Medium Voltage Distribution

WS

up to 36 kV

Gas-insulated switchgear with vacuum circuit-breaker for primary distribution

System configuration

Schneider Electric

Delivery Conditions

The General Delivery Conditions as amended shall apply.

Illustrations

The illustrations are not binding.

Contents

Introduction

WS switchgear units with

- rated voltages up to 36 kV
- rated currents up to 2,500 A
- rated peak withstand currents up to 80 kA
- rated short-time currents up to 31.5 kA 3s
- arc resistant-classification IAC max. 31.5 kA 1s

WSB double busbar switchgear

A switchgear concept of high economic efficiency, availability and versatility

The gas-insulated, metal-enclosed and metal-clad WS switchgear has been designed for application in transformer substations, industry and infrastructure and satisfies the most exacting requirements regarding

- operating reliability
- operator safety
- availability
- environmental compatibility.

The panels are suitable for configuring single and double busbar switchgear for indoor installation. Bilateral extension of existing switchgear is straightforward.

The WS is a systematically gasinsulated switchgear whose busbar systems are also consistently located in gas-insulated cladded compartments.

WS switchgear units with

- rated voltages up to 36 kV
- rated currents up to 2,500 A
- rated peak withstand currents up to 80 kA
- rated short-time currents up to 31.5 kA 3s,
- arc resistant-classification IAC max. 31.5 kA 1s,

are primarily used as consistently gas-insulated switchgear for application in transformer and switching stations of

- power supply companies
- infrastructure, e.g. buildings
- government authorities
- industry
- open-cast lignite mining
- mining
- ships and offshore plants
- railway traction power supply.

The WS satisfies maximum requirements regarding

- operating reliability
- operator safety
- availability
- environmental compatibility.

With WS switchgear, the same space is required for the single busbar and double busbar models. The compact design with extremely small dimensions is very advantageous for use

- in confined spaces
- when substituting old switchgear in existing operating aisles.

Introduction (contd.)

Features

Operator-safe

- Maximum protection againstn accidental contact due to complete metal cladding of all switchgear components
- Optimum operator safety due to a complete interlocking system
- Successfully tested regarding behaviour in case of internal faults according to IEC 60298 Appendix AA

User-friendly

- Compact und clear design
- Easy access to all functional groups
- Modern industrial design according to ergonomic aspects facilitates operator guidance
- Visually highlighted control panel for mechanical switch position signalling on the switchgear panel
- Logical operator control
- Good visual operator guidance for mechanical operation of the panel

Economical

- Reduced space and surface area requirements
- Short assembly times
- Modest financial expense as the system can be extended step by step due to the extension options offered for different conditions
- Minimized operating costs

Climate-independent

- All high-voltage components are in SF6 atmosphere under slight excess pressure, thus protected against atmospheric humidity and contamination, independently of the installation altitude
- Gas tank made of stainless chromiumnickel steel

Safe to operate

- All active medium-voltage components are located in hermetically enclosed, gas-filled cladded compartments and are thus insensitive to
  - aggressive atmosphere
  - dirt
  - dust
  - vermin
- Systematic gas-insulated technology: Even the busbar system is gas-insulated and is continuously monitored with regard to insulating capacity together with all the other medium-voltage components.
- Inert insulating gas SF6 provides protection against a fire in the station and prevents contact oxidation.
- Subdivision of the three-phase enclosure by poles using metal partitions (M enclosure)
- No partial discharge possible between the phases
- Negligible sheath currents
- Simple drive mechanisms: e.g. in case of single busbar switchgear units, simply an outside push rod
- Stable and reliable gas system

Reliable

Introduction (contd.)

- Central electronic gas monitoring device, temperature-compensated
- Few gas compartments and pressure relief devices
- Low number of static and dynamic seals
- High number of mechanical and electrical operations due to the use of vacuum circuit-breakers
- Very robust and reliable drive and interlocking system

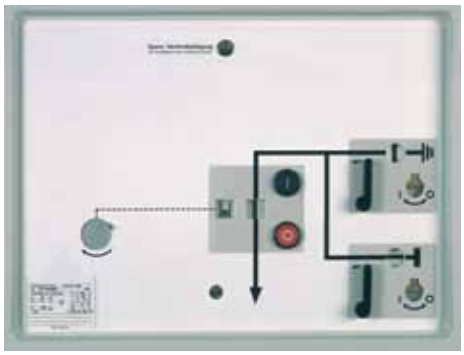
Expandable

- Bilateral extension is possible

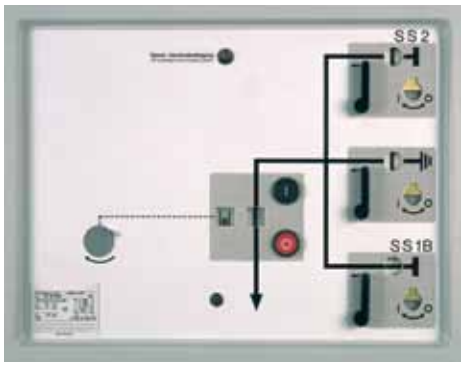
Easy to assemble

- Light-weight
- Optimum access to the spacious cable connection area
- Can be installed in the switching compartment without the use of lifting devices

Introduction (contd.)



Mechanical control panel Single busbar WSA



Mechanical control panel Double busbar WSB

Straightforward operation due to a functional user interface

Mechanical operation is performed the same way as with the habitual operation of conventional switchgear with stationary switching devices. Separate control elements and mechanical indicators are available for the following functions:

- Circuit-breaker ON - OFF
- Disconnector ON - OFF
- Outgoing feeder / busbar earthing ON - OFF

The mechanical control panel is located at an ergonomically convenient height and arranged in a recessed position on the switchgear front. Thus, the operating area is clearly visible while no control elements protrude from the switchgear front. The position of the individual elements has been selected according to their function, i.e. according to their allocation to the corresponding device functions.

The elements which form part of a main switching device, such as position indicators, interrogating levers and crank ports, are visually linked by a specific pattern and integrated in a mimic diagram.

The WS is characterized by the following operating features:

- Ergonomic operability
- Logical operation
- Logical function states
- Good visual communication of the overall function and operating states
- Optimum operator guidance
- All operations can be performed optionally via a motor-operated mechanism

Front view of a double busbar switchgear WSB with operator

Standards
Regulations, provisions and standards

Completion of the WSA and WSB switchgear panels

WSA switchgear units are
- metal enclosed
- SF_6 insulated
- prefabricated and type-tested
- arc resistant-classification IAC max. 31.5 kA 1s

Environmental and operating conditions

WS switchgear units must be operated under normal operating conditions according to the specifications EN 60694 or the IEC publicationn 60694 (new: IEC 62271-1).

Operation under conditions other than these is only admissible upon consultation and with the consent of the manufacturer.

Ambient conditions		
Temperature class		"minus 5 indoors" [1]
Min./max. ambient temperature	**°C**	-51) / 40 [2]
Average value over 24 hours (max.)	**°C**	35 [3]
Maximum installation altitude above sea level	**m**	1000 [4]
Insulating gas		
Type		Sulphur hexafluorid (SF_6)
Rated filling pressure [pre] at 20 °C	**MPa**	0.03 - 0.05

[1] Optional: “minus 25 indoors”
[2] Optional up to 55°C in case of reduction of normal currents
[3] Optional up to 40°C in case of reduction of normal currents
[4] Higher installation altitudes possible on request

Degrees of protection against accidental contact and foreign objects

Main electric circuits IP65	
Drives	IP2X, IP 5X [1]
Low-voltage cabinets and cable connection compartments (Operator's side with cable compartment coverand side panels)	IP3X, IP 5X [1]
[1] Optional	

Standards applied

WS switchgear units meet the following standards and regulations:

Designation	IEC standard	IEC classes	EN standard
Switchgear	**IEC 62271-200 IEC 60694 (new IEC 62271-1)**	**Category for operating availability LSC 2A Partition class (compartmentalization class): PM**	**EN 62271-200 EN 60694 (new EN 62271-1)**
Circuit-breaker	IEC 62271-100	M2, E1, C1	EN 62271-100
Earthing switch	IEC 62271-102	E2	EN 62271-102
Disconnectors		M1	EN 62271-102
Current transformers	IEC 60044-1		EN 60044-1
Inductive voltage transformers	IEC 60044-2		EN 60044-2
Voltage detection systems	IEC 61243-5		
Protection against accidental contact, foreign objects and water	IEC 60529		EN 60529
Installation			HD 637 S1
Operation of electrical equipment			EN 50110

Standards

Regulations, provisions and standards (contd.)

Type designation

The type designation of the typetested, prefabricated panels contains information about their design, rated voltage, insulation level, panel width and panel height.

Type designation		Explanation			
Series		Gas-insulated (SF_6) panels for extremely demanding requirements			
Version		Single busbar, indoors			
	B	Double busbar, indoors			
Rated peak withstand current	**6/**	Rated peak withstand current	63 kA		
	8/		80 kA		
Rated voltage	**/12-2/**				
	/17-2/				
	/24-2/				
	/36-2/				
Dimension code	**/623**	Panel width	600 mm	Panel height	2300 mm
	/627		600 mm		2798 mm

Example:

Prefabricated, type-tested panel of the **WS** series with single busbar, for indoor installation, version **A**

Rated peak withstand current **63** kA

Rated voltage **12** kV

Panel width: **600** mm; panel height: **2300** mm

Type designation: **WSA 6/12-2/623**

Selection tables

WSA/WSB with vacuum circuit-breaker and disconnector, 12 KV

Type	Panel width	Rated voltage	Rated insulation level			Rated filling pressure P_{re} at 20 °C	Rated frequency	Rated (normal) current	Rated peak withstand current, equal to rated short-circuit making current	Rated short-time current		Rated short-circuit breaking current	Percentage value of the DC component	Rated operating sequence			
			Rated lightning impulse withstand voltage	Rated power frequency withstand voltage	Rated values of the isolating distance (lightning impulse / power frequency withstand voltage)									O-3 min-CO-3 min-CO	O-0.3 s-CO-3 min-CO	CO-15 s-CO	O-0.3 s-CO-15 s-CO
		U_r	U_p	U_d		p_{re}	f_r	I_r	I_p	I_k		I_{sc}		Electrical class			
								Outgoing feeder	(50/60 Hz)	t_k = 1 s	t_k = 3 s			E2	E2	E2	E2
	mm	kV	kV	kV	kV	MPa	Hz	A	kA	kA	kA	kA	%				
WSA/B 6/12-2/623	600	12	75	28	85/32	0.03	50/60	630[1]	40/42	16	16	16	37	■	■	■	■
WSA/B 6/12-2/623	600	12	75	28	85/32	0.03	50/60	≤1250	50/52	20	20	20	37	■	■	■	■
WSA/B 6/12-2/623	600					0.075		1600									
WSA/B 6/12-2/623	600					0.075		2000									
WSA/B 6/12-2/623	600					0.075		2500[2]									
WSA/B 6/12-2/623	600	12	75	28	85/32	0.03	50/60	≤1250	63/65	25	25	25	37	■	■	■	■
WSA/B 6/12-2/623	600					0.075		1600									
WSA/B 6/12-2/623	600					0.075		2000									
WSA/B 6/12-2/623	600					0.075		2500[2]									
WSA/B 8/12-2/623	600	12	75	28	85/32	0.03	50/60	≤1250	80/82	31.5	5)	31.5	38	■	■	■	■
WSA/B 8/12-2/623	600					0.075		1600									
WSA/B 8/12-2/623	600					0.075		2000									
WSA/B 8/12-2/623	600					0.075		2500[2]									
WSA/B 8/12-2/623	600					0.03		≤1250									

LS = Power category

TS = Disconnector

E = Earthing switch

* higher categories or values available on request

Selection tables (contd.)

Class for cap. switching [3]	cap. switching capacity: Cable breaking current I_c	cap. switching capacity: Single capacitor bank Rated breaking current I_{sp}	cap. switching capacity: Parallel capacitors: Rated breaking current I_{bb}	cap. switching capacity: Parallel capacitors: Rated making current I_{ib}	cap. switching capacity: Parallel capacitors: Frequency of the rated making current I_{ib}	Rated breaking current under asynchronous conditions I_{id}	Number of operating cycles without overhaul: mechanical: LS, TS, E	Number of operating cycles without overhaul: mechanical: Mechanical classes	Number of operating cycles without overhaul: electrical: with rated (normal) current	Number of operating cycles without overhaul: electrical: with rated short-circuit breaking current	Operating times with release: Opening time with AV (25 W)	Operating times with release: Opening time without AV (160 W)	Operating times with release: Closing time (160 W)	Arc duration (max.)	Command times: with 160 W release: Close	Command times: with AV 160 W: Open	Command times: without AV 25 W: Open	Charging time for circuit-breaker	Operating time for disconnector and earthing switch with motor-actuated drive mechanism, 160 W
	A [4]	A [4]	A	kA	kHz	kA					ms	ms	ms	ms	ms	ms		s	s
C2	25	–	–	–	–	4	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
							2000	M1			-	-	-						
							2000	–			70	50	70						
C2	25	–	–	–	–	5	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	25	–	–	–	–		2000	M1			-	-	-						
C2	25	–	–	–	–		1000	–			70	50	70						
C2	25	–	–	–	–														
C2	25	–	–	–	–	6.3	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	25	–	–	–	–		2000	M1			-	-	-						
C2	25	–	–	–	–		1000	–			70	50	70						
C2	25	–	–	–	–														
C2	25	–	–	–	–	8	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	25	–	–	–	–		2000	M1			-	-	-						
C2	25	–	–	–	–		1000	–			70	50	70						
C2	25	–	–	–	–														
C2	25	400	400	20	4.25														

electrical class of the outgoing earthing switch: E2

[1] 1,000 A also possible

[2] with motor-actuated fans

[3] capacitive class for cable switch; if capacitor bank switching is defined, then also valid for this application

[4] max. normal current 280 A, as capacitor bank current features harmonics

[5] on request

Selection tables (contd.)

