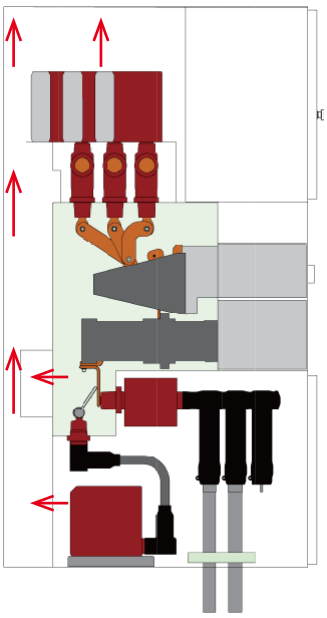


Fig. 7.13.1

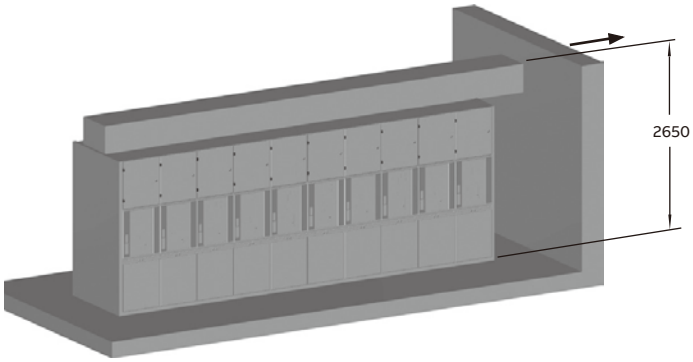


Fig. 7.13.2

8. Monitoring and diagnostics

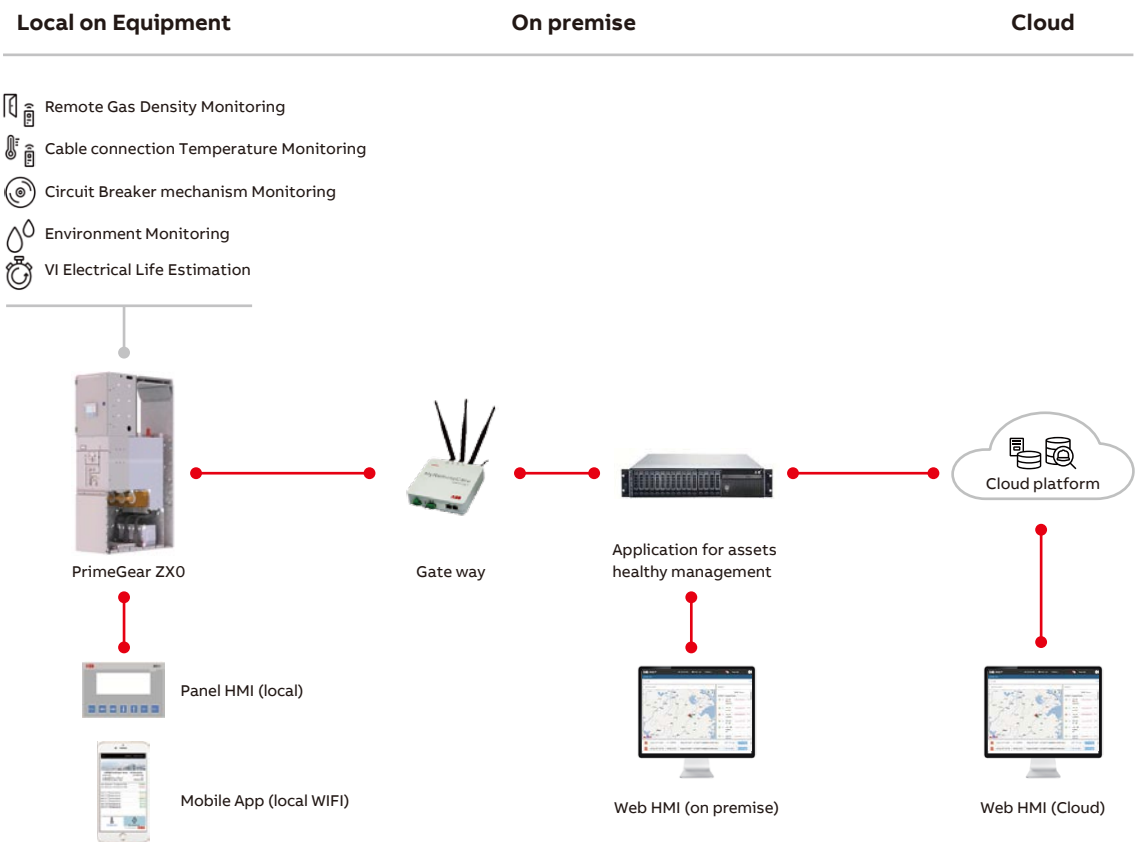
PrimeGear ZX0 can be fitted with Monitoring and Diagnostics (M&D) features, which provide operators with valuable insights on the health condition of the switchgear.

The M&D solution for Primary GIS is based on a modular platform and users can choose those features that fit best their application and needs.

It is ABB's philosophy to decouple the M&D system from the operation & control system so that an unintended mal-operation does not occur.

Although ABB's GIS is highly reliable and practically maintenance free, a Monitoring & Diagnostics solution can offer added value to GIS users:

- Lower operational cost
- Less travels to site for voluntary inspections
- Make the invisible visible
- Have knowledge of insightful data that is otherwise hidden and inaccessible
- Easy access anytime
- Local or remote solutions for convenient access anytime from anywhere
- Peace of mind: Certainty that the switchgear is in a good and safe condition



Remote Gas Density Monitoring

The correct gas density is essential for a safe and reliable operation of every gas insulated switchgear, so every ABB GIS has a gas density sensor with alarm contacts. Our M&D solution takes this to the next level and even allows a remote reading of the numerical gas density value – without traveling to site.

Our M&D feature for remote gas density shows the actual value of gas temperature and P20 gas density, which is the temperature-compensated gas pressure at 20°C. For a safe and reliable fallback, the combination with a traditional manometer and auxiliary contacts is available.

On the optional Web HMI a color scheme indicates the health status (green, yellow, red) and shows the historic development of P20 gas pressures in a diagram.

Cable connection Temperature Monitoring

The cable connection is one of the potential weak points in a gas-insulated switchgear. It is not always the case that the installation of cables and plugs were done properly, which could lead to a weak connection after some years of operation.

Our M&D solution monitors the temperature on the cable in close proximity to the cable connection point, and helps to detect an abnormal temperature rise by comparing temperatures of all three phases. The sensors are self-powered without a battery, and installed on the earthed cable screen – safely separated from the medium-voltage parts. The sensors use wireless communication from the cable compartment directly to the low-voltage compartment.

This function shows actual values of cable connection temperatures for phases A, B, C, and has two-level threshold algorithms (warning & alarm) to indicate over-temperature. Also includes one-level threshold algorithm to warn in case of temperature difference between the phases. The optional WebHMI also shows color scheme to indicate health status (green, yellow, red) and shows historic development of cable connection temperatures in phases A, B, C in a diagram.

CB mechanism Monitoring

The circuit-breaker is the core component of every switchgear panel. Our solution measures the open/close times and motor spring charging time, via hall current sensors and auxiliary position contacts as well as average currents of open / close coil and spring charging motor. The solution can be easily installed in the low-voltage compartment, without direct connection on the CB mechanism.

Environment Monitoring

An environment sensor is placed in the low-voltage compartment of the switchgear panel, to monitor temperature and humidity.

It shows actual values of temperature and humidity, and includes a threshold algorithm for alarm and warning of high temperature, low temperature and high humidity.

This can help to identify danger of condensation, or malfunction of the air-conditioning system, for example.

VI Electrical Life Estimation

Estimation of contact wear of the vacuum interrupter in the circuit breaker, based on measuring the current during CB opening. The current measurement happens safely with AC current transformers in the low-voltage compartment over the secondary CT wires.

This function includes algorithm to estimate accumulated energy from switching operations and the related contact wear, and shows actual value of remaining number of operations at rated current level.

