
DISTRIBUTION SOLUTIONS

UniSafe 2.0

Technical guide



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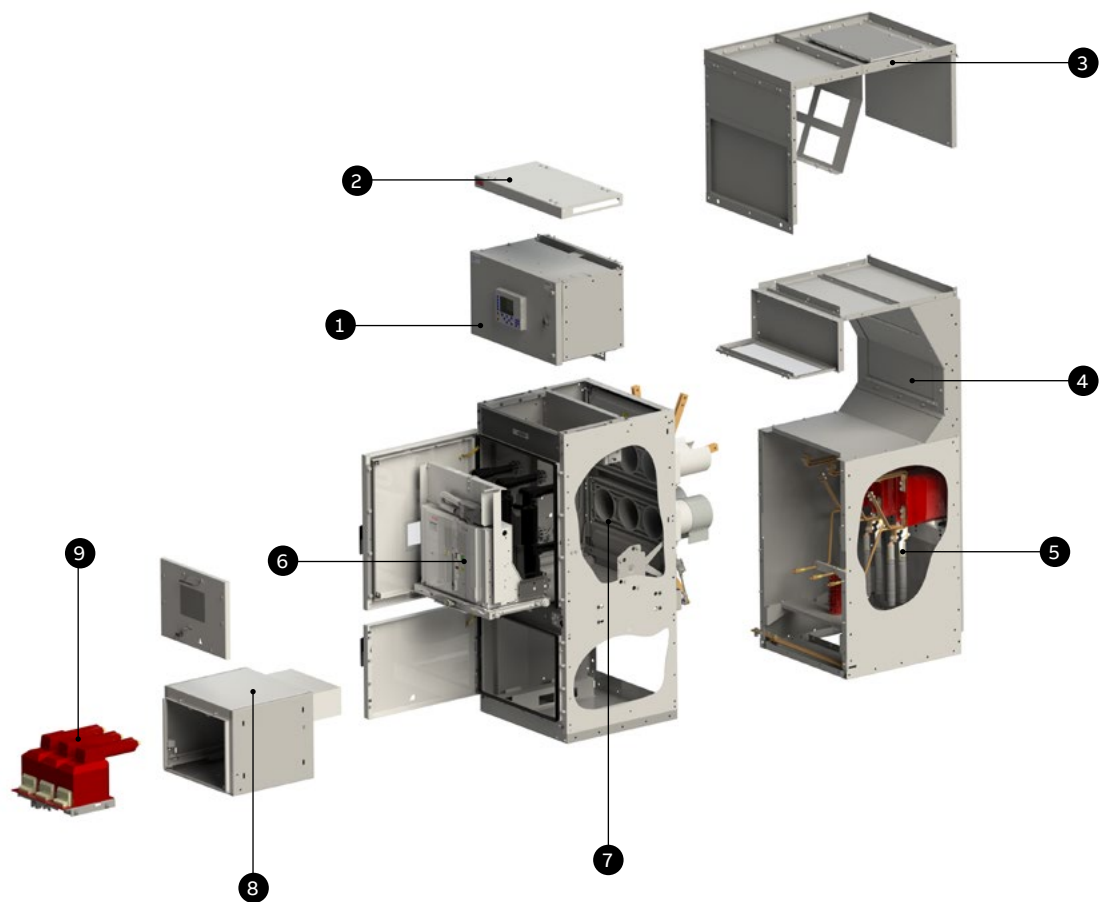
1. Description

1.1 Compartments

The typical units of UniSafe 2.0 switchboard consist of up to a maximum of seven compartments segregated from each other by metal partitions (incoming/outgoing unit with measurements shown in the figure). For details of the other units, please see chapter 2.