WSA/WSB with vacuum circuit-breaker and disconnector, 17.5 KV

Type	Panel width	Rated voltage	Rated insulation level			Rated filling pressure P_{re} at 20 °C	Rated frequency	Rated (normal) current	Rated peak withstand current, equal to rated short-circuit making current	Rated short-time current		Rated short-circuit breaking current	Percentage value of the DC component	Rated operating sequence			
			Rated lightning impulse withstand voltage	Rated power frequency withstand voltage	Rated values of the isolating distance (lightning impulse / power frequency withstand voltage)									O-3 min-CO-3 min-CO	O-0.3 s-CO-3 min-CO	CO-15 s-CO	O-0.3 s-CO-15 s-CO
		U_r	U_p	U_d		p_{re}	f_r	I_r	I_p	I_k t_k =		I_{sc}		Electrical class			
								Outgoing feeder	(50/60 Hz)	1 s	3 s			E2	E2	E2	E2
	mm	kV	kV	kV	kV	MPa	Hz	A	kA	kA	kA	kA	%				
WSA/B 6/17-2/623	600	17.5	95	38	110/45	0.03	50/60	630[1]	40/42	16	16	16	37	■	■	■	■
WSA/B 6/17-2/623	600	17.5	95	38	110/45	0.03	50/60	≤1250	50/52	20	20	20	37	■	■	■	■
WSA/B 6/17-2/623	600					0.075		1600									
WSA/B 6/17-2/623	600					0.075		2000									
WSA/B 6/17-2/623	600					0.075		2500[2]									
WSA/B 6/17-2/623	600	17.5	95	38	110/45	0.03	50/60	≤1250	63/65	25	25	25	37	■	■	■	■
WSA/B 6/17-2/623	600					0.075		1600									
WSA/B 6/17-2/623	600					0.075		2000									
WSA/B 6/17-2/623	600					0.075		2500[2]									
WSA/B 8/17-2/623	600	17.5	95	38	110/45	0.03	50/60	≤1250	80/82	31.5	5)	31.5	38	■	■	■	■
WSA/B 8/17-2/623	600					0.075		1600									
WSA/B 8/17-2/623	600					0.075		2000									
WSA/B 8/17-2/623	600					0.075		2500[2]									

LS = Power category

TS = Disconnector

E = Earthing switch

* higher categories or values available on request

Selection tables (contd.)

Class for cap. switching [3]	cap. switching capacity: Cable breaking current I_c [4]	Single capacitor bank Rated breaking current I_{sp} [4]	Parallel capacitors: Rated breaking current I_{bb}	Parallel capacitors: Rated making current I_{ib}	Parallel capacitors: Frequency of the rated making current I_{ib}	Rated breaking current under asynchronous conditions I_{id}	Number of operating cycles without overhaul: mechanical: LS, TS, E	Mechanical classes	Number of operating cycles without overhaul: electrical: with rated (normal) current	with rated short-circuit breaking current	Operating times with release: Opening time with AV (25 W)	Opening time without AV (160 W)	Closing time (160 W)	Arc duration (max.)	Command times: with 160 W release	with AV 160 W	without AV 25 W	Charging time for circuit-breaker	Operating time for disconnector and earthing switch with motor-actuated drive mechanism, 160 W
															Close	Open	Open		
	A	A	A	kA	kHz	kA					ms	ms	ms	ms	ms	ms		s	s
C2	31.5	–	–	–	–	4	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
							2000	M1			-	-	-						
							2000	–			70	50	70						
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–	5	1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–	6.3	1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–	8	1000	–			70	50	70						
C2	31.5	–	–	–	–														

electrical class of the outgoing earthing switch: E2

[1] 1,000 A also possible

[2] with motor-actuated fans

[3] capacitive class for cable switch; if capacitor bank switching is defined, then also valid for this application

[4] max. normal current 280 A, as capacitor bank current features harmonic

[5] on request

Selection tables (contd.)

WSA/WSB with vacuum circuit-breaker and disconnector, 24 KV

Type	Panel width	Rated voltage	Rated insulation level			Rated filling pressure P_{re} at 20 °C	Rated frequency	Rated (normal) current	Rated peak withstand current, equal to rated short-circuit making current	Rated short-time current		Rated short-circuit breaking current	Percentage value of the DC component	Rated operating sequence			
			Rated lightning impulse withstand voltage	Rated power frequency withstand voltage	Rated values of the isolating distance (lightning impulse / power frequency withstand voltage)									O-3 min-CO-3 min-CO	O-0.3 s-CO-3 min-CO	CO-15 s-CO	O-0.3 s-CO-15 s-CO
		U_r	U_p	U_d		p_{re}	f_r	I_r Outgoing feeder	I_p (50/60 Hz)	I_k t_k = 1 s	I_k t_k = 3 s	I_{sc}		Electrical class			
	mm	kV	kV	kV	kV	MPa	Hz	A	kA	kA	kA	kA	%	E2	E2	E2	E2
WSA/B 6/24-2/623	600	24	125	50	145/60	0.03	50/60	630[1)]	40/42	16	16	16	37	■	■	■	■
WSA/B 6/24-2/623	600	24	125	50	145/60	0.03	50/60	≤1250	50/52	20	20	20	37	■	■	■	■
WSA/B 6/24-2/623	600					0.075		1600									
WSA/B 6/24-2/623	600					0.075		2000									
WSA/B 6/24-2/623	600					0.075		2500[2)]									
WSA/B 6/24-2/623	600	24	125	50	145/60	0.03	50/60	≤1250	63/65	25	25	25	37	■	■	■	■
WSA/B 6/24-2/623	600					0.075		1600									
WSA/B 6/24-2/623	600					0.075		2000									
WSA/B 6/24-2/623	600					0.075		2500[2)]									
WSA/B 8/24-2/623	600	24	125	50	145/60	0.03	50/60	≤1250	80/82	31.5	5)	31.5	38	■	■	■	■
WSA/B 8/24-2/623	600					0.075		1600									
WSA/B 8/24-2/623	600					0.075		2000									
WSA/B 8/24-2/623	600					0.075		2500[2)]									

LS = Power category

TS = Disconnector

E = Earthing switch

* higher categories or values available on request

Selection tables (contd.)

Class for cap. switching [3]	cap. switching capacity: Cable breaking current I_c 4) A	Single capacitor bank Rated breaking current I_{sp} 4) A	Parallel capacitors: Rated breaking current I_{bb} A	Parallel capacitors: Rated making current I_{ib} kA	Parallel capacitors: Frequency of the rated making current I_{ib} kHz	Rated breaking current under asynchronous conditions I_{id} kA	Number of operating cycles without overhaul: mechanical: LS, TS, E	Number of operating cycles without overhaul: mechanical: Mechanical classes	Number of operating cycles without overhaul: electrical: with rated (normal) current	Number of operating cycles without overhaul: electrical: with rated short-circuit breaking current	Operating times with release: Opening time with AV (25 W) ms	Operating times with release: Opening time without AV (160 W) ms	Operating times with release: Closing time (160 W) ms	Arc duration (max.) ms	Command times: with 160 W release Close ms	Command times: with AV 160 W Open ms	Command times: without AV 25 W Open	Charging time for circuit-breaker s	Operating time for disconnector and earthing switch with motor-actuated drive mechanism, 160 W s
C2	31.5	–	–	–	–	–	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
							2000	M1			-	-	-						
							2000	–			70	50	70						
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–	–	2000	M1			-	-	-						
C2	31.5	–	–	–	–		1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–	–	1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–		10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–	–	1000	–			70	50	70						
C2	31.5	–	–	–	–														

electrical class of the outgoing earthing switch: E2

[1] 1,000 A also possible

[2] with motor-actuated fans

[3] capacitive class for cable switch; if capacitor bank switching is defined, then also valid for this application

[4] max. normal current 280 A, as capacitor bank current features harmonics

[5] on request

Selection tables (contd.)

WSA/WSB with vacuum circuit-breaker and disconnector, 36 KV

Type	Panel width	Rated voltage	Rated insulation level			Rated filling pressure P_{re} at 20 °C	Rated frequency	Rated (normal) current	Rated peak withstand current, equal to rated short-circuit making current	Rated short-time current		Rated short-circuit breaking current	Percentage value of the DC component	Rated operating sequence			
			Rated lightning impulse withstand voltage	Rated power frequency withstand voltage	Rated values of the isolating distance (lightning impulse / power frequency withstand voltage)									O-3 min-CO-3 min-CO	O-0.3 s-CO-3 min-CO	CO-15 s-CO	O-0.3 s-CO-15 s-CO
		U_r	U_p	U_d		p_{re}	f_r	I_r	I_p	I_k t_k =	I_k t_k =	I_{sc}		Electrical class			
								Outgoing feeder	(50/60 Hz)	1 s	3 s			E2	E2	E2	E2
	mm	kV	kV	kV	kV	MPa	Hz	A	kA	kA	kA	kA	%				
WSA/B 6/36-2/623	600	36	170	70	195/80	0.05	50/60	≤1250	50/52	20	20	20	37	■	■	■	■
WSA/B 6/36-2/623	600					0.075		1600									
WSA/B 6/36-2/623	600					0.075		2000									
WSA/B 6/36-2/623	600					0.075		2500[2)]									
WSA/B 6/36-2/623	600	36	170	70	195/80	0.05	50/60	≤1250	63/65	25	25	25	37	■	■	■	■
WSA/B 6/36-2/623	600					0.075		1600									
WSA/B 6/36-2/623	600					0.075		2000									
WSA/B 6/36-2/623	600					0.075		2500[2)]									
WSA/B 8/36-2/623	600	36	170	70	195/80	0.05	50/60	≤1250	80/82	31.5	5)	31.5	37	■	■	■	■
WSA/B 8/36-2/623	600					0.075		1600									
WSA/B 8/36-2/623	600					0.075		2000									
WSA/B 8/36-2/623	600					0.075		2500[2)]									

LS = Power category

TS = Disconnector

E = Earthing switch

* higher categories or values available on request

Selection tables (contd.)

Class for cap. switching [3]	cap. switching capacity: Cable breaking current I_c [4] A	Single capacitor bank Rated breaking current I_{sp} [4] A	Parallel capacitors: Rated breaking current I_{bb} A	Parallel capacitors: Rated making current I_{ib} kA	Parallel capacitors: Frequency of the rated making current I_{ib} kHz	Rated breaking current under asynchronous conditions I_{id} kA	Number of operating cycles without overhaul: mechanical: LS, TS, E 2000	Number of operating cycles without overhaul: mechanical: Mechanical classes –	Number of operating cycles without overhaul: electrical: with rated (normal) current	Number of operating cycles without overhaul: electrical: with rated short-circuit breaking current	Operating times with release: Opening time with AV (25 W) ms	Operating times with release: Opening time without AV (160 W) ms	Operating times with release: Closing time (160 W) ms	Arc duration (max.) ms	Command times: with 160 W release Close ms	Command times: with AV 160 W Open ms	Command times: without AV 25 W Open	Charging time for circuit-breaker s	Operating time for disconnector and earthing switch with motor-actuated drive mechanism, 160 W s
C2	31.5	–	–	–	–	5	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			=	=	=						
C2	31.5	–	–	–	–		1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–	6.3	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–		1000	–			70	50	70						
C2	31.5	–	–	–	–														
C2	31.5	–	–	–	–	8	10000	M2	10000	100	45	33	35	12	20	20	50	≤7	≤8
C2	31.5	–	–	–	–		2000	M1			-	-	-						
C2	31.5	–	–	–	–		1000	–			70	50	70						
C2	31.5	–	–	–	–														

electrical class of the outgoing earthing switch: E2

[1] 1,000 A also possible

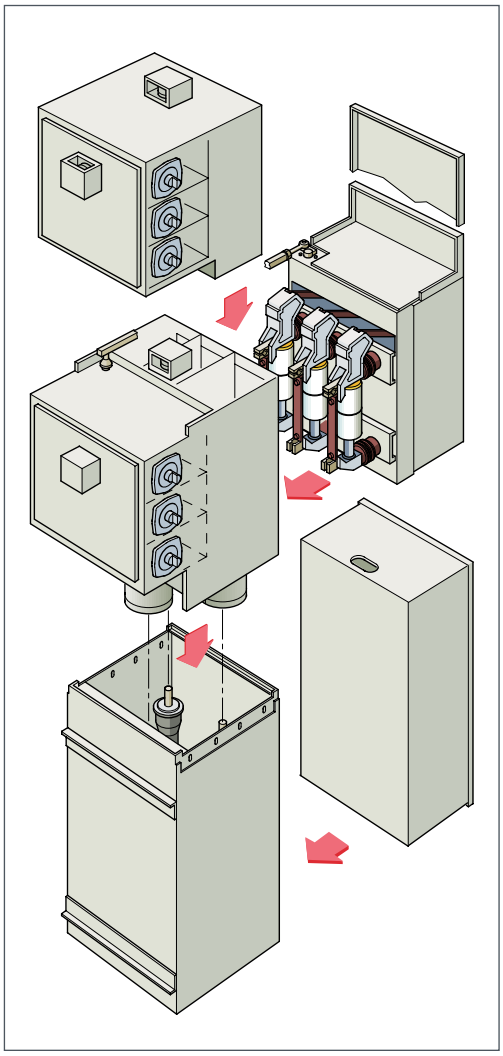
[2] with motor-actuated fans

[3] capacitive class for cable switch; if capacitor bank switching is defined, then also valid for this application

[4] max. normal current 280 A, as capacitor bank current features harmonics

[5] on request

Product description



Design of the WSA/WSB panels

The prefabricated, type-tested WS panels are metal-enclosed. SF_6 gas is used as insulating medium. The modular design of a panel comprises the following units: busbar component and three-position switch, circuit-breaker component with drive box, low-voltage cabinet and supporting structure with cable connection area. The busbar compartment and the circuit-breaker compartment are segregated from each other.

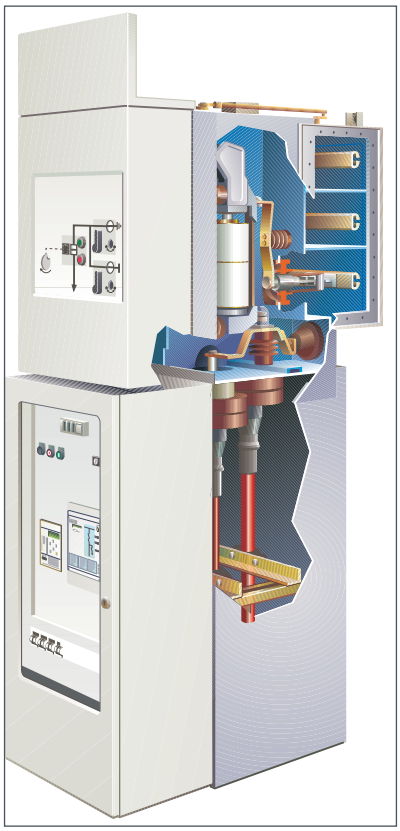
The gas tanks made of CrNi steel accommodate the busbars and the vacuum circuit-breaker. The outgoing feeder area comprises the post insulators, the busbar terminal leads and the cable connection parts. In this area, the gas tank has three tubular extensions onto which the low-voltage toroidal-core current transformers are mounted coaxially; these can be replaced – in case of the single cable connection – without opening the gas compartment.