9. Range of panels

The following panel variants are available:

- Feeder panels
  - Panels with circuit-breaker and three position disconnector
  - Cable termination panels
- Sectionaliser
- Riser
- Bus sectionaliser/riser

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 variants	Rated normal current [A]	Panel width [mm]
Feeder panel	... 630	450, 25 kA
	... 1250	500 / 600, 25 kA
Bus coupler panel	... 1250	500 / 600, 25 kA
Riser panel	... 1250	500 / 600, 25 kA
Sectionaliser/Riser panel	... 1250	600

9.1 Feeder panels

9.1.1 Incoming and outgoing feeder panels with circuit-breaker

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Fig. 9.1.1.1: Feeder panel with circuit breaker, 24 kV, 630 A, 25 kA width 450 mm

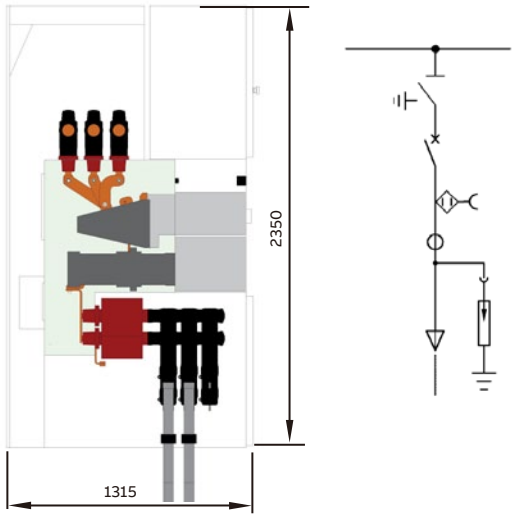

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Fig. 9.1.1.2: Feeder panel with circuit breaker, 12 kV, 1250 A, 25 kA width 500 mm

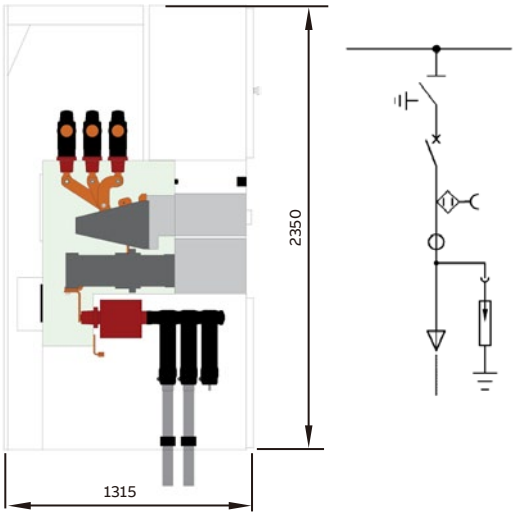

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Fig. 9.1.1.3: Feeder panel with circuit breaker 24 kV 1250 A, 25 kA voltage transformers (isolatable in the off circuit condition) on the cables and plug in voltage transformers on the busbars, width 600 mm.

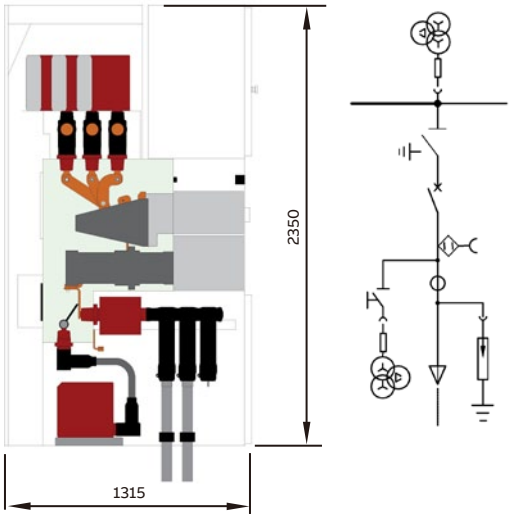

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Fig. 9.1.1.4: Feeder panel with circuit breaker 1250 A, with current and voltage sensors (isolatable in the off-circuit condition) panel width 500 mm for 25 kA

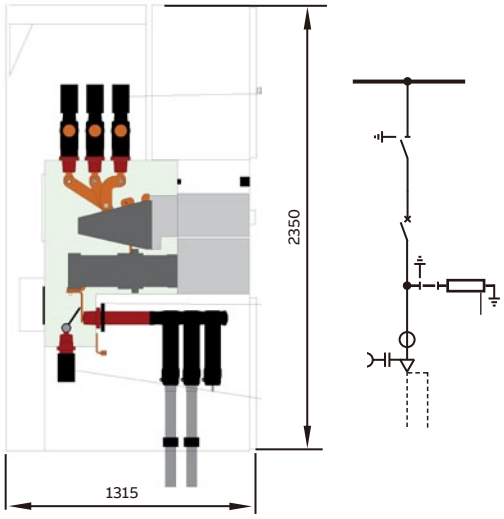
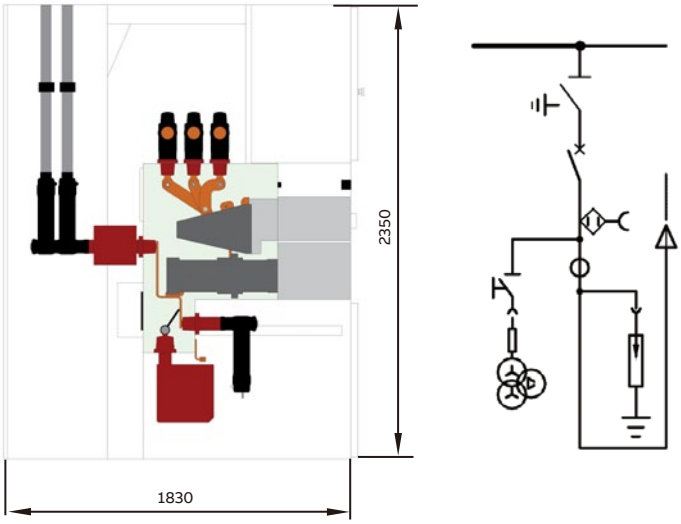


Fig. 9.1.1.5 Feeder panel with circuit breaker 24 kV 25 kA with rear cable entry



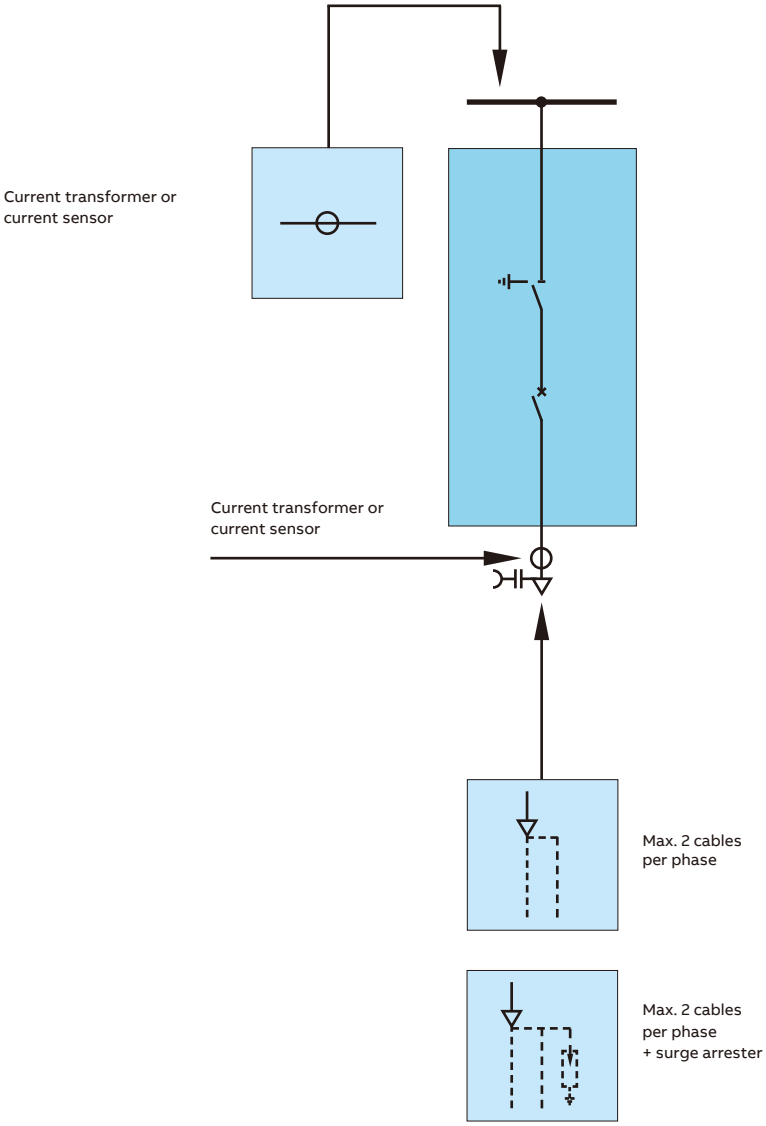


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Table 9.1.1.1: Overview of variants for incoming and outgoing feeder panels with circuit-breaker, Ir up to 630 A