Caption

- 1 Instrument compartment
- 2 Auxiliary circuit interconnection wiring duct
- 3 Gas exhaust duct
- 4 Busbar compartment
- 5 Feeder compartment
- 6 Circuit-breaker compartment
- 7 Circuit-breaker compartment
- 8 Withdrawable voltage transformers compartment
- 9 Withdrawable voltage transformers with fuses



1.2 Components of the structure

1.2.1 Pre-galvanized steel-sheet

Type: UNI EN 10346 DX51D+Z275

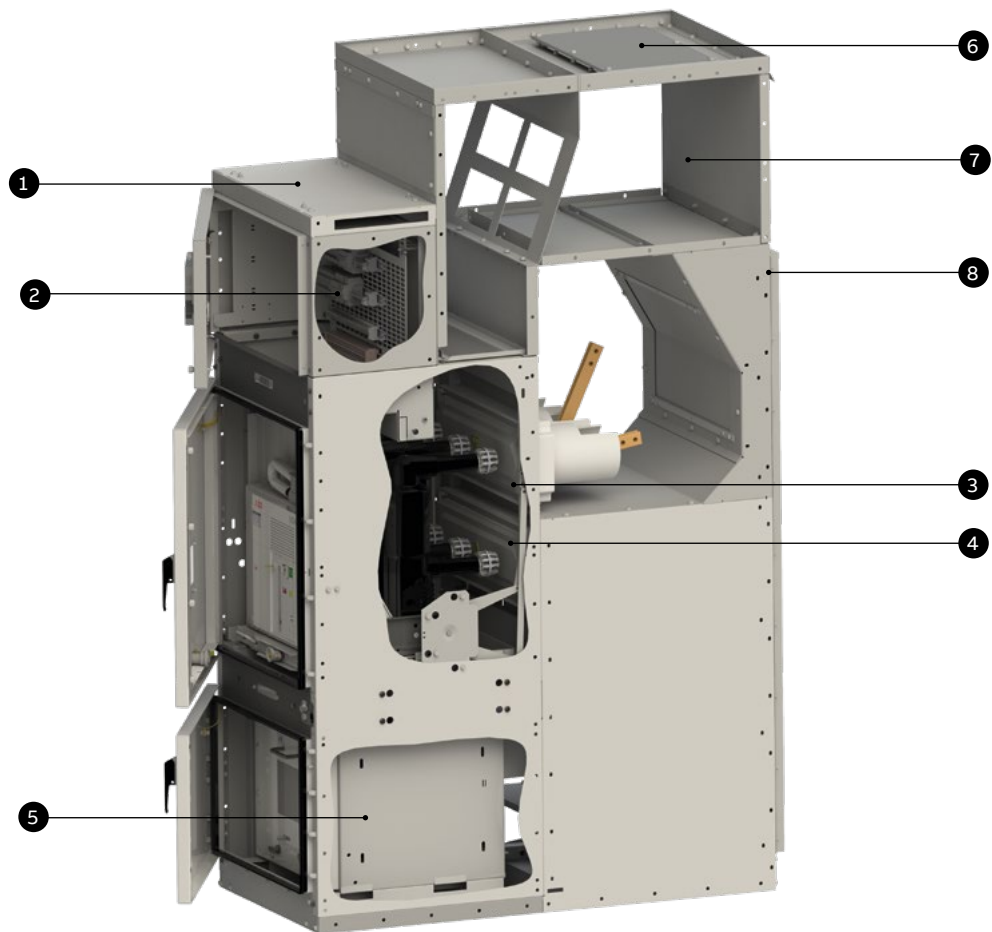
Thickness: 2 mm (some details 0.8 or 1.5 mm)

Weight (average): 310...350 Kg

Use: supporting structure, compartments, segregations, shutters, auxiliary circuit wiring duct, gas exhaust duct, gas exhaust flap, auxiliary instrument support, end panels (also available painted on request).