In case of double busbar panels, the 2nd busbar system is arranged above busbar system 1. The busbar compartment is segregated from the circuit-breaker compartment metallically and as regards gas leakage. In the case of double busbar panels, both busbar compartments are segregated from each other, and the second busbar system is also segregated from the circuit-breaker compartment metallically and as regards gas leakage. Busbar compartment 1 houses the three-position switch, and busbar compartment 2 accommodates the two-position switch. The supporting structure, designed as a metalenclosed cable connection compartment, is located below the central high-voltage component. The low-voltage cabinet mounted in front of it terminates the lower panel front.

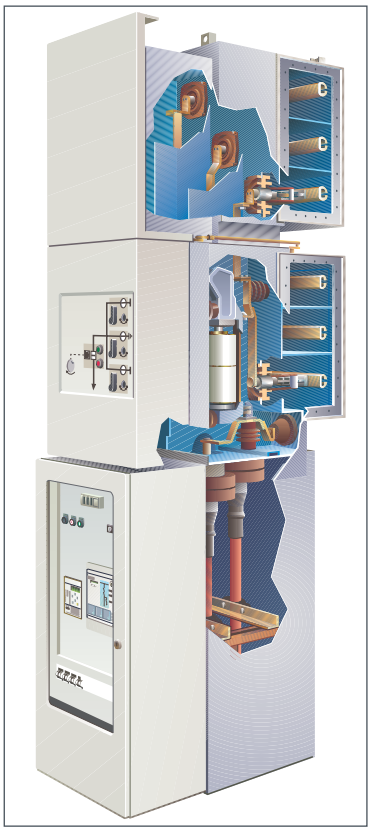
Each gas-filled cladded compartment has its own pressure relief device.

- each circuit-breaker compartment
- each busbar system, or each busbar compartment

Thanks to their modular design, the panels can be extended subsequently so that prepared reserve panels can be completed, and e.g. a circuit-breaker can be mounted/ removed without isolating the busbars or the adjacent panels.

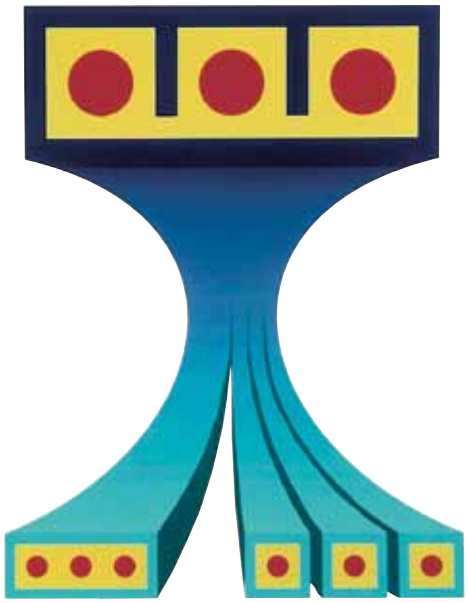


WSA single busbar



WSB double busbar

Product description (contd.)



M enclosure

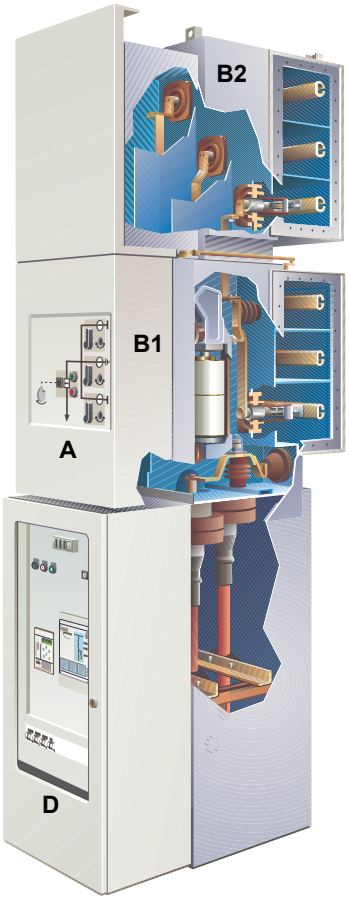
M enclosure

The M enclosure system combines the advantages of both threephase enclosure and - through the additional metallic partitions between the phases in all gas-filled cladded compartments – the electrical advantages of single-pole enclosure. In zones with low field intensity, the metallic partitions have feed-through openings for communication between the individual partial gas compartments. This M enclosure is the prerequisite for a compact modular design which enables extremely spacesaving solutions in case of double busbar configurations.

Features of the M enclosure

- no partial discharge possible between the phases
- self-extinguishing of earth fault currents in compensated systems
- extremely low sheath currents
- small space requirement of switchgear, especially in case of double busbar systems
- clearly structured and easily accessible design
- straightforward drive kinematics for all switching devices
- practical disconnection feature of circuit-breaker module in case of energized busbars and adjacent panels
- straightforward and clearly structured gas compartment technology

Thus, the M enclosure used combines the advantages of threephase and single-phase enclosure. Moreover, the systematic metallicsegregation of the functional compartments satisfies high demands regarding protection against accidental contact in case of any work which might be required.



A Circuit-breaker with drive mechanism

B1 Basic tank with busbar 1

B2 Tank with busbar 2

C Supporting structure and cable connection

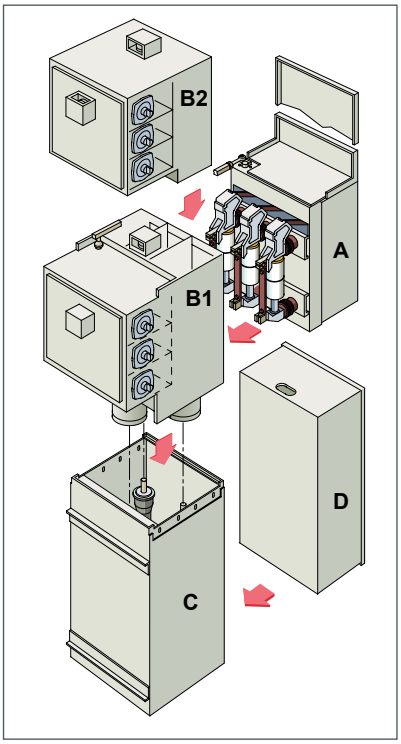
D Low-voltage cabinet

Modules of a switchgear panel

Module A Circuit-breaker drive

- Switching device “vacuum circuit-breaker”
- Drive component Circuit-breaker drive, drives for the two-/three-position switches including all interlocks, the auxiliary switches and the low-voltage plugging device
- Motor-operated drive mechanism to charge the energy-storing device
- Auxiliary switch with 8, 12, 16 or 20 switching elements; 8 switching elements are required for the basic circuit (standard contact coating: silver)
- Passing contact Wiping time prolongation (Standard contact coating: silver)
- Push switches actuated by the energy storing device. (The push switches for the basic circuit are included in the basic design)
- Push switches actuated by “ON-OFF“ pushbutton. (The basic design includes 1 push switch each)
- Shunt closing release 1 ea.
- Shunt tripping coil 1 or 2 ea. with or without auxiliary spring energy store
- Secondary release 1 or 2 ea., or 3 ea. in case of design without undervoltage release
- Undervoltage release with or without time delay
- Blocking coil on “ON“ pushbutton. Always required on tie breaker in case of bus section coupler and bus coupler, consisting of 2 panels (switchgear panel + busbar riser panel)
- Blocking coil on “OFF“ pushbutton. Always required on tie breaker in case of bus section coupler and bus coupler, consisting of 1 or 2 panels (switchgear panel + busbar riser panel)
- Locking mechanism with lock (for vacuum circuit-breaker and three-position switch)
- Operating counter

Product description (contd.)



A Circuit-breaker with drive mechanism

B1 Basic tank with busbar 1

B2 Tank with busbar 2

C Supporting structure and cable connection

D Low-voltage cabinet

Low-voltage cabinet WSB with swing frame

Circuit-breaker module with WSB control panel

Module B I Basic tank with busbar 1

- Gas tank
- Busbar 1
- Three-position switch
- Lower appliance couplers
- Rear appliance couplers (on request)
- Toroidal-core current transformer
- Pressure

Module B II Basic tank with busbar 2

- Gas tank
- Busbar 2
- Disconnector
- Pressure relief device for circuitbreaker compartment

Module C Supporting structure and cable connection

- Supporting structure
- Cable terminals
- Cable supports

optional:
second voltage detection system IVIS on the back of the supporting structure

Module D Low-voltage cabinet

Accommodating all protective equipment, for the voltage detection system IVIS, and other lowvoltagecomponents.

Supplementary parts for the two-/three-position switch

- Motor-operated drive mechanism In case of single busbar with three-position switch per motoroperated drive mechanism for the function “Disconn. I-O” and the function “Earth I-O”. In case of double busbar panels, the two-position disconnector of the busbar system 2 with one motor drive can be utilized for the function “Disconn. I-O”.

- Auxiliary switches with 2 to 20 elements, each for the functions “Disconn. I-O” and “Earth I-O”

Technical description

Circuit-breaker module

The modular vacuum circuit-breaker with drive housing comprises the fully functional unit: vacuum circuit-breaker with the three poles arranged side by side, circuit-breaker drive, drive for three-position switch of busbar 1 or, additionally in case of double busbar panels, drive for the disconnector of busbar 2, all the auxiliary equipment (e.g. auxiliary switch, auxiliary release etc.) and mechanical interlocking block. The circuit-breaker module is flange-mounted to the gas-filled cladded compartment of the circuit-breaker compartment and can thus be removed from the system in a straightforward fashion without switching off the busbarsand without affecting the adjacent panels. The interfaces to the highand low-voltage components are pluggable.

Low-voltage cabinet

On the switchgear front, below the control panel, there is a spacious low-voltage cabinet, at choice with inspection glass (size 1: 480 mm x 485 mm, size 2: 426 mm x 850 mm). It is fully shrouded and segregated from the high-voltage components in a pressure-proof fashion. The built-in units are installed, amongst other things, in the swing frame. Thus, the secondary equipment has ample space and is easily accessible, and functional elements with indicators are clearly visible. On the secondary end, the low-voltage cabinet and the circuitbreaker module are connected to a 64-pole screw-connected plug- and- socket connector.

Installation in the swing frame is especially advantageous for the digital protection relay and the bay computer of a computerized control system, as these feature e.g. a display and/or multiple LED function indicators.

The voltage indicator system IVIS on the front is also located in the low-voltage cabinet.

Product description (contd.)

Cable connection compartment with surge arresters and multiple cable connection

High-voltage cable test (1-phase) via test adapters mounted on the rear

IMOS Monitoring and Operating System

Cable connection/ bar connection

The cables are connected in conformity with the system via fully insulated connectors in the standard inner or outer cone-type system, or via fully the insulated conductor bar system.

Metal-enclosed cable connection systems are mainly suitable for connecting plastic cables.

The cable or bar connection systems are adapted to the rated current of the switchgear panel concerned. Multiple cable connections are also suited e.g. to connect voltage transformers or pluggable surge arresters.

Surge arrester

Metal-enclosed surge arresters can be connected to protect the medium-voltage switchgear and the consumers mounted downstreamn against external overvoltages.

Cable testing

DC voltage tests are performed on the connected cables without interfering with the metal-enclosed cable connection compartment, without pulling off/ releasing the cable end boxes and without introducing test equipment into the gas compartment.

In switch position ”outgoing feeder earthed”, cable test connectors aremounted and the external cable test equipment connected to therear test sockets. The cable test as such is performed with the vacuum circuit-breaker in position OFF and the three-position switch in position “Earth I”.

For connection of the test equipment, rear-side connectors are available on request at a height of approx. 1.2 m above floor level.

Voltage detection system IVIS

IVIS is an intelligent electronic volt age detection system with integrated indicator to determine the oper ating voltage and zero voltage– optional – in medium-voltage switchgear. The system has been designed for maximum operatingreliability. It does not require supply from an external source. It features climate-proof encapsulated electronics and is maintenance-free, due to permanent monitoring of the indication thresholds. The signal evaluation and display electronic system is designed for redundancy. Phase coincidence is determined via hermetically shielded measuring sockets which are an integral part of the system. IVIS meets the requirements according to IEC 61243-5, VDE 0682 part 415, for integrated voltage indication systems.

IMOS Monitoring and Operating System

The **I**ntelligent **M**onitoring and **O**perating **S**ystem IMOS can be used optionally for operation and control of medium-voltage switchgear. A central control unit is provided for operator control.

Mechanical actuation is possible in case of failure of the auxiliary voltage. The digital protection and measuring relays in the switchgear are retained as autonomous units. IMOS processes the signals of the conventional relay outputs emitted from these protection and measuring relays. IMOS provides a userfriendly and comfortable operating functionality. These properties help relieve the operators’ workload.

The central screen

- comprises a fully graphic colour screen; all operating screens appear in the form of logical and user-friendly graphs
- informs the user about all data of individual sections or about the entire switchgear
- provides ergonomically designed operating functions in professional design
- permits continuous operator guidance
- provides information in clear, non-coded text in long form.

Product description (contd.)

System earthing and earthing for work purposes

Outgoing feeder earthing

The vacuum circuit-breaker's high making capacity is used advantageously for earthing the outgoing and incoming and feeders. The combination of the three-position switch and the vacuum circuitbreaker permits earthing of the WS series with actuating processes in analogy to conventional switchgear with firmly installed switching devices. When the vacuum circuitbreaker is ready to operate, it is switched ON and OFF automatically during the actuation "Earth I" or "Earth 0" by a mechanical intertripping circuit. The WS series does not require separate actuations, e.g. for the process "Prepare ear thing" and "Connect vacuum circuitbreaker for earthing", as well as the provision/actuation of additional releases or locks. In position "Earth I", opening the vacuum circuit-breaker is prevented by mechanical and electrical means. An additional earthing feature for work can be utilized optionally on the cable end via the test sockets at the rear, e.g. if the vacuum circuit-breaker module has been removed.

Busbar earthing

For earthing, a 200 mm wide module with a make-proof earthing switch actuated on the panel front can be arranged in line with or at the end of the busbar.

Another possible way of system earthing is provided by the threeposition switch and vacuum circuit- breaker in bus section coupler and bus coupler panels with two panel widths.

To perform earthing for work purposes, a 200 mm module element with plug-and-socket connectors can be provided for the earthing device.

Earthing device

A manually operated earthing device can be installed in the rear cable test sockets as system earth ing and earthing in the outgoing feeder.