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

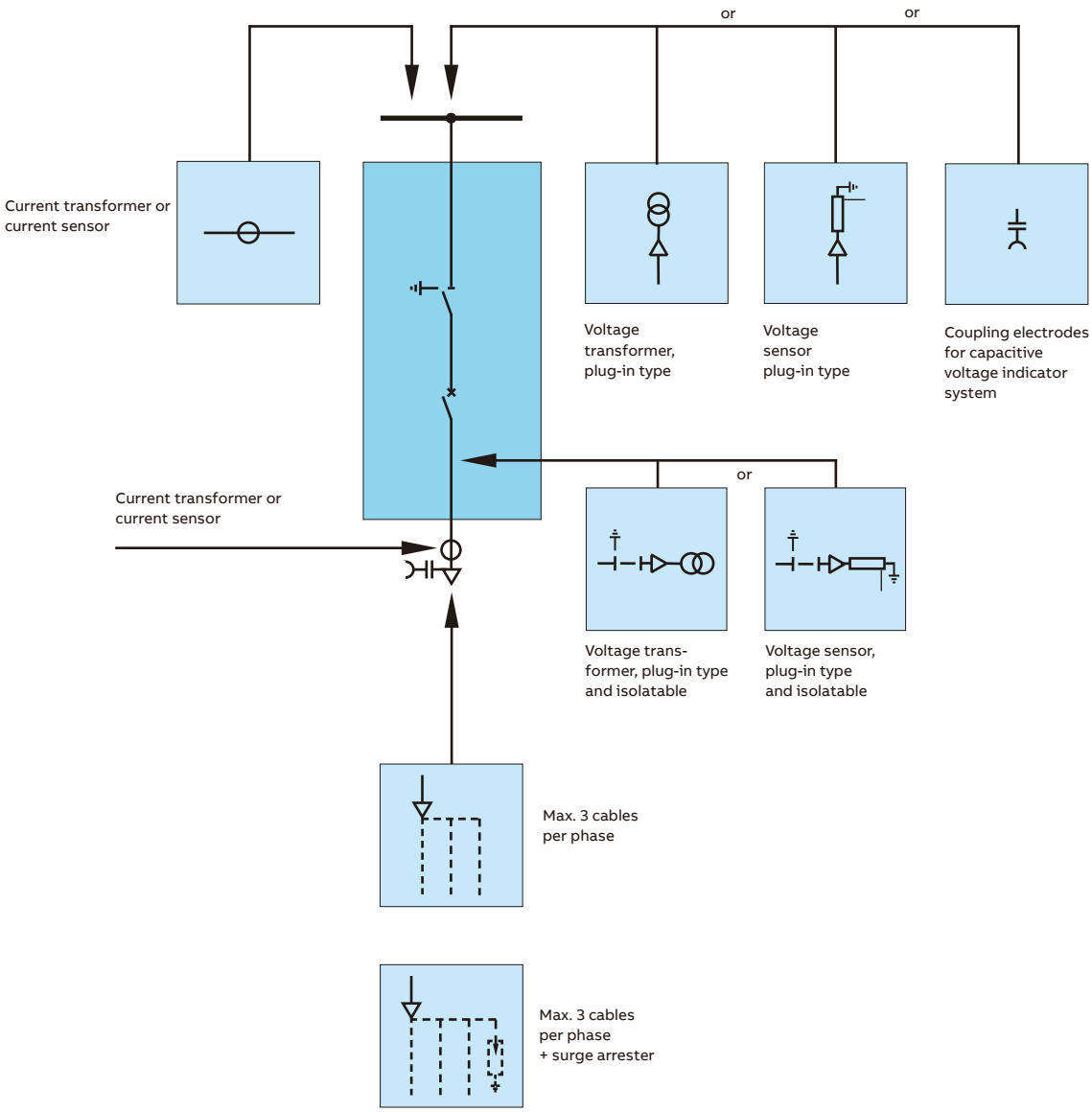


Table 9.1.1.2: Overview of variants for incoming and outgoing feeder panels with circuit-breaker, Ir up to 1250 A

U_r:	...24 kV, panel width 600 mm	... 12 kV, panel width 500 mm
I_r:	... 1250 A	...1250 A
I_p:	... 25 kA	...25 kA

9.1.2 Cable terminal panels

Fig. 9.1.2.1: Cable termination panel 1250 A

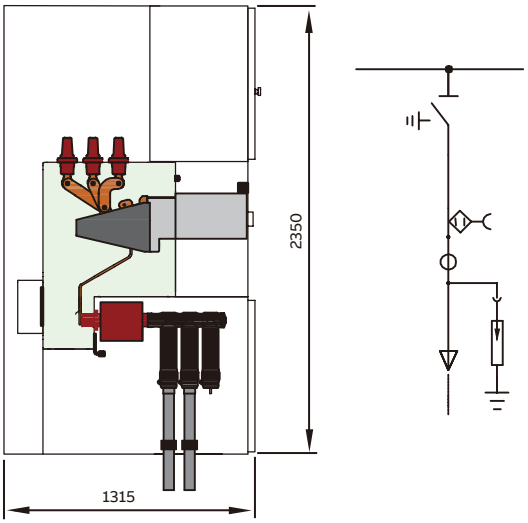
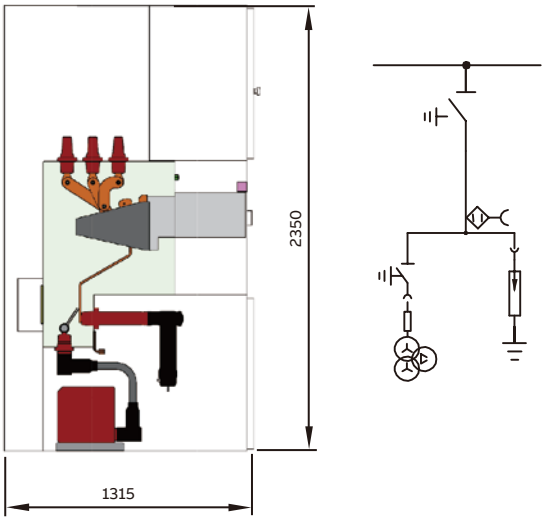


Fig. 9.1.2.2 PT panel



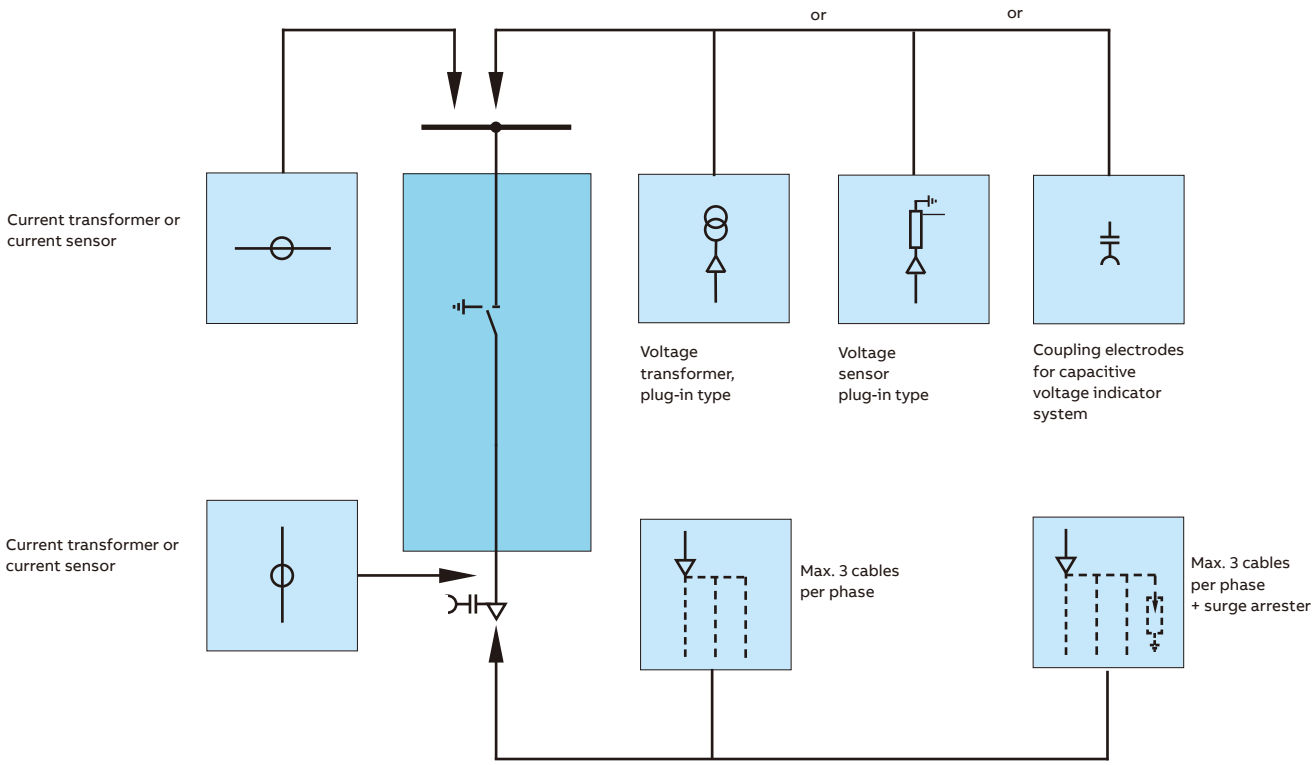


Table 9.1.2.1: Overview of variants for cable termination panels, Ir up to 1250 A

U_r:	...24 kV, panel width 600 mm	... 12 kV, panel width 500 mm
I_r:	... 1250 A	...1250 A
I_p:	... 25 kA	...25 kA

9.2 Busbar sectionaliser and riser panels

A sectionaliser and a riser panel are required for the implementation of bus couplings. In addition, a Sectionalizer/Riser panel containing a circuit-breaker and two three position disconnectors is also available.

Bus couplings can be integrated in a switchgear block. The riser and sectionaliser panels are connected by a solid insulated bar below the panel module.

Couplings between two system blocks can be effected by means of cables.

9.2.1 Couplings within a switchgear block

Sectionaliser 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. Sectionaliser and riser panels can be fitted with voltage transformers for busbar measurement.

The installation variants “sectionaliser left – riser right” and vice versa are possible.

For future extension a riser panel can be installed at the end of the switchgear system.

Fig. 9.2.1.1: Sectionaliser panel 1250 A,width 500 mm or 600 mm.