Caption

- 1 Wiring duct
- 2 Instrument support
- 3 Top shutter
- 4 Bottom shutter
- 5 Compartments (e.g. VT)
- 6 Gas exhaust flap
- 7 Segregations
- 8 Closing panels

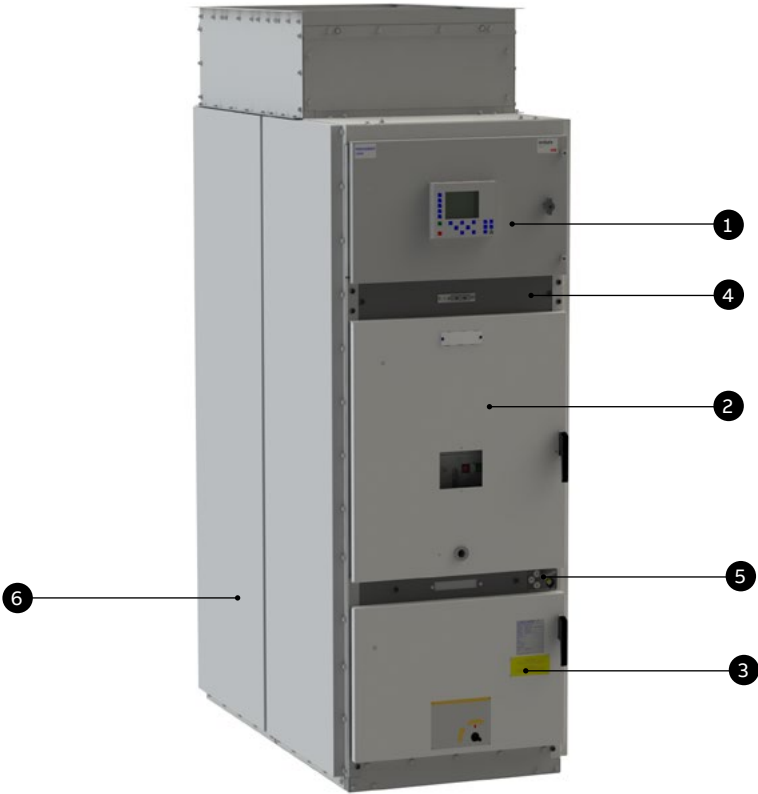


1. Description

1.2.2 Painted sheet-steel
Type: UNI EN 10130 DC01-B-m
Standard colour: RAL7035 (doors and end covers)
Standard colour: RAL7012 (horizontal bands)
Thickness: 3 mm for the doors – 2 mm for the other components
Weight: 52...60 Kg
Use: LV compartment door, CB compartment door, cables compartment door.

Weight of used paint	
12-17.5 kV	Kg
600 mm wide units	0.3
750 mm wide units	0.4
1000 mm wide units	0.5
1550 mm deep end covers	0.8
2000 mm deep end covers	1
24 kV	Kg
750 mm wide units	0.4
1000 mm wide units	0.5
1900 mm deep end covers	1
2300 mm deep end covers	1.2

Caption
1 Auxiliary instrument compartment door
2 Circuit-breaker compartment door
3 Cables compartment door
4 Horizontal band
5 Horizontal band
6 End cover (closing panels of the right and left units of the switchboard. They can be both galvanized or painted)



1.2.3 Copper

Type: UNI EN 5649 Cu ETP⁽¹⁾

12 - 17,5 kV				
Rated current (A)	Cross-section of main busbars (mm)	Cross-section of top branches (mm)	Cross-section of bottom branches (mm)	Cross-section of earthing busbar (mm)
–	–	–	–	1x40x10
630	–	1x40x10	1x40x10	–
1250	2x40x10	2x40x10	2x40x10	–
1600	3x60x10	3x50x10	3x60x10	–
2000	4x60x10	4x50x10	3x60x10	–
2500	4x60x10	4x60x10	3x80x10	–
3150	4x80x10	4x80x10	3x120x10	–
3600 ⁽²⁾	4x80x10	4x80x10	3x120x10	–
4000 ⁽²⁾	4x80x10	4x80x10	3x120x10	–

24 kV				
Rated current (A)	Cross-section of main busbars (mm)	Cross-section of top branches (mm)	Cross-section of bottom branches (mm)	Cross-section of earthing busbar (mm)
–	–	–	–	1x40x10
630	–	1x40x10	1x40x10	–
1250	2x40x10	2x40x10	2x40x10	–
1600	3x50x10	3x50x10	3x80x10	–
2000	4x50x10	4x50x10	3x80x10	–
2500 ⁽²⁾	4x50x10	4x50x10	3x80x10	–

Use: main busbars, top and bottom branches, branches for CT and VT, cable connections, monoblock fixed contacts, earthing switch fixed contacts, earthing busbar.