Current transformer

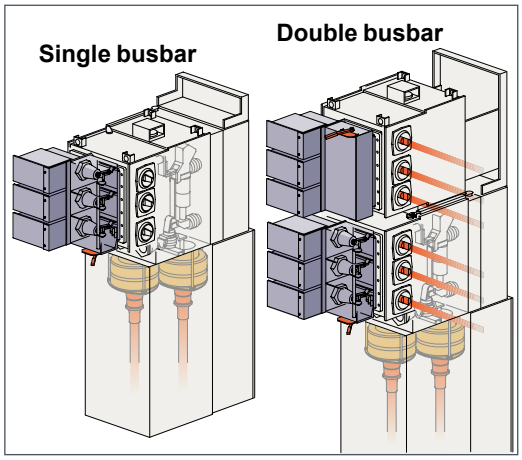
Current transformer in outgoing feeder area

The current transformers are of toroidal-core transformer design and are mounted on the areas of the cable outgoing feeder with single-pole enclosure. In the outgoing feeder area of the panel, several transformer cores per phase can be arranged up to the maximum stacking height provided. A measuring core of the toroidal-core current transformer kit per phase permits billing metering using calibratable or calibrated meters, pursuant to the German provisions for calibrated transformers. Billing metering can be performed in combination with calibratable/calibrated voltage transformers in the outgoing feeder block or on the busbar.

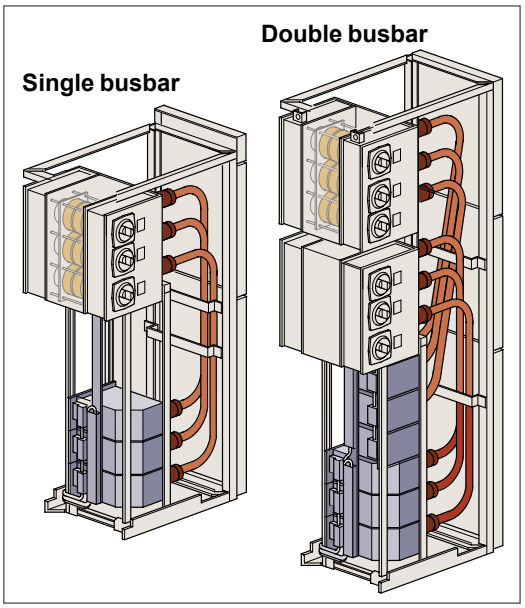
Dimensions of toroidal-core current transformers in outgoing feeder area:

Inside diameter	185 mm
Outside diameter	275 mm
Standard design:	
Stacking height incl.	
intermediate layer	max. 250 mm
Optional:	
Stacking height incl.	
intermediate layer	max. 490 mm

Product description (contd.)



■ Flange-mounted transformer with isolating device



■ Metal-enclosed voltage transformers without isolating device

Voltage transformer on busbar

■ Flange-mounted transformer with isolating device

The busbar voltage transformers are normally designed as metalenclosed flange-mounted transformers with single-pole insulation. The transformers are flange-mounted via pluggable inner cone-type connections and can be replaced without gas-handling. A three-phase pluggable device with the positions ”transformer ON” and “transformer earthed” enables disconnection of the medium-voltage components from the busbar and safe primary earthing of the transformers. If required, the metalenclosed voltage transformers can be replaced safely with the busbar energized.

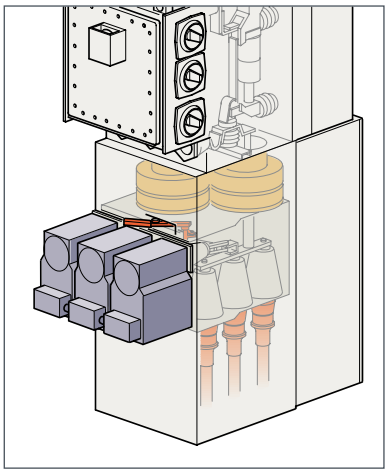
■ Metal-enclosed voltage transformers without isolating device

Preferably in combination with voltage transformers in line with the busbar, busbar voltage transformers can be designed as hived off metal-enclosed transformers. The connection between the busbar connection module with a width of 200 mm (connection of voltage transformers only) or 600 mm (busbar voltage transformer combined with busbar transformer terminal) and the transformer is established using fully insulated cable connector systems via highly flexible trailing cables. Dual-kit voltage transformers incl. dual-kit resistors for the procurement of the e/n windings, for example, are installed in a switchgear module with a width of 600 mm.

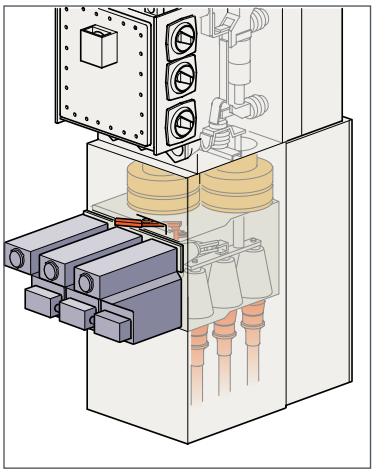
Voltage transformer in outgoing feeder area

The preferred design comprises metal-enclosed inductive voltage transformers directly flange-mounted to the outgoing feeder block, with isolating / earthing device mounted upstream. An externally actuated isolating device allows for disconnecting the voltage transformers from the main circuit in case of DC voltage tests on the cable. This isolating device features two positions “ON” and “Voltage transformer earthed”. In the earthed position, voltage transformers, for example, can be replaced safely, as required, while the main circuit remains operative.

Directly flange-mounted voltage transformers can also be delivered for billing metering.



Voltage transformer with isolating device in outgoing feeder cable, current transformer on outgoing feeder cable



Voltage transformer with isolating device in outgoing feeder cable, with primary protection. Current transformer on outgoing feeder cable

Product description (contd.)

Current transformer in line with busbar

In line with the busbars, toroidalcore current transformers can be installed outside of the gas atmosphere on single-phase enclosed tank components.

Dimensions:

Inside diameter 135 mm

Outside diameter 195 mm

Stacking height incl.

intermediate layer max. 180 mm

In combination with busbar voltage transformers, a calibrated transfer / billing metering can be realized in line with the busbar of WSA and WSB.

Current transformers in the bus coupler in case of panel widths up to 1250 A

Dimensions:

Inside diameter 135 mm

Outside diameter 195 mm

Stacking height incl.

intermediate layer max. 80 mm

Technical data		Metal-enclosed, single-pole voltage transformers		
Max. service voltage	**kV**	**12**	**24**	**36**
Primary voltage	**kV**	5.0/√3	13.8/√3	25.0/√3
		6.0/√3	15.0/√3	25.8/√3
		6.6/√3	17.5/√3	30.0/√3
		7.2/√3	20.0/√3	33.0/√3
		10.0/√3	22.0/√3	34.5/√3
		11.0/√3		35.0/√3
Secondary voltage	**V**	100/√3	100/√3	100/√3
		110/√3	110/√3	110/√3
Auxiliary winding for earth fault detection	**V**	100/3	100/3	100/3
		110/3	110/3	110/3
Secondary, thermal limit current of measuring winding	**A**	7	7	7
		(12)	(12)	(12)
Rated voltage factor U_N/8h		1.9	1.9	1.9
Rated continuing current/8h	**A**	6	6	6
Accuracy class		0.2–0.5–1	0.2–0.5–1	0.2–0.5–1
Power	**VA**	15–50–120	15–50–120	20–50–120
		(45–100–200)	(45–100–200)	(30–100–200)
Standards		IEC 60186, DIN VDE 0414		

Calibratable/calibrated winding available on special request

( ) on request

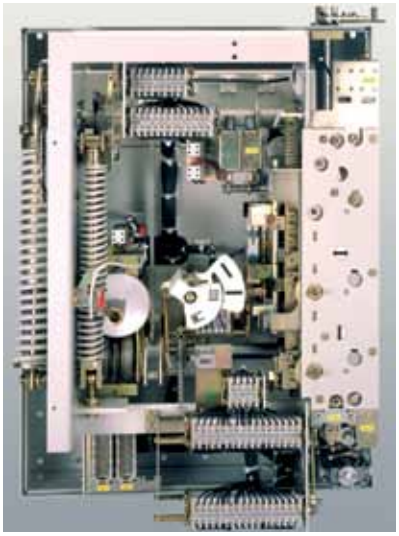
Flange-mounted transformer with primary protection in outgoing feeder / incoming feeder: up to 24 kV available on request

Product description (contd.)

Technical data of toroidal-current transformer		
Service voltage	max. 0.8 kV	
Rated power frequency withstand voltage	3 kV (winding test)	
Rated frequency	50/60Hz	
Continuous thermal current	1.0 x In (1.2 x In on request)	
Rated thermal short-time current	max. 31.5 kA, max. 3 s	
Primary rated current	50 to 2500 A	
Multiratio properties secondary	200-100 to 2500-1250 A	
Secondary rated current	1A (5A on request)	
Number of cores	max. 3, higher number on request	
Core data (depending on primary rated current)	Measuring core	Protection core
Power	2.5 to 10 VA	2.5 to 30 VA
Class / overcurrent factor	0.2 to 1 / M10	5 to 10 / P10 to P30
Admissible ambient temperature	max. 60 °C	
Standards	IEC 60185, VDE 0414	

Calibratable/calibrated model available on special request

Robust actuating and interlocking block for double busbar WSB



Combined drive and interlocking unit for double busbar WSB

Interlocks and switchgear interlocking

Interlock Single busbar

The systematic, continuous mechanical interlock between vacuum circuit-breaker and threeposition switch and the actuation of the three-position switch has been designed so as to ensure that the operator can proceed as normal, in analogy to conventional switchgear with fixed installations. This means separate, completely interlocked actuations for the switching procedures ”Establishing isolating distance” and “Earthing”. The procedure ”Earth I” can only be performed with the three-position switch in disconnected position, the vacuum circuit-breaker OFF and the vacuum circuit-breaker’s energy storing device precharged. With the three-position switch in earthing position, the vacuum circuit-breaker is connected positively by a mechanical intertripping circuit. In “Earth ON”position, the vacuum circuit-breaker is interlocked against mechanicaland electrical opening.

Vice versa, on de-earthing, the vacuum circuit-breaker is first switched off positively by mechanical means, and then the conditions for the isolating distance are established. The interlocks ensure that each switching operation is always performed completely. This prevents both reversal of the motion once the switching operation has commenced, as well as removal of the operating crank before the defined end position is reached.

Interlock Double busbar

In case of interlocks with motorized three-position or two-position disconnector in double busbar switchgear, some of the intra- and inter-panel interlocking functions are performed by electro-magnetic interlocks (blocking coils).This also applies for motorized three-position or two-position disconnectors in single-busbar switch gear.

WSA and WSB fulfil the following internal interlocking functions of a panel:

No closing of a disconnector with the vacuum circuit-breaker closed or outgoing feeder earthed.
No opening of a disconnector with the vacuum circuit-breaker closed.
Closing the vacuum circuit-breaker only in the defined end positions of the disconnector.
No outgoing feeder earthing with the disconnector engaged.
No outgoing feeder earthing with the vacuum circuit-breaker closed. No outgoing feeder earthing without the vacuum circuit-breaker’s readiness to operate.

Product description (contd.)

Positive mechanical connection of vacuum circuit-breaker on earthing the outgoing feeder.
Positive mechanical disconnection of vacuum circuit-breaker on dearth ing the outgoing feeder.

The following has been ensured:

The operating crank for the disconnecting and earthing functions can only be removed after the defined end positions have been reached. The vacuum circuit-breaker cannot be actuated with the crank inserted for the disconnection or earthing procedure.

The vacuum circuit-breaker cannot be switched off with the ”outgoing feeder earthing ON”.

An operating crank can only be inserted for disconnection or ear thing once the insertion port has been released via a manual interrogation system.

All interlocks can also be effective with motorized three-position disconnectors.

In case of single busbar switchgear, all interlocks for manually actuated switching devices are effected mechanically. In the case of double busbar switchgear, this is performed mechanically and electro-magnetically (blocking coils).

Due to its systematic design and accuracy, this interlocking system fulfils all requirements of optimum switchgear interlocking.

■ In the case of exclusively electrically actuated switchgear, the electro-magnetic interlocks can be dispensed with on request and be replaced, if necessary, by mechanical locks.

■ If a switchgear control system is used, all interlocking functions are performed by microprocessors, so that the electromagnetic interlocks can be dispensed with in case of electrical actuations.Special interlocking conditions for mechanical manual emergency actuation are stipulated depending on the specific project in question.

■ In the case of double busbar systems with bus couplers, change-over from one system to the other without interrupting the power supply is standard, contrary to the above specifications.

Sealed for life

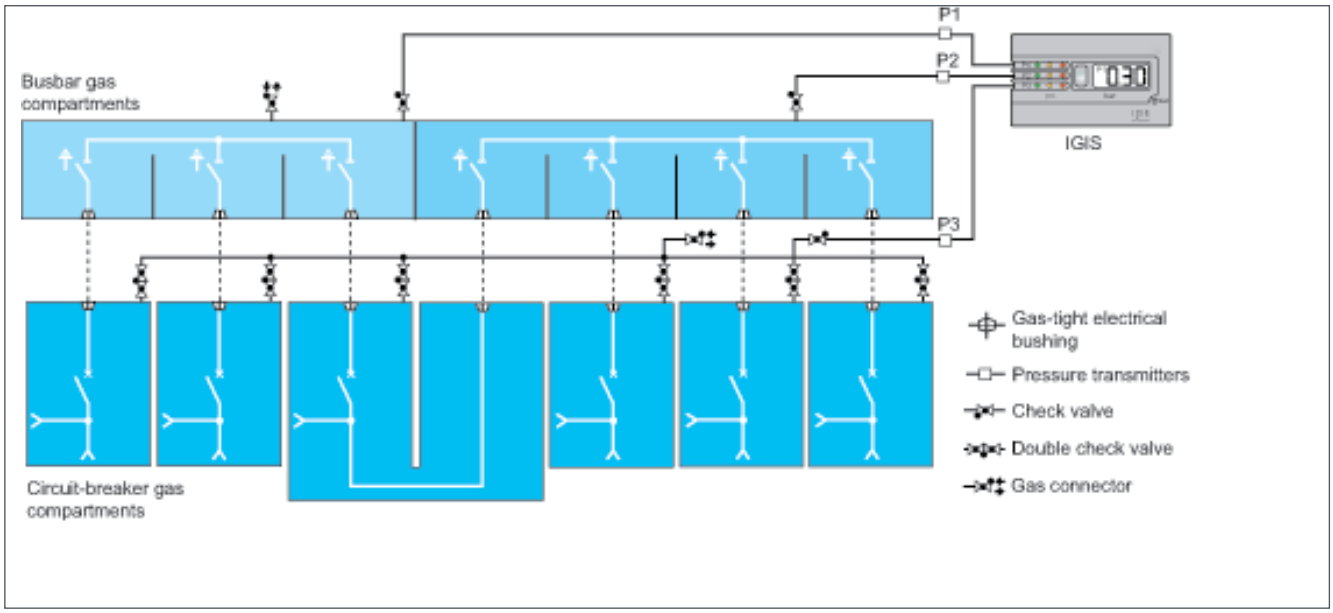
The cladded gas compartments of the WS series are hermetically sealed pressure systems acc. to IEC 60694 (new IEC 62271-2). Replenishing insulating gas SF_6 during normal operation is not necessary during the expected useful life.