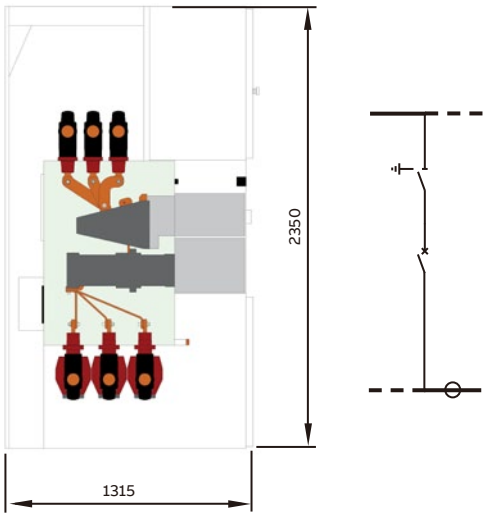
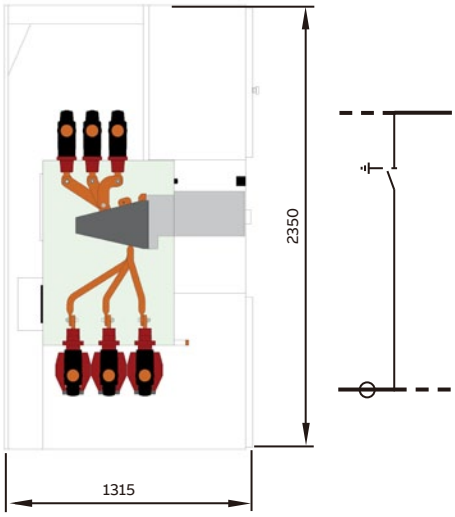


Fig. 9.2.1.2: Riser panel 1250 A,width 500 mm or 600 mm.



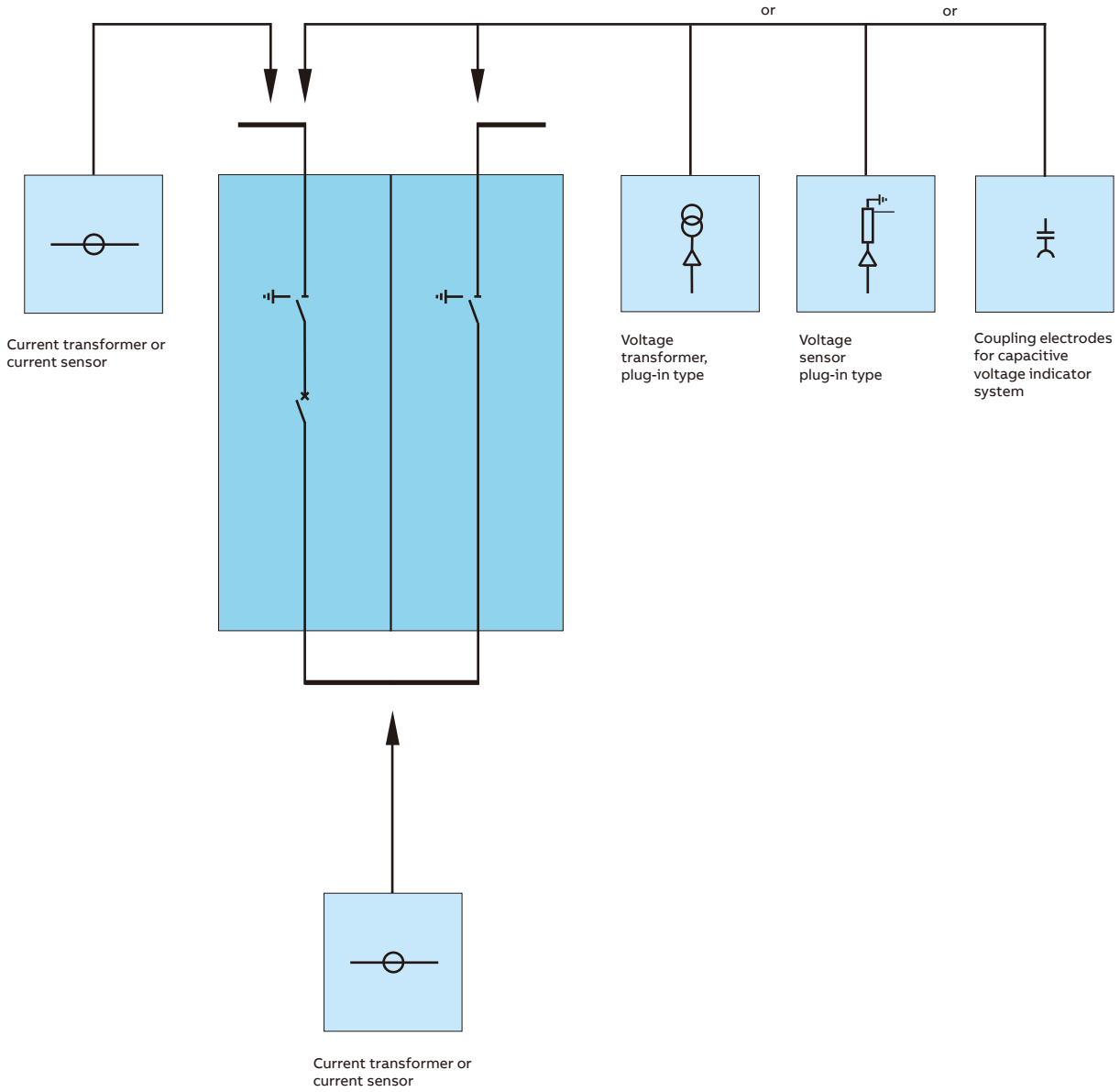


Table 9.2.1.1: Overview of variants for sectionaliser and riser panels for installation within a switchgear block

U_r:	...24 kV, panel width 2 x 600 mm	... 12 kV, panel width 2 x 500 mm
I_r:	... 1250 A	...1250 A
I_p:	... 25 kA	...25 kA

9.2.2 Bus sectionaliser/riser panel

The bus coupler panel contains a circuit-breaker and two three position disconnector. In this panel variant. The bushings on the left-hand busbar section can be fitted with voltage transformers.

Voltage transformers for voltage detection in the right-hand busbar section can be located on the busbar of the adjacent panel on the right. Current transformers can be positioned on the busbars of the adjacent panels.

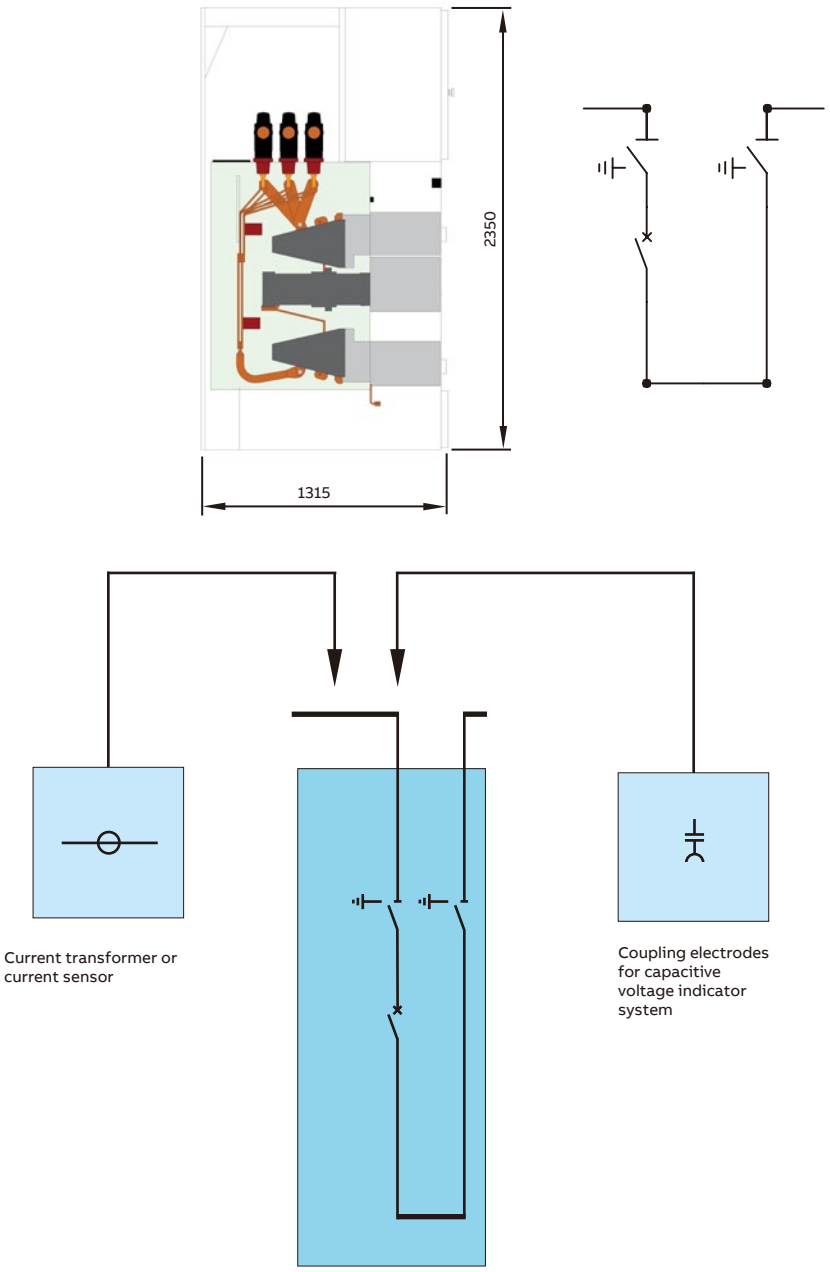


Table 9.2.2.1: Bus coupler panel

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

10. Busbar earthing

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Fig. 10.1.1: Busbar earthing by earthing set
—
Fig. 10.2.1: Busbar earthing by sectionaliser 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.