Product description (contd.)

Gas compartment monitoring

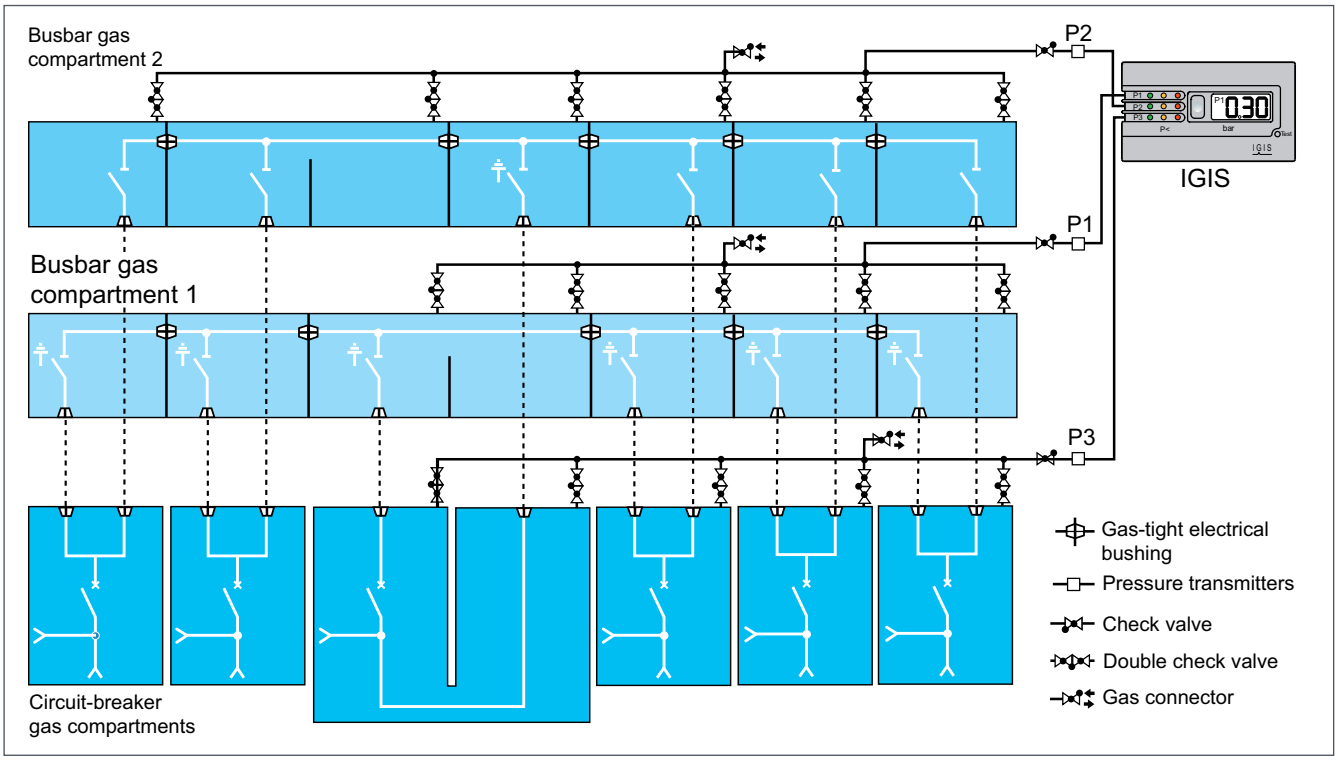
Several gas-filled cladded compartments are combined for gas compartment monitoring. The gas compartment connections are pipe connections with a small crosssection, located outside of the enclosure. The individual gas compartments are connected by valves which can be coupled. The valves are designed so as to permit only one of the two states – coupled or isolated. As long as the valves are disconnected, meaning that the gas compartment connection is interrupted, each of the gas compartments in question is closed gas-tight. This enables each cladded compartment to be uncoupled from the integrated gas compartment e.g. when removing a vacuum circuit-breaker module or when expanding the switchgear. The integrated series WS gas compartment technology is especially positive in case of any gas leakage from the switchgear.

Gas compartment monitoring by Intelligent Gas Information System IGIS Single busbar WSA



Product description (contd.)

Gas compartment monitoring by Intelligent Gas Information System IGIS Double busbar WSB



In the case of integrated gas-filled cladded compartments, the number of measured variables resulting from the monitoring of each gasfilled functional compartment is computed to a single measured variable. This considerably reduces monitoring complexity while increasing reliability. Each of the integrated gas-filled cladded compartments features a single sensor for monitoring the gas status. The signals measured by the pressure and temperature sensors are evaluated in the digital IGIS monitoring system.

If the actual values fall below the programmed pressure values, this is signalled via two graduated warn ing levels. The pressure value can be interrogated locally via a display on the IGIS device to which max. three pressure sensors are connected.

In the case of single busbar WSA's, the busbar system forms an integrated gas-filled cladded compartment, as far as monitoring is concerned. All circuit-breaker compartments form the second integrated gas-filled cladded compartment.
In the case of double busbar WSB's, the second busbar system is additionally monitored via another pressure sensor. A double busbar system with two busbar sections and bus section couplers each comprises e.g. six integrated gas compartments.
A design with analog pressure gauges incl. auxiliary contacts for remote signalling is available optionally.

Pressure relief device

Each gas-filled cladded compartment of a WS switchgear is equipped with a pressure relief device. The pressure relief is primarily effected upwards and to the rear.

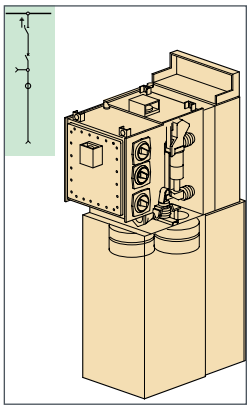
System for detection of the insulating gas pressure IGIS

IGIS is an intelligent electronic system for recording temperature compensated insulating gas pressure in gas-insulated medium-voltage switchgear. It is used for automatic, permanent monitoring of the insulating gas pressure during operation, and - if necessary - for issuing quick signals to the switchgear and the control room. IGIS uses a microcontroller which has proved extremely efficient in industry. Comprehensive self-monitoring for peripheral and internal components alike and a practice-proven system architecture ensure the reliability of IGIS.

IGIS display

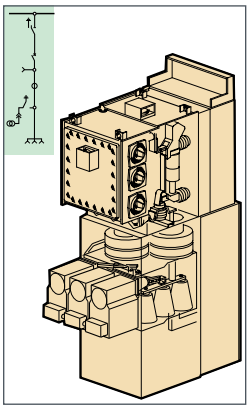
Range of equipment

Basic modules of a Single busbar WSA switchgear



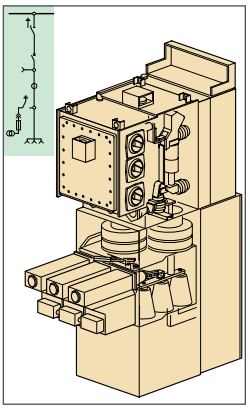
Circuit-breaker panel

- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection



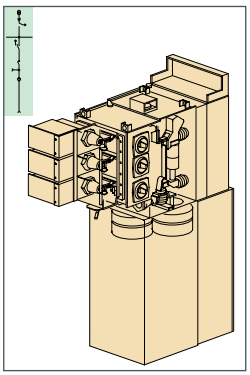
Circuit-breaker panel

- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers



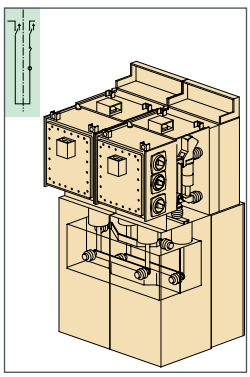
Circuit-breaker panel

- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers with primary fuse protection (on request in case of 36 kV)



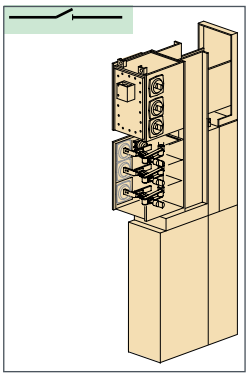
Circuit-breaker panel

- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection
- Disconnectable, flangemounted voltage transformers on the busbar



Bus section coupler

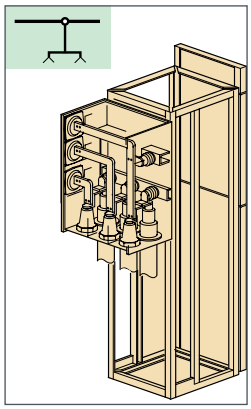
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Lower busbar tie connection in gas-filled cladded compartment



Bus sectionalizer

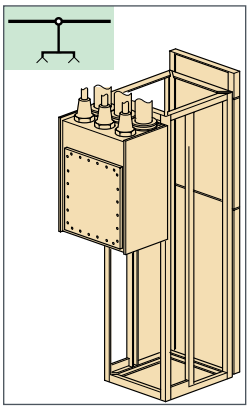
with disconnector in line with busbar.

Basic modules of a single busbar WSA switchgear



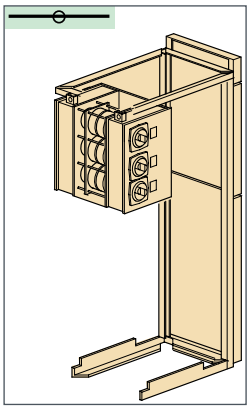
End panel

Cable and/or fully insulated conductor bar terminal downwards for max. 1x inner cone-type bushing size 2 and 1x size 3 or 1x3 fully insulated conductor bar as well as 1x inner cone-type bushing size 2(e.g. for voltage transformers connected via cable)



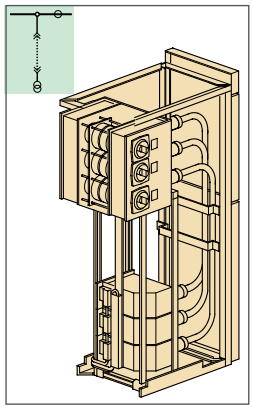
End panel

Cable and/or fully insulated conductor bar terminal upwards for max. 1x inner cone-type bushing size 2 and 1x size 3 or 1x3 fully insulated conductor bar as well as 1x inner cone-type bushing size 2 (e.g. for voltage transformers connected via cable)



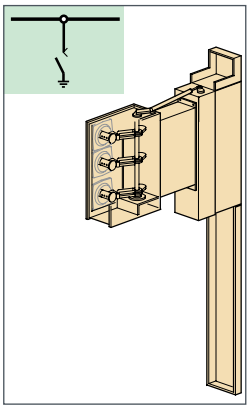
Busbar metering panel

with current transformers in line with busbar



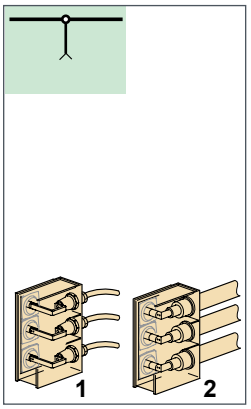
Busbar metering panel

with current transformers in line with busbar - metal-enclosed voltage transformers in outgoing feeder area, connected via cable



Busbar earthing

with earthing switch in line with busbar

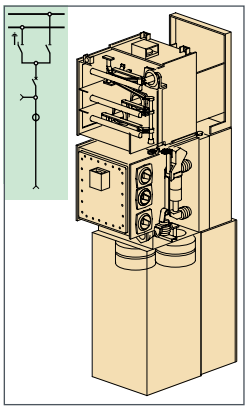


1 Cable connection and earthing for work purposes on the busbar, e.g. for metal-enclosed busbar voltage transformer or cable connections. Inner cone size 1 or 2

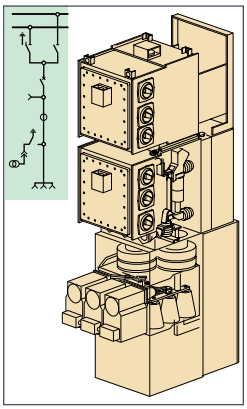
2 Fully insulated conductor bar terminal forward, to busbar ends

Range of equipment (contd.)

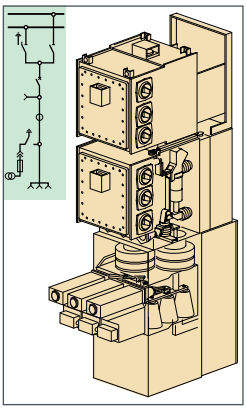
Basic modules of a Double busbar WSB switchgear



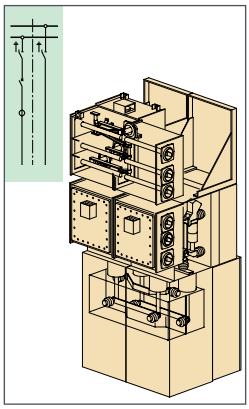
Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection



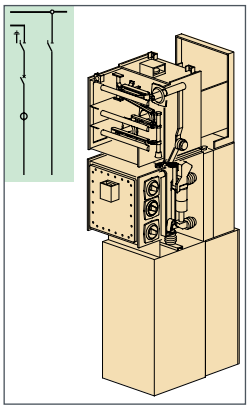
Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers



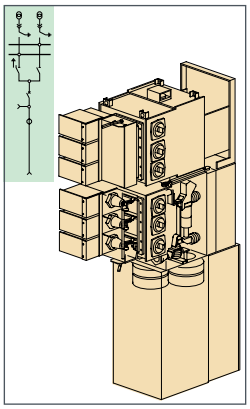
Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Multi-cable connection
- Disconnectable, flangemounted voltage transformers with primary fuse protection (on request in case of 36 kV)



Bus coupler
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Lower busbar tie connection in gas-filled cladded compartment



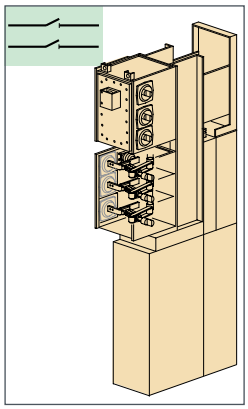
Bus section coupler in single panel width, with
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- up to max. 1250 A



Circuit-breaker panel
- Circuit-breaker
- Disconnecting / earthing switch
- Toroidal-core current transformer
- Single cable connection
- Disconnectable, flangemounted voltage transformers on the busbar

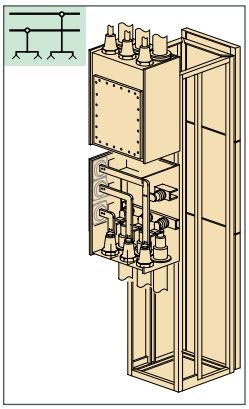
Range of equipment (contd.)