10.1 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. 10.1.1). Earthing can also be effected similarly via a switch disconnector panel with cable termination.

10.2 Earthing the busbar by means of a sectionaliser and riser or bus coupler

Earthing is effected by the three position disconnector and the circuit-breaker in a bus sectionaliser (see fig. 10.2.1).

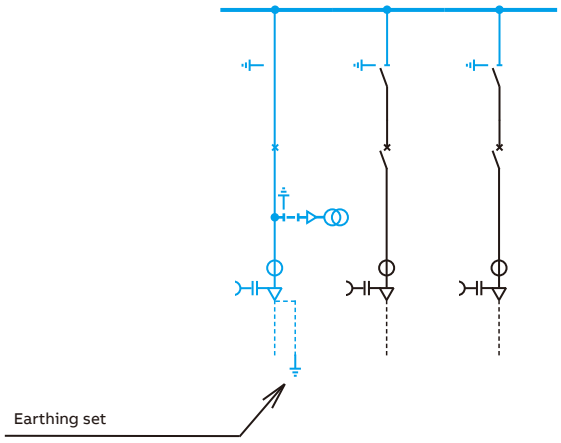

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Fig. 10.1.1

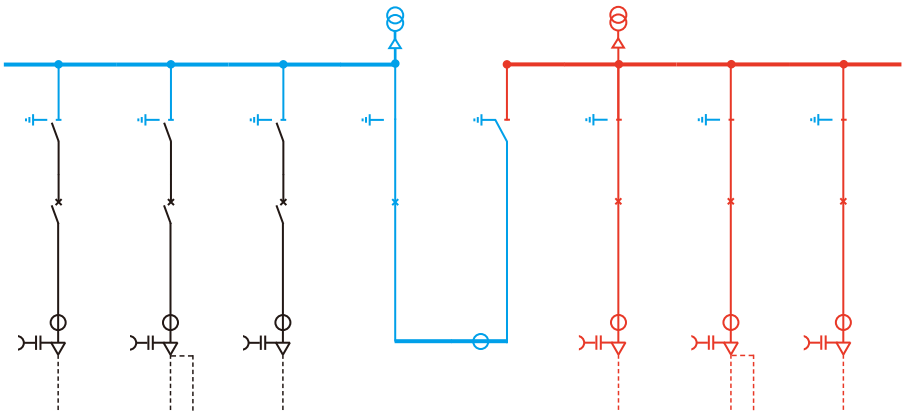

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Fig. 10.2.1

11. Building planning

11.1 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.

Floor openings for power cables can be configured as cutouts for each panel, as continuous cutouts (one each for power and control cables) or as drill holes. The floor openings are to be free from eddy currents (drill holes for power cables three phase – without ridges in between).

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

Pressure stress on the switchroom
With pressure relief inside the switchroom or to the cable basement, 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.

Construction materials
When selecting suitable construction materials, you should comply with any applicable national regulations. We fundamentally recommend non-flammable materials of class A2 to EN 13501-1.

Ventilation of the switchroom
Lateral ventilation of the switchroom 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, vapours 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 vapour 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 vapour 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 (> -15 °C) are also to be ensured by means of room heating.

11.2 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 mounting-installation
4. Pressure relief to the outside through a duct / Free-standing

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

a) Fulfilment 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) Fulfilment 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) Fulfilment 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 thebuilding 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 ac cessibility 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 1295 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 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 fulfils 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 pressure relief duct, the distance of the switchgear system from the wall at the rear is not relevant for the IAC classification. We recommend that a dimension of 1400 mm + 200 mm from the front edge of the switchgear system to the wall of the switchgear room behind the system be maintained. This ensures that the distance between the switchgear system and the wall is sufficient and that any unevenness in the wall has no adverse consequences.

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

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

11.2.1 Space required with pressure relief into the switchgear room

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Fig. 11.2.1.1: Wall mounting installation, example of a single row installation (Top view, dimensions in mm)

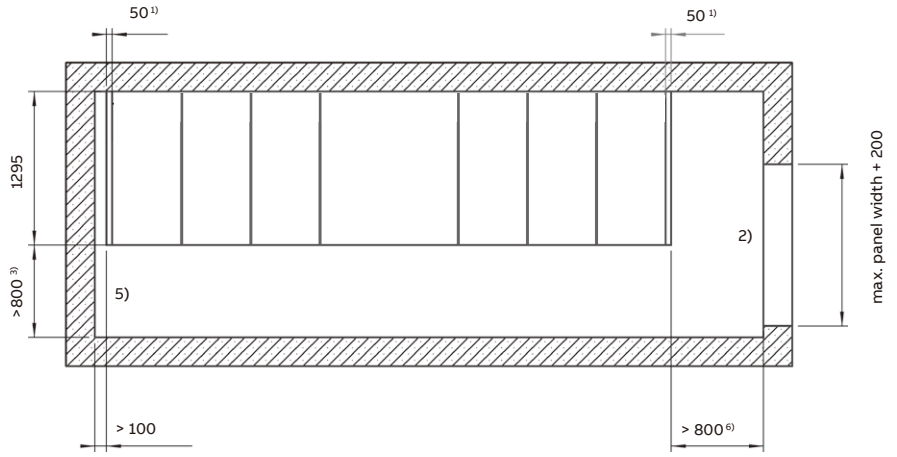

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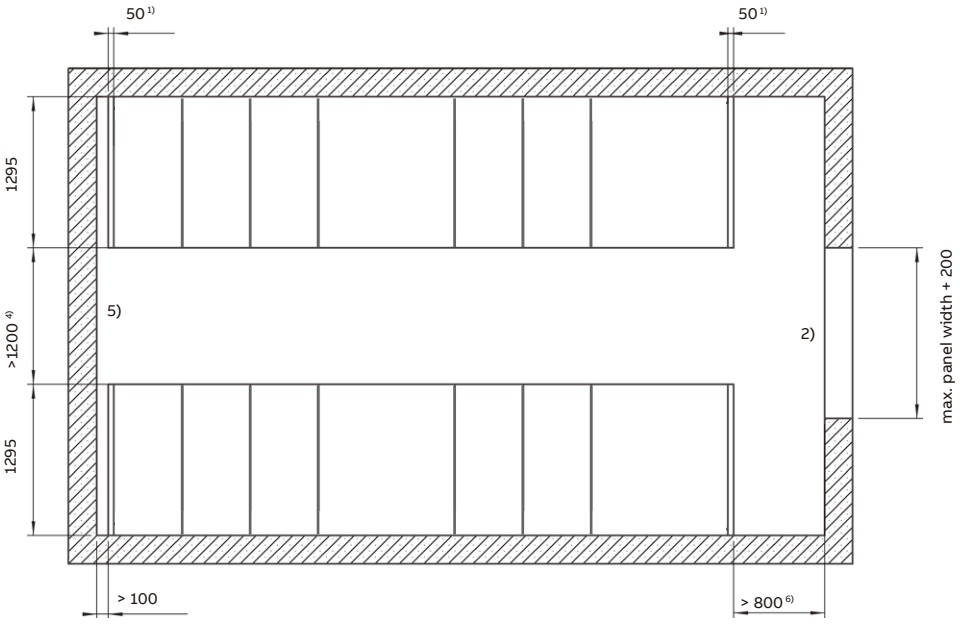
Fig. 11.2.1.2: Wall mounting installation, example of a double row installation (Top view, dimensions in mm)



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: 1. The low voltage compartment doors close in the direction of the emergency exit. 2. 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: 1 The low voltage compartment doors close in the direction of the emergency exit. 2. 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.