Basic modules of a Double busbar WSB switchgear



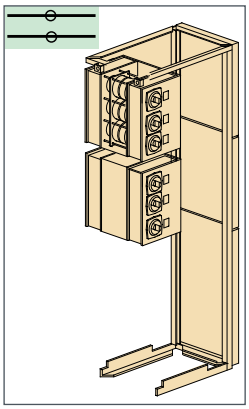
Bus sectionalizer

with disconnector in line with busbar



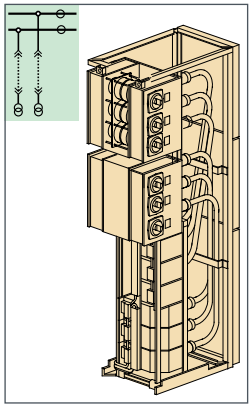
End panel

Cable and/or fully insulated conductor bar terminal upwards for max. 1x inner cone-type bushing size 2 and 1x size 3 or 1x3 fully insulated conductor bar as well as 1x inner cone-type bushing size 2 (e.g. for voltage transformers connected via cable)



Busbar metering panel

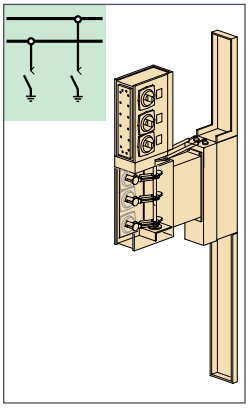
with current transformers in line with busbar



Busbar metering panel

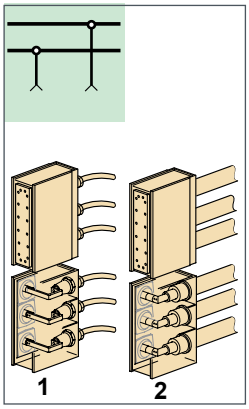
with current transformers in line with busbar

- metal-enclosed voltage transformers in outgoing feeder area, connected via cable



Busbar earthing

with earthing switch in line with busbar



1 Cable connection and earthing for work purposes of busbar, e.g. for metal-enclosed busbar voltage transformer or cable connections. Inner cone size 1 or 2

2 Fully insulated conductor bar terminal forward, to busbar ends

Range of equipment (contd.)

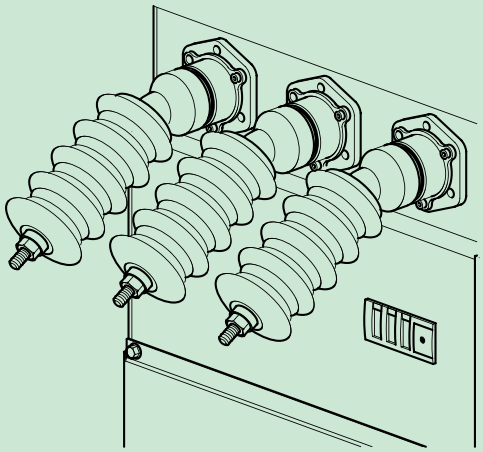
Weight of panels

Single Busbar ESS		Busbar/ Outgoing feeder	Busbar/ Outgoing feeder	Busbar/ Outgoing feeder
Nominal current	**A**	**1250/1250**	**2500/1250**	**2500/2500**
Weight		**approx. kg**	**approx. kg**	**approx. kg**
Circuit-breaker panel **Single cable connection** Isolating / earthing switch Toroidal-core current transformer Circuit-breaker		630	710	880
Bus section coupler in 2 module widths lower busbar transition	CB Riser	540 500		690 650
Bus sectionalizer with disconnector in the busbar run		450		600
End panel for cable or fully insulated connection to busbar (top or bottom)		280	310	310
Busbar metering panel with current transformer in the busbar run (without metal-enclosed voltage transformers) connected via cables in the outgoing feeder area		260	290	290
Busbar metering with current transformer along with busbar		200	200	200
Multi-cable connection		110	110	110
Disconnecting device for voltage transformer in the outgoing feeder block		110	110	110
Disconnecting device for Voltage transformer on busbar		50	50	50
Busbar earthing with earthing switch in the busbar run		130	150	150
Low-voltage cabinet	without extension	35	35	35
	with extension	80 to 150	80 to 150	80 to 150

Double busbar DSS				
Circuit-breaker panel **Single cable connection** Isolating / earthing switch Toroidal-core current transformer Circuit-breaker		710	740	950
Bus coupler in 1 panel width		850		950
Bus coupler in 2 panel width	CB Riser	590 670		740 820
Bus section coupler of lower busbar in 2 panel widths	CB Riser	590 550		740 700
Bus section coupler of upper busbar in 2 panel widths	CB Riser	790 750		940 900
Busbar metering panel with current transformer in the busbar run (without metal-enclosed voltage transformers) connected via cables in the outgoing feeder area		460	490	490
Disconnecting device for Voltage transformer on busbar		100	100	100
Disconnecting device for voltage transformer in the outgoing feeder block		110	110	110
Multi-cable connection		110	110	110
Busbar metering with current transformer along with busbar cable or fully insulated connection to busbar (top / bottom)		400 60	400 80	400 80
Busbar earthing with earthing switch in the busbar run		260	300	300
Low-voltage cabinet	without extension	35	35	35
	with extension	80/180	80/180	80/180

Cable connections

Inner cone-type system for cable high-voltage test



Cable test sockets Design as inner or outer cone-type system

Inner cone-type system

The medium-voltage cables are connected to the WS panels via the inner cone-type plug-in terminations. The WS switchgear comprises inner cone-type appliance couplers as per EN 50181

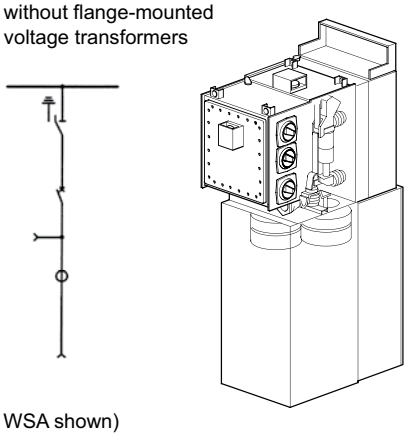
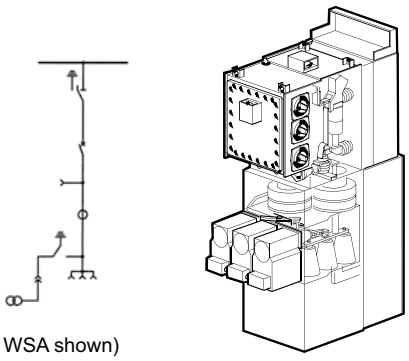
- terminal type 1 /size 1:630 A,
- terminal type 2 /size 2:800 A,
- terminal type 3 /size 3:1250 A,
- terminal type 4 /size 4:2500 A.

The specifications of the plug-in terminations' manufacturers regard ing selection and assembly of the plug-in terminations must be adhered to. This does not only apply to the selection of size, but also for all electrical rated data, coordinated to match the WS switchgear's data.

It is essential that all appliance couplers in WS panels which are not assigned plug-in terminations correctly using tension springs and fully shrouded insulating terminals/ dummy plugs.
Sizes 1 to 3 inner cone-type cable plug-in terminations for attachment to the WS do not require any capacitive coupling. The coupling electrode for the capacitive voltage detection system is an integral partof the appliance couplers installed in the switchgear panel.

Inner cone-type system for cable test sockets

The cable high-voltage test can be performed via inner cone-type appliance couplers on the rear side of the panel (optional design). Design as per EN 50181, terminal type 1/size 1. Also optionally available: terminal type 2/size 2.

	Number of appliance couplers per phase		
12 kV , 24 kV , 36 kV WSA and WSB	Size 1 630 A	Size 2 800 A	Size 3 1250 A
without flange-mounted voltage transformers  WSA shown)	1		
		1	
			1
	2		
		2	
			2
	3		
		3	
			3
	4		
		4	
			4
		5	
with flange-mounted voltage transformers including isolating device  WSA shown)	1		
		1	
			1
	2		
		2	
			2
	3		
		3	
			3
	4		
		4	
			4

Cable connections (contd.)

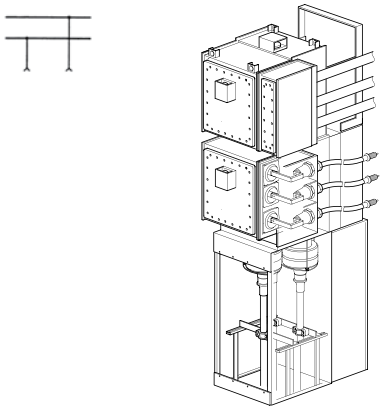
Inner cone-type system Size 4 in outgoing feeder

For single-conductor cables with very high cross sections up to 1000 mm2 the following variants of the cable connection tank are available:

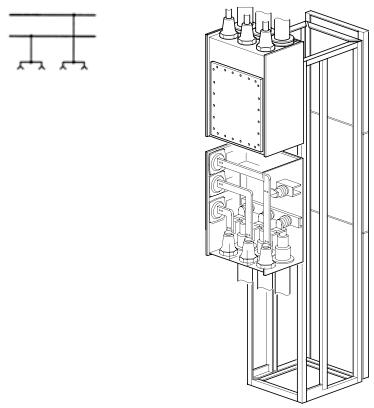
	Number of appliance couplers per phase
	Size 4 2500 A
without flange-mounted outgoing voltage transformers	1
	–
with flange-mounted outgoing voltage transformer	1 (on request)
	2

Inner cone-type system Size 1, 2 and 3 on the busbar

	Number of appliance couplers per phase		
12 kV, 24 kV, 36 kV	Size 1 630 A	Size 2 800 A	Size 3 1250 A
■ 200 mm disk for WSA and WSB end lead routed forward	1		
		1	
■ 600 mm wide busbar tank for WSA and WSB Cable end leads: no at the bottom: lower BB system at the top: upper BB system	1		
		1	
			1
	2		
		2	
			2
	1	+	1
		1 + 1	



(WSB shown)



(WSB shown)

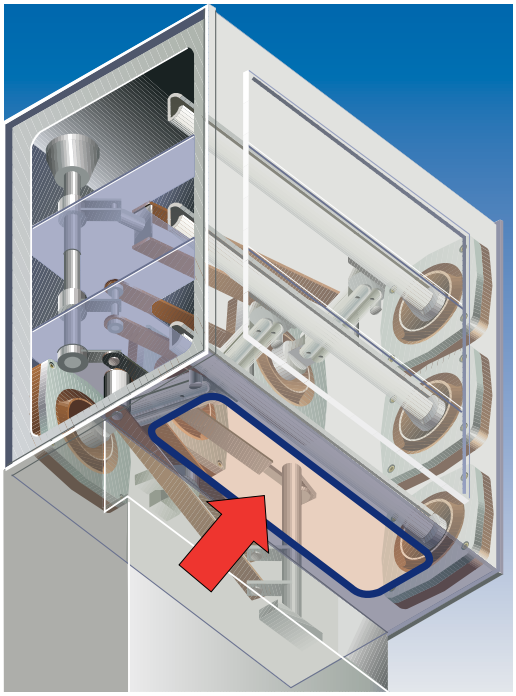
Cable connections (contd.)

Outer cone-type couplers 630 A in outgoing feeder

Standardized cable terminals as per EN 50181, connection type C, 630 A are used in the 630 A outgoing feeder panels, e.g. to connect belted cables up to 12 kV.

	Number of appliance couplers 630 A per phase
12 kV **WSA and WSB**	**Outer cone with inside thread M 16x2 as per EN 50181**
without flange-mounted voltage transformers including adapter for conventional cable lug terminal; not fully shrouded, insulated connection of belted cables	1
	2
	3
	4
	–
Cable connection adapter Raychem RCAB 10 kV in conjunction with Raychem cable end box systems IXSU-F, TFTI-31. . , UHGK/EPKT and transition end box from paper-insulated belted cable to flexible EPR-conductors: SMOE	
The rear cable test sockets can also be designed as outer cone-type system as per EN 50181, terminal type C, 630 A. Cable connections on busbars with outer cone-type system available on request.	

Special models



Visible isolating distance of the busbar earthing contacts

The following are a selection of examples which take the specificities of the WS models for application in various areas of the world or for special models into account.

Please contact our company to request models available for specific applications.

■ Vibration-resistant design for application on open-cast equipment in mining applications.

■ Specific locking devices using locks such as so-called pad locking.

■ Top entry model: The outgoing feeder cables of the WS panels are routed to the top through a modified cable terminal.

■ Cable end leads to the rear: for WS application in container stations, cable end leads to the rear (instead of downwards) are often preferable.

■ Gas-insulated busbar connection to busbar outgoing feeder for connection of GASLINK.

■ Second digital user interface arranged in front of the mechanical control panel: Today, the new switchgear protection and control devices are very frequently designed with a separate control and display panel. WS models with digital display – arranged in front of the mechanical control panel – are available on request.

■ WS model for Canada, USA, Australia etc. using the so-called Pipe Window: An inspection glass enables the earthed and disconnected position of the three-position disconnector in the busbar compartment to be seen from the outside.

■ For application in the Russian Federation: design and certification according to GOST R standard.

■ Approval by the Electricity Association (EA) for application of the WS in the electrical power supply networks of the United Kingdom (VK) and for stationary use in railway power supply.

■ Certifications and approvals of a great variety of power supply companies worldwide with their own requirements which exceed IEC standards. This is based on a specific, separate approval procedure of the power supply companies for the WS series.

Ecological considerations

Average material distribution in gas-insulated switchgear

Materials		Wt. %
Metals	Steel	7
	Copper	6.5
	Aluminium, brass	2
Plastics	Thermosetting plastics	7
	Thermoplastics	2
	Elastomers	0.5
Electronics	Plastics	0.5
	Metals	1
Insulating gas	Sulphur hexafluoride	0.5

The WS switchgear satisfies to a high degree the ecological requirements in view of environmental protection thanks to

- optimization of material and energy consumption during manufacture
- compliance with all ecological requirements during its service life
- the use of recyclable materials for efficient disposal at the end of its service life.

Our design directives regarding environmentally compatible designspecify the use of materials which are easily recyclable and can be disassembled. The metals which form approx. 90% of the switchgear are easily recyclable. These are 100 % recycled as homogenous materials after the end of their service life.

Plastics can also be recycled. The thermosetting – i.e. non-melting – plastics can be comminuted and reused as fillers in other plastic components; the melting thermoplastic materials can be recycled as homogenous materials. This means that the material is preserved, melted and used for the construction of new durable parts. To ensure efficient and environmentally compatible disassembly and assignment of materials by the responsible disposal experts, the plastic components have been identified accordingly. Moreover, material and utilization data sheetsare available to provide the customer with an overview of the materials used, and the disposal company with important informationregarding the recycling process. Thus, the materials used for our products can be reused 100 %.

This contributes essentially to saving primary energy and material resources.

All materials were selected and developed so that e.g. switchgear affected negatively in case of fires in buildings only affect the fire load to a minimum extent (heat development, pollutants in the emissions).

Another important ecological aspect is the longevity of our products (min. 30 to 40 years), which is an extremely long service life compared to other capital goods. The switchgear units have been designed, moreover, so as to require little maintenance which would cost energy and material, and so as to enable straightforward replacement of part components, e.g. if new controllers have been developed on the market (upgrading).

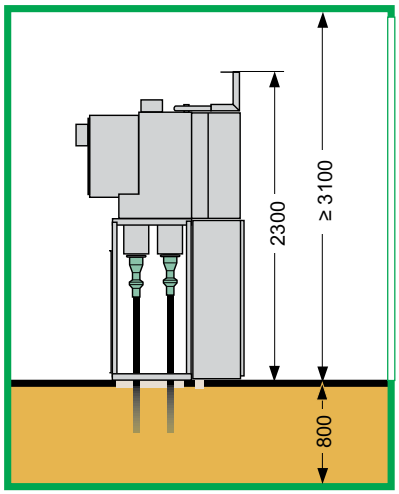
In our gas-insulated WS switchgear unit, the major part of the switchgear panel has been sealed hermetically in an insulating inert gas (sulphur hexafluoride SF6 which is neither reactive nor toxic). Thus, all environmental influences reducing the service life are shut out. The particular characteristics of the insulating gas also enable the overall size to be decreased by approx. 50 % versus switchgear designed without insulating gas with comparable technical properties. This again saves a lot of material and energy required for material production. The portion of insulating gas used for WS switchgear amounts to approx. 0.5 percent by weight. Once the switchgear's service life has elapsed, the gas is extracted completely via the disposal valve provided serially in each gas-filled, cladded compartment, and then recycled. To this effect, the gas suppliers have developed an efficient recycling concept.

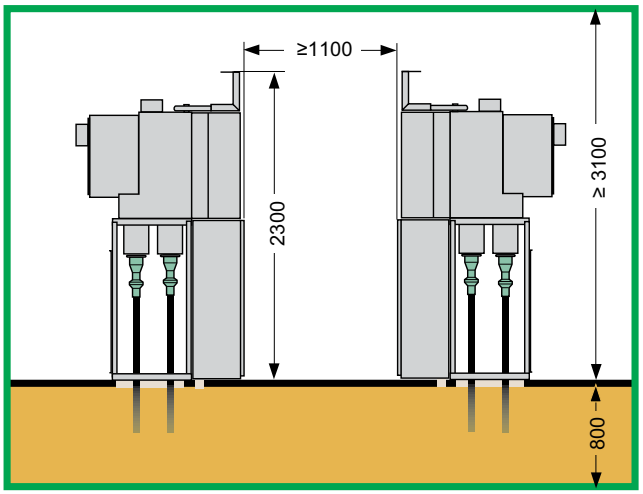
During normal operation, the gas need not be replenished during the entire service life of the switchgear. The switchgear is a hermetically sealed pressure system acc. to IEC 60694 (IEC 62271-1).

Design data
Basic dimensions and flooring ducts

Space required by a WSA

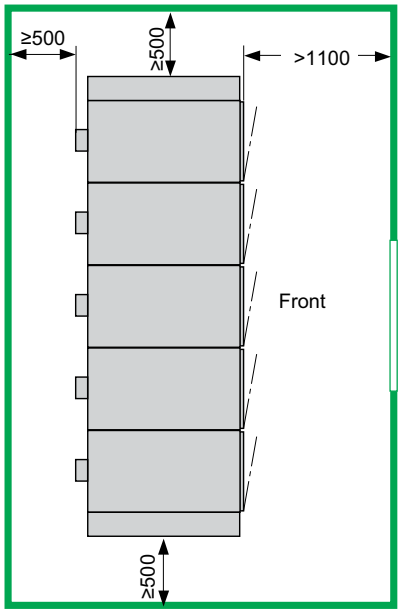
Minimum clearances

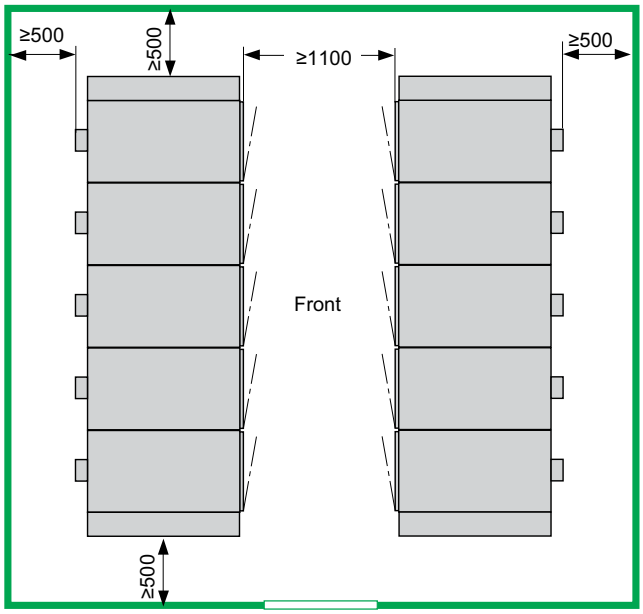




Minimum opening for placing the components: 1250 x 3000 mm

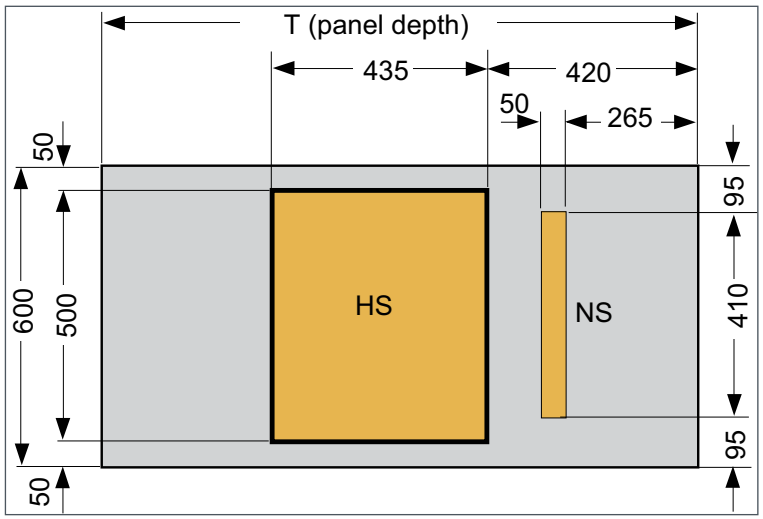
Attention to cable radius





Smaller dimensions available on request

Flooring ducts for cable connection/busbar connection



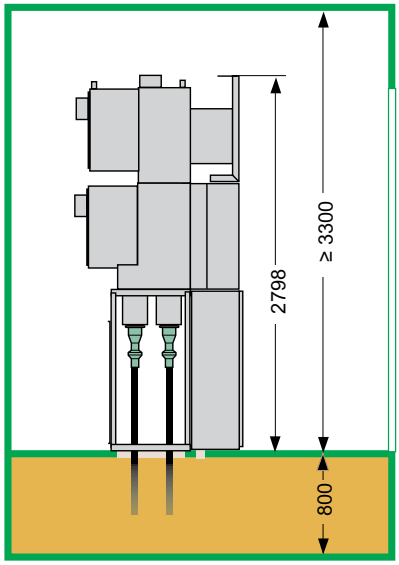
HV: area for high-voltage cable entry or fully insulated bar end lead
LV: area for low-voltage cable entry

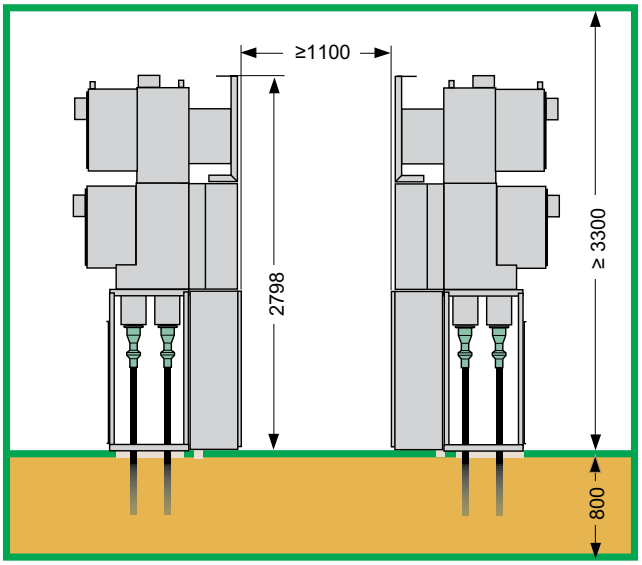
T	Panel design
1242	up to 1250 A outgoing rated current
1254	with heat sink at busbar
1434	with fan attachment
1371	with disconnectable voltage transformers in outgoing feeder
1587	with disconnectable voltage transformers on busbar

dimensions in mm

Design data
Basic dimensions and flooring ducts (contd.)

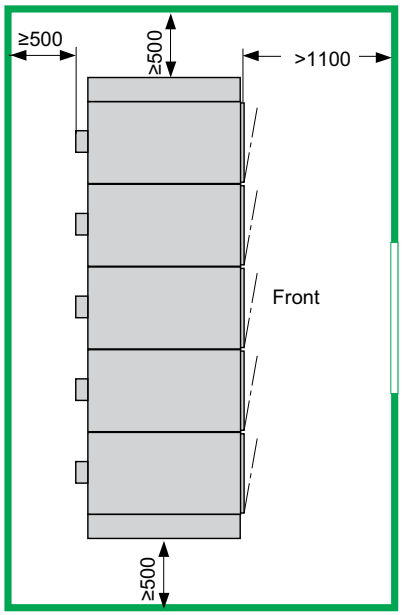
Space required by a WSB
Minimum clearances

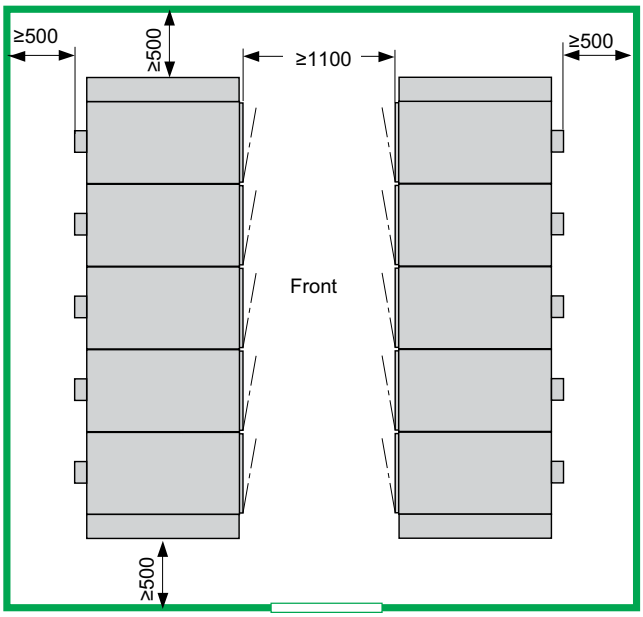




Minimum opening for placing the components: 1250 x 3000 mm

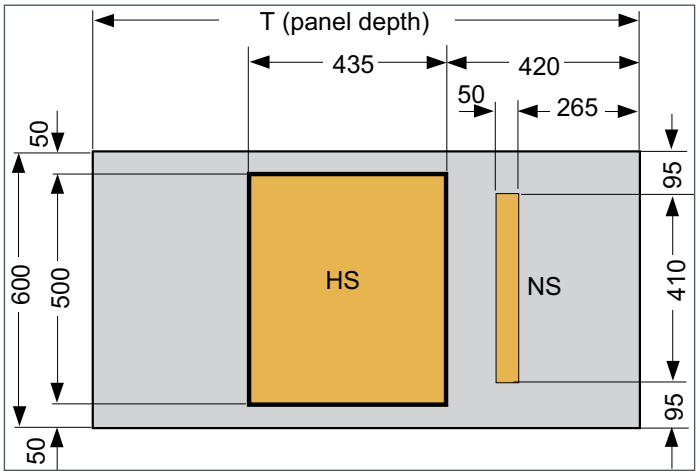
Attention to cable radius





Smaller dimensions available on request

Flooring ducts for cable connection/busbar connection



HV: area for high-voltage cable entry or fully insulated bar end leads
LV: area for low-voltage cable entry

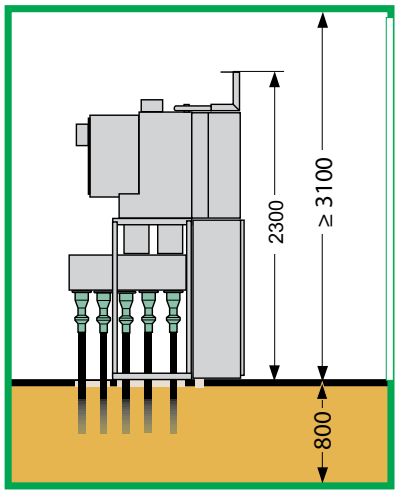
T	Panel design
1242	up to 1250 A outgoing rated current
1254	with heat sink at busbar
1434	with fan attachment
1371	with disconnectable voltage transformers in outgoing feeder
1587	with disconnectable voltage transformers on busbar

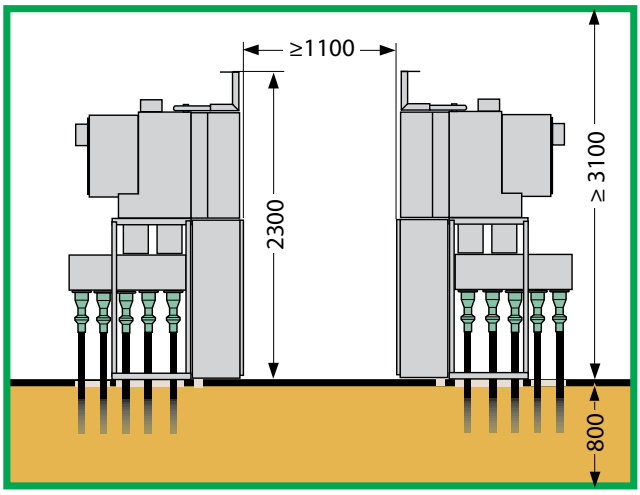
dimensions in mm

Design data
Basic dimensions and flooring ducts (contd.)