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Fig. 11.2.1.3: Free- standing installation, example of a single row installation (Top view, dimensions in mm)

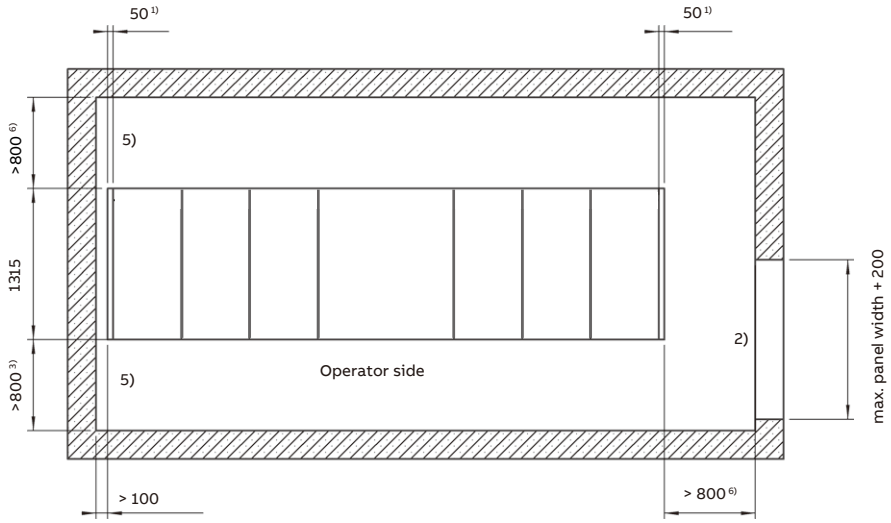

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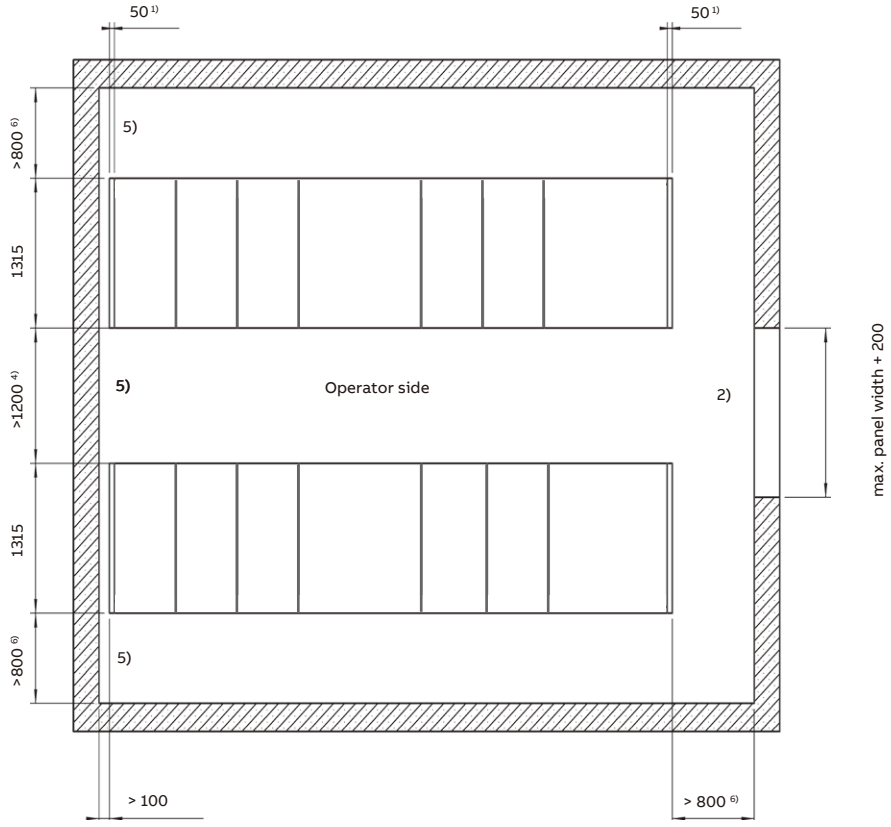
Fig. 11.2.1.4: Free- standing installation, example of a double row installation (Top view, dimensions in mm)



1) End cover
2) Recommended minimum door height: 2550 mm.
3) Conditions for a minimum clearance of 800 mm in front of the system: 1. The low voltage compartment doors close in the direction of the emergency exit. 2. 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: 1 The low voltage compartment doors close in the direction of the emergency exit. 2. 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.

11.2.2 Space required when a pressure relief duct is fitted

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Fig. 11.2.2.1: Wall mounting installation, example of a single row installation (Top view, dimensions in mm)

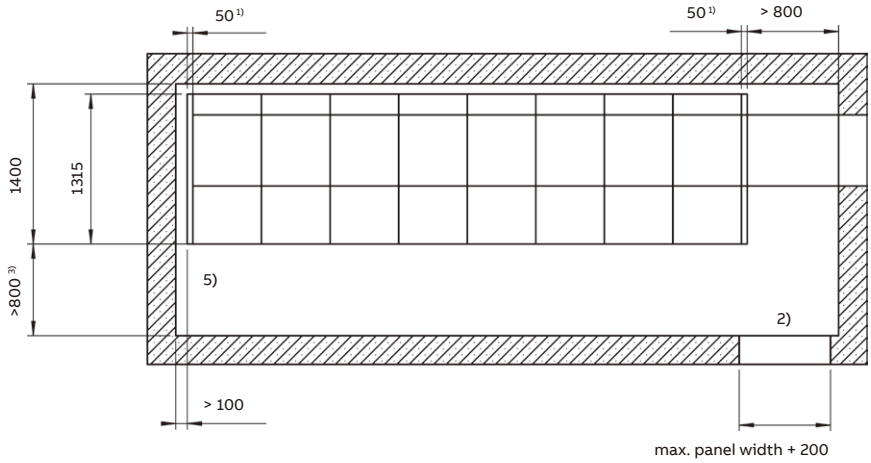

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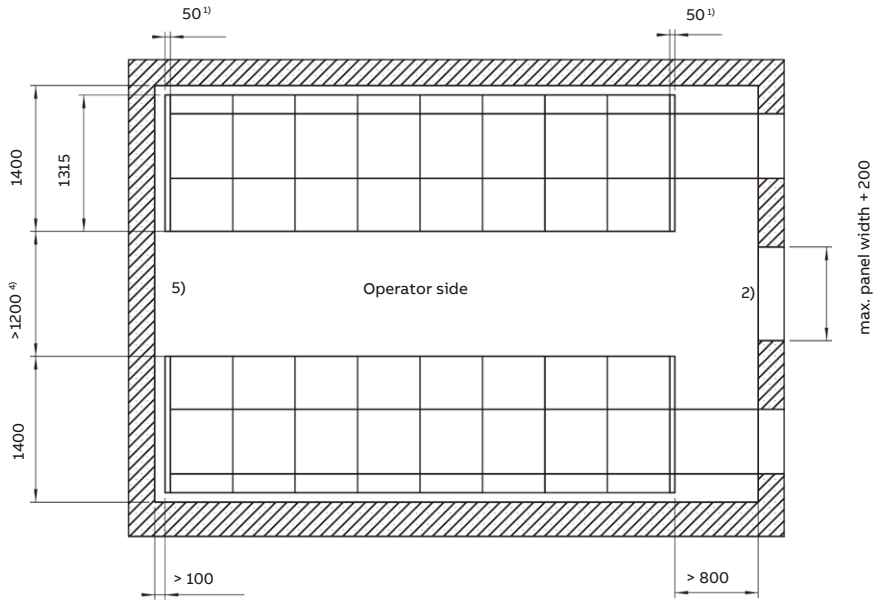
Fig. 11.2.2.2: Wall mounting installation, example of a double row installation (Top view, dimensions in mm)



1) End cover
2) Recommended minimum door height: 2550 mm.
3) Conditions for a minimum clearance of 800 mm in front of the system: 1. The low voltage compartment doors close in the direction of the emergency exit. 2. 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: 1 The low voltage compartment doors close in the direction of the emergency exit. 2. 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.
For determination the operator side width between the panel blocks observe the required door width of the switchgear room and the area defined in section “Hazardous areafor pressure relief to the outside”
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.

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Fig. 11.2.2.3: Free- standing installation, example of a single row installation (Top view, dimensions in mm)