Space required by a WSA

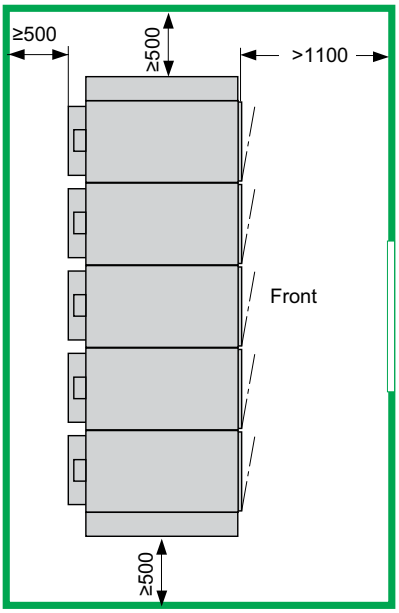
Minimum clearances

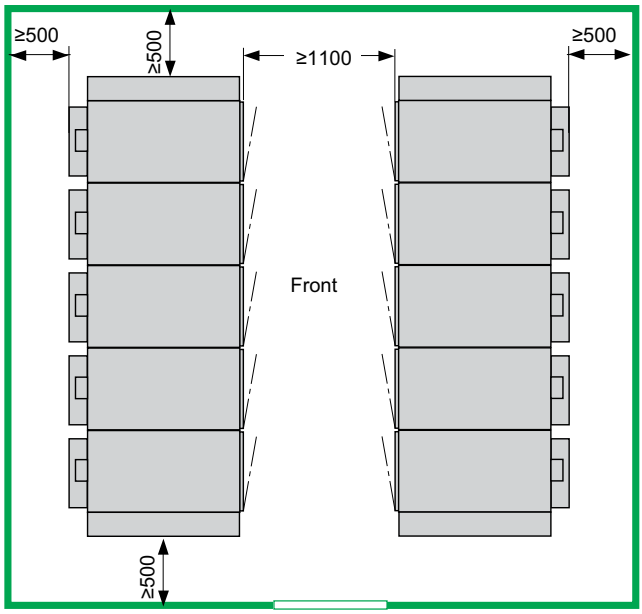




Minimum opening for placing the components: 1250 x 3000 mm

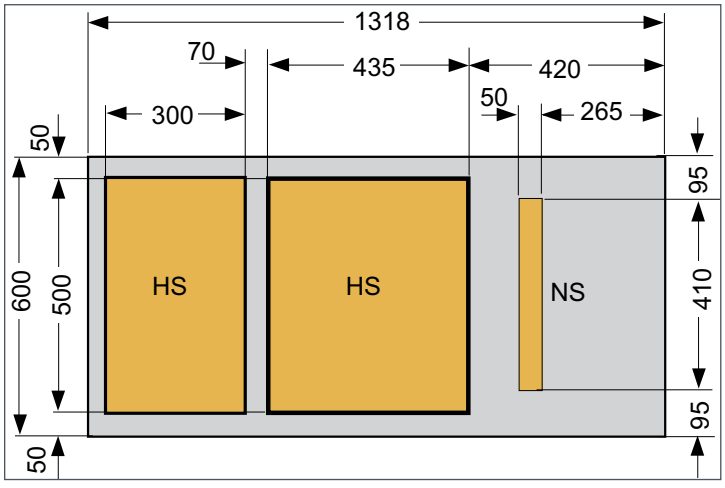
Attention to cable radius





Smaller dimensions available on request

Flooring ducts



HV: area for high-voltage cable entry or fully insulated bar end leads
LV: area for low-voltage cable entry

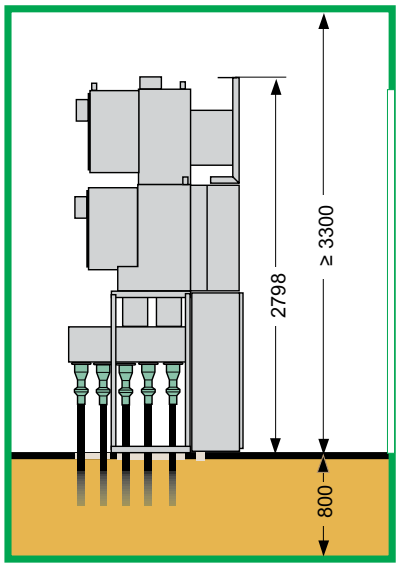
Cable connection/bar connection
4 x size 3
5 x size 2
3 x size 3 with disconnectable sleeve size 2
4 x size 3 with disconnectable sleeve size 2
4 x size 2 with disconnectable sleeve size 2

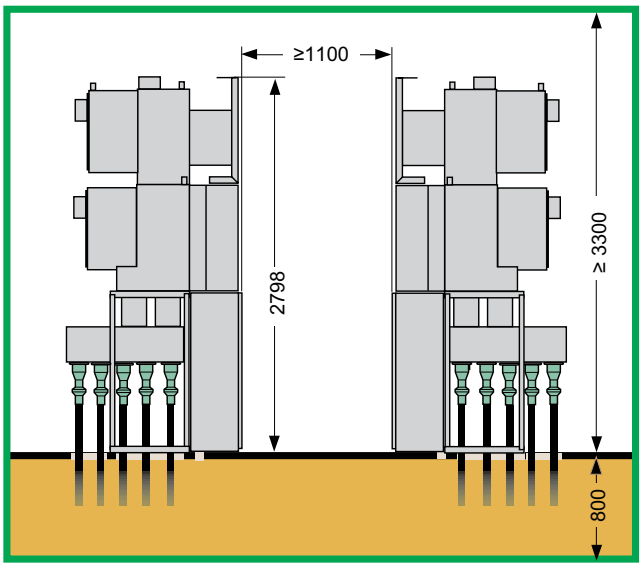
dimensions in mm

Design data
Basic dimensions and flooring ducts (contd.)

Space required by a WSB

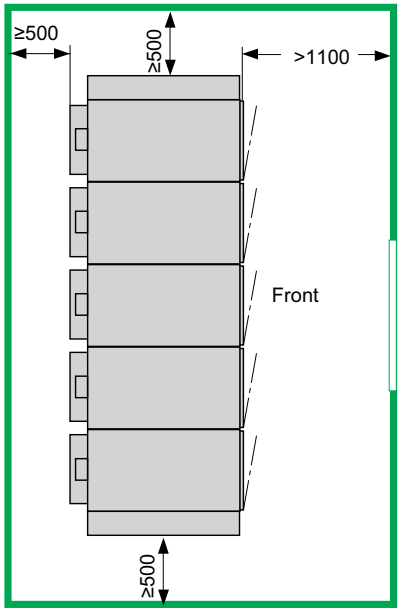
Minimum clearances

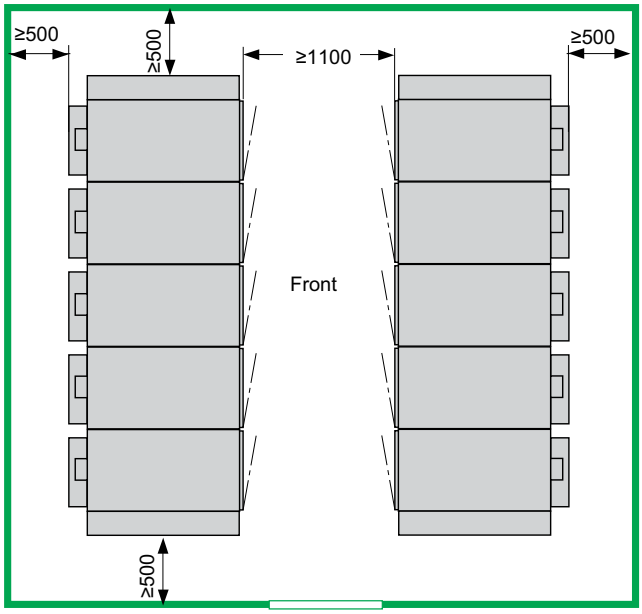




Minimum opening for placing the components: 1250 x 3000 mm

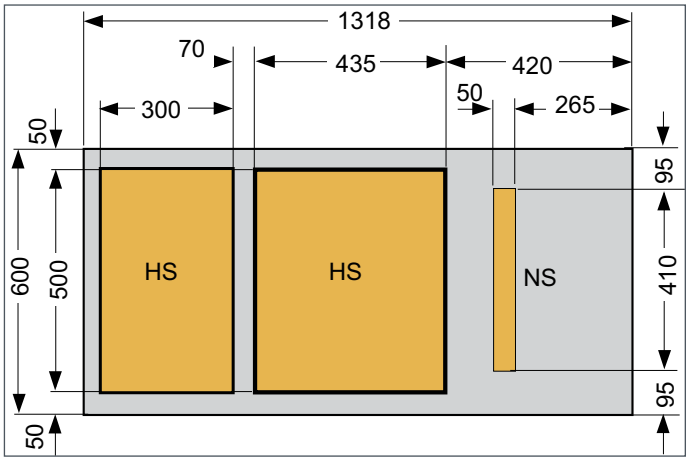
Attention to cable radius





Smaller dimensions available on request

Flooring ducts



HV: area for high-voltage cable entry or fully insulated bar end leads
LV: area for low-voltage cable entry

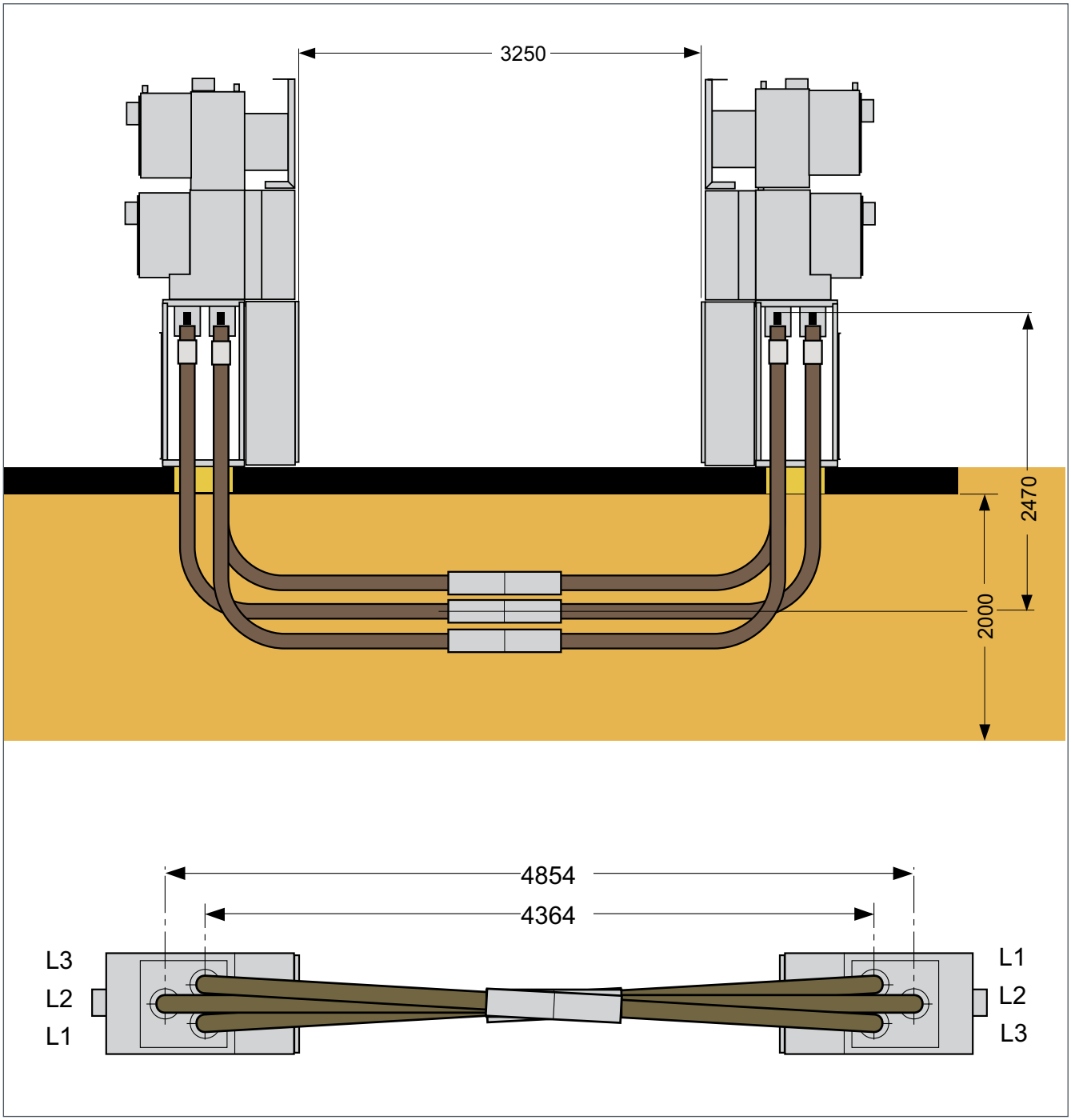
Cable connection/bar connection
4 x size 3
5 x size 2
3 x size 3 with disconnectable sleeve size 2
4 x size 3 with disconnectable sleeve size 2
4 x size 2 with disconnectable sleeve size 2

dimensions in mm

Design data

Basic dimensions and flooring ducts (contd.)

Space required by a WSB



Shipping instructions

Transport of the Switchgear unit

When transporting the switchgear unit, it must be ensured that the transport units do not slip or tilt (if necessary, nail transport pallet down to the loading surface). Reuse the original packaging to store parts which have been unpacked for inspection.

Packaging the switchgear

■ If packed for truck transport, the switchgear unit is delivered on a pallet with PE protective film.

■ For sea-worthy transport, the units are packed in sealed aluminium film with desiccant and in a closed case with tightly closed wooden base.

■ In case of air transport, the switchgear unit is packaged in a wooden crate with closed wooden base and with a blister IPE film as dust protection or in wooden crates, also with closed wooden base.

Transport to the site of installation

For storage, the operating conditions admissible for switchgear operation must exist.
Avoid condensation.

During transport to the site of installation, it must be taken into account that the main weight is located in the top area of the switchgear – “top-heavy”.

Transport using a forklift truck: Only transport the switchgear on a pallet. Attention – “top-heavy“!

Transport without pallet:

The crane mounting harness must be hooked into the jack rings of the switchgear.

Notes

Notes

Notes

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