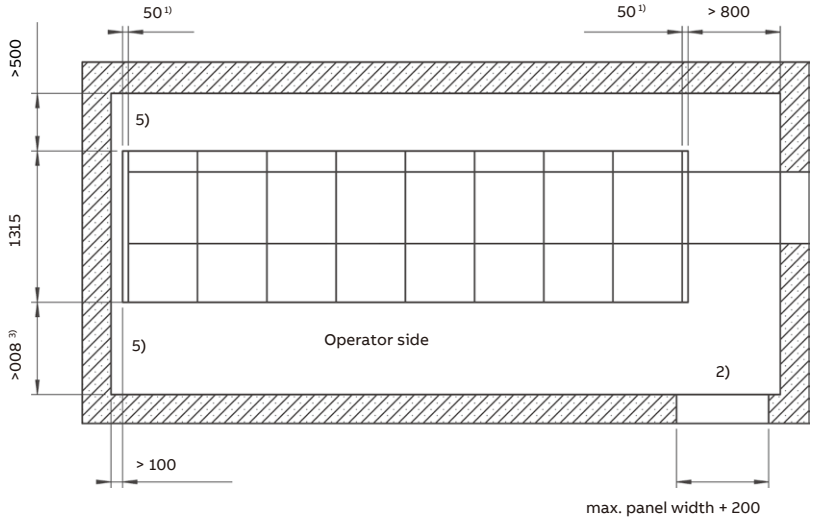

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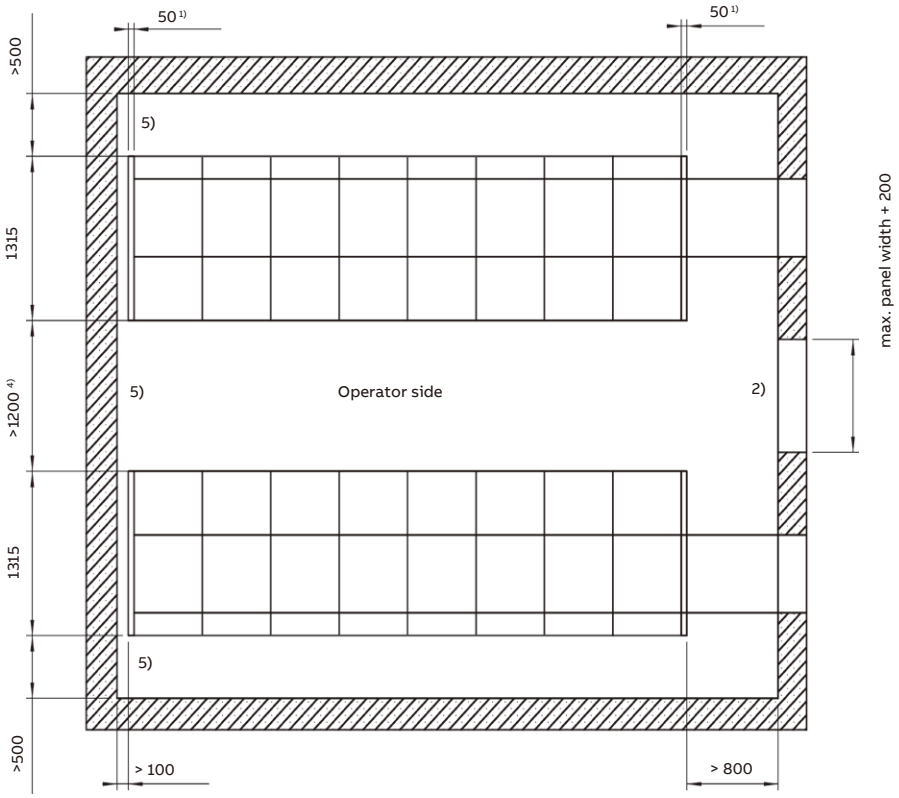
Fig. 11.2.2.4: Free- standing installation, example of a double row installation (Top view, dimensions in mm)



1) End cover
2) Recommended minimum door height: 2550 mm.
3) Conditions for a minimum clearance of 800 mm in front of the system: 1. The low voltage compartment doors close in the direction of the emergency exit. 2. 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: 1 The low voltage compartment doors close in the direction of the emergency exit. 2. 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.
For determination the operator side width between the panel blocks observe the required door width of the switchgear room and the area defined in section “Hazardous areafor pressure relief to the outside”
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.

Fig. 11.2.2.1.1: Dimensions of the hazardous area for pressure relief to the outside

11.2.2.1 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 figure 10.2.2.1.1 and table 10.2.2.1.1 for the dimensions of the hazardous area.

Table 11.2.2.1.1: 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

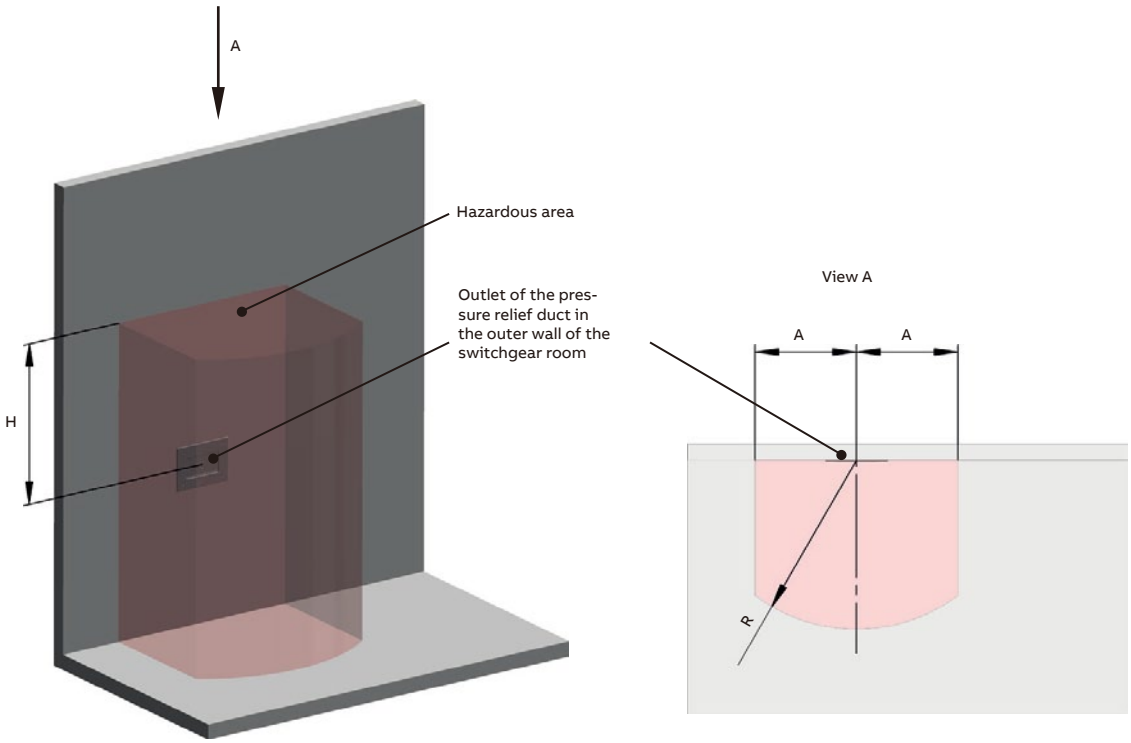


Fig. 11.2.2.1.1

11.3 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 2 000 mm [clear height] and the minimum clear opening 750 mm.” [1)]

—

Table 11.3.1: 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 11.3.2: Recommended aisle widths (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.
2) Enlarging the aisle width might be required due to the area defined in section “Hasardous area for pressure relief to the outside”.
3) Length of the standard pressure duct: 800 - 1000 mm.

11.4 Minimum room heights

Busbar covers fitted

Fulfilment of the IAC qualification requires a clear ceiling height of min. 2950 mm for the switchgear room.

Pressure relief duct fitted for discharge to the outside

A clear ceiling height of 2900 mm is required.

11.5 Concrete floor

11.5.1 Floor openings

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Fig. 11.5.1.1 Opening for cables,panel width 450 mm

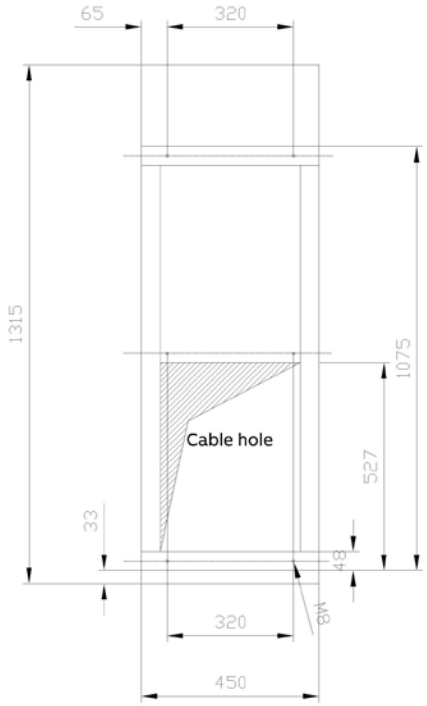

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Fig. 11.5.1.2 Opening for cables,panel width 500 mm

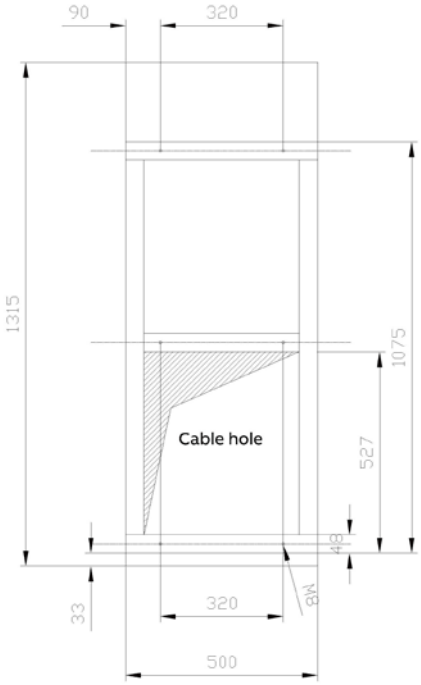

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Fig. 11.5.1.3 Opening for cables,panel width 600 mm

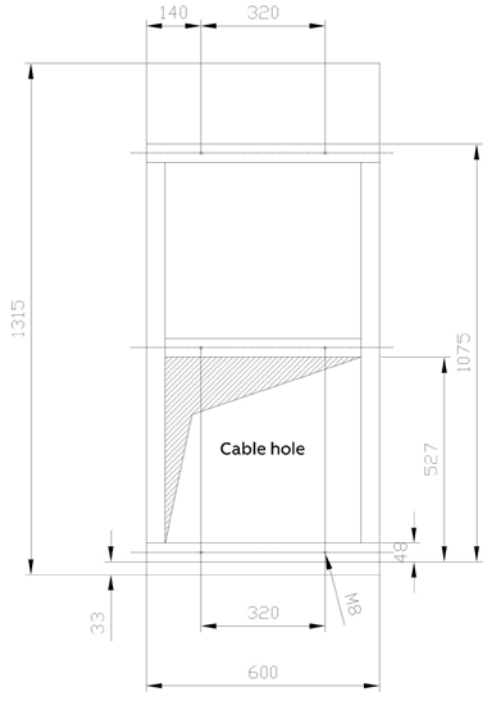

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Fig.11.5.1.4 Floor openings for entry of secondary cables from below (optional) in sectionaliser and riser panels (panel width 600 mm) and in the transfer panel(panel width 600 mm) and in the PT panel (panel width 600 mm)

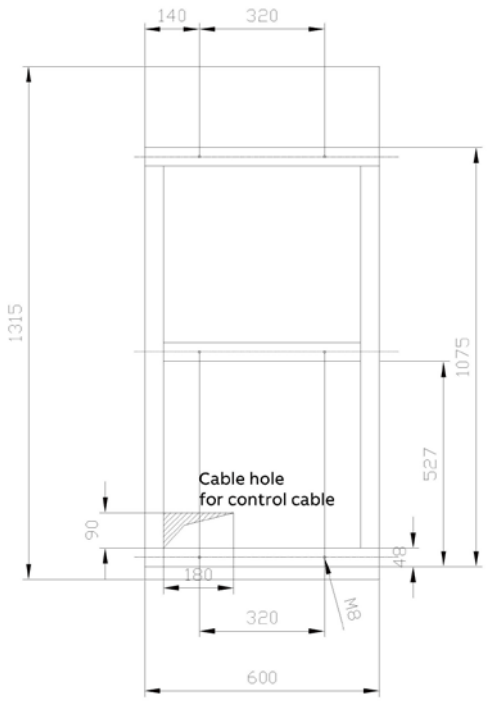

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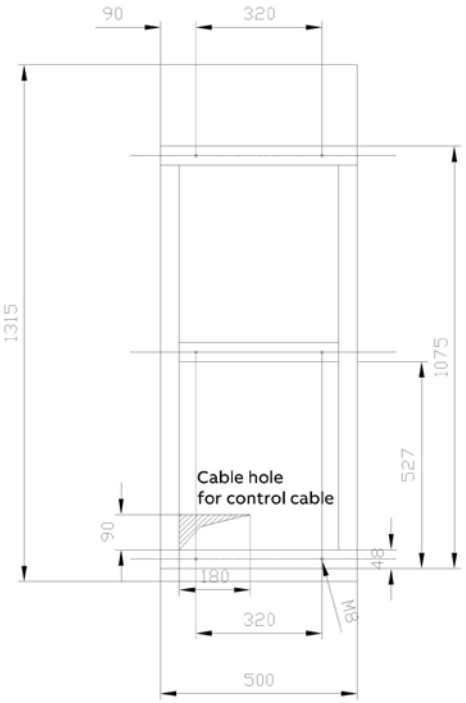
Fig.11.5.1.5 Floor openings for entry of secondary cables from below (optional) in sectionaliser and riser panels (panel width 500 mm) and in the PT panel (panel width 500 mm)



11.7 Earthing of the switchgear

11.7.1 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 240 mm^2 (ECuF30, 30 mm x 8 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.

11.7.3 Recommendations on configuration of the switchgear earthing

We recommend that the switchgear be earthed as shown in figures 11.7.3.1 and 11.7.3.2.

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 11.7.3.1 and 11.7.3.2.

Fig. 11.7.3.1: Earthing recommendation, schematic diagram showing the concrete floor

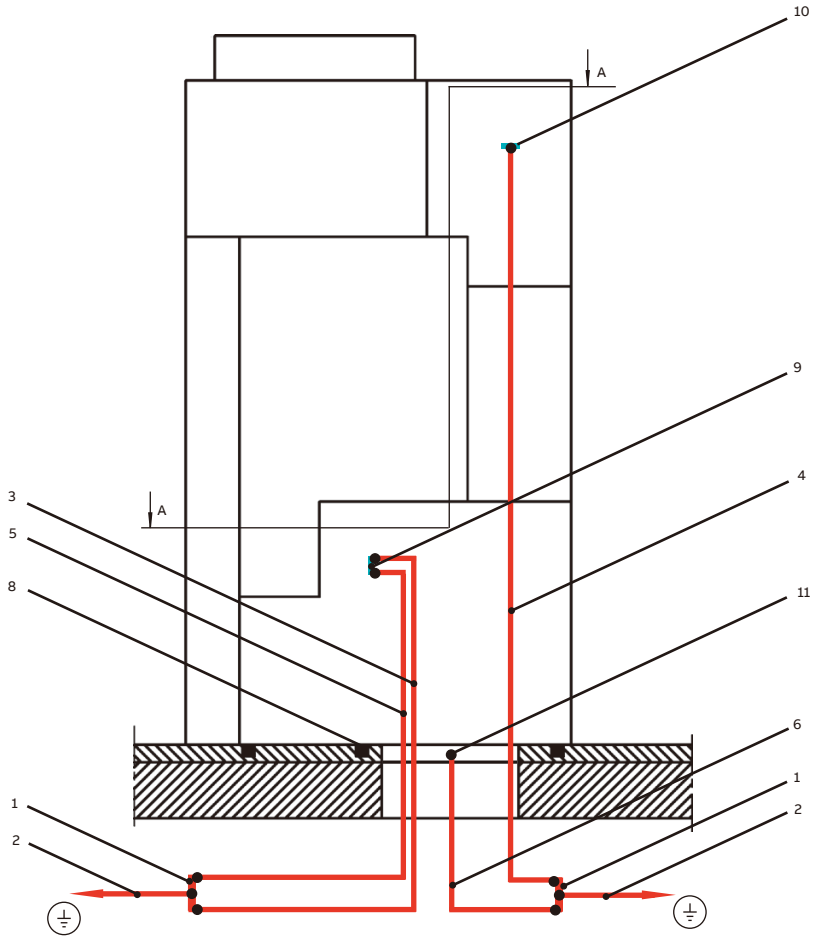


Fig. 11.7.3.1

Legend to figures 10.7.3.1

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: galvanised 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

11.8 Panel weights

Table 11.8.1: Panel weights

Panel type	Panel width [mm]	Rated normal current [A]	Weight, max [kg]
Feeder panel	450	630	650
Feeder panel	500/600	1250	800
Feeder panel (Rear Entry)	500/600	1250	1000
Bus Tie Panel	500/600	1250	900
Bus Riser Panel	500/600	1250	700
Bus Tie & Riser Panel	600	1250	1400
Disconnector Panel	500/600	1250	800
Load Break Switch Panel	600	Depends on fuses	600

12. Non-standard operating conditions

Fig. 12.1: Relationship between ambient air temperature and current carrying capacity

Non-standard operating conditions may require special action. Our design team will be pleased to submit and implement technical proposals to fulfil your 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 no reduction is necessary.

Seismic withstand capability
The panels are tested to GB/T 13540-2009.

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 450 mm and 500 mm wide

At site altitudes > 1000 m, a reduction of the permissible operating current and / or the ambient temperature may be necessary. The correction factors for the permissible operating current can be found in table 12.1.

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.

Table 12.1: Correction factors for permissible operating current at site altitudes > 1000 m

Maximum ambient air temperature / °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 uo 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	-	-	-	-

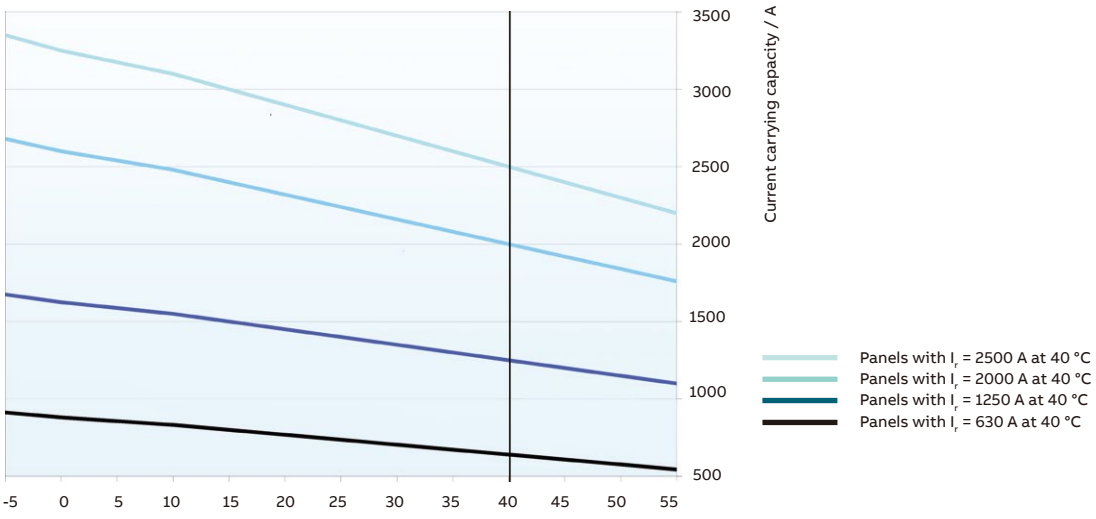


Fig. 12.1

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