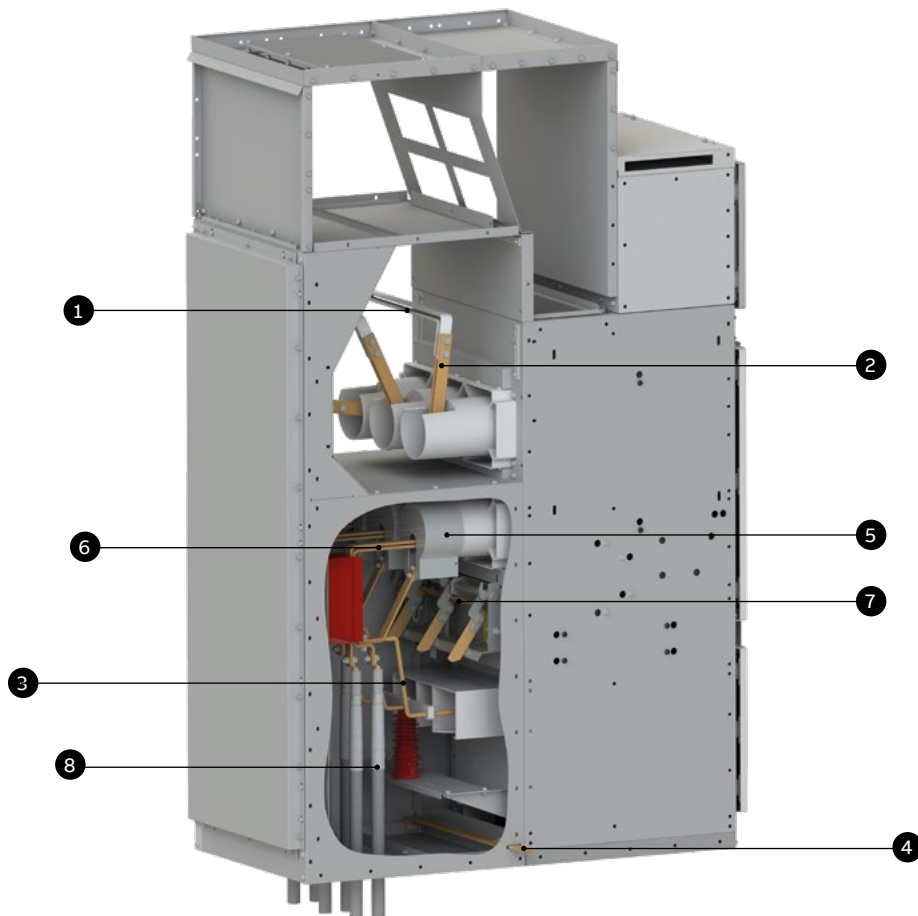
⁽¹⁾ Silver-plated copper is used for the main busbar system. The branches are made of bare copper.

The main busbar system can be made with insulating covering.

⁽²⁾ With forced ventilation in the circuit-breaker compartment: a further fan is required at the rear of the switchboard for 4000 A versions.

Caption

- 1 Main busbars
- 2 Top branches
- 3 VT branches
- 4 Earthing busbar
- 5 Monoblock fixed contacts
- 6 Bottom branches
- 7 Earthing switch fixed contacts
- 8 Cable connections



1. Description

1.2.4 Insulating materials

Type: Polyester glass

Weight (average): 30...40 Kg

Use: circuit-breaker compartment and withdrawable VT compartment monoblocks.

Type: Epoxy resin

Weight (average): 2 Kg

Use: insulating covering of busbars and branches (when requested).

Type: Epoxy resin

Weight: see chapter 6

Use: CT, VT, sensors, insulators (in variable quantities, see single units - chapters 2 and 3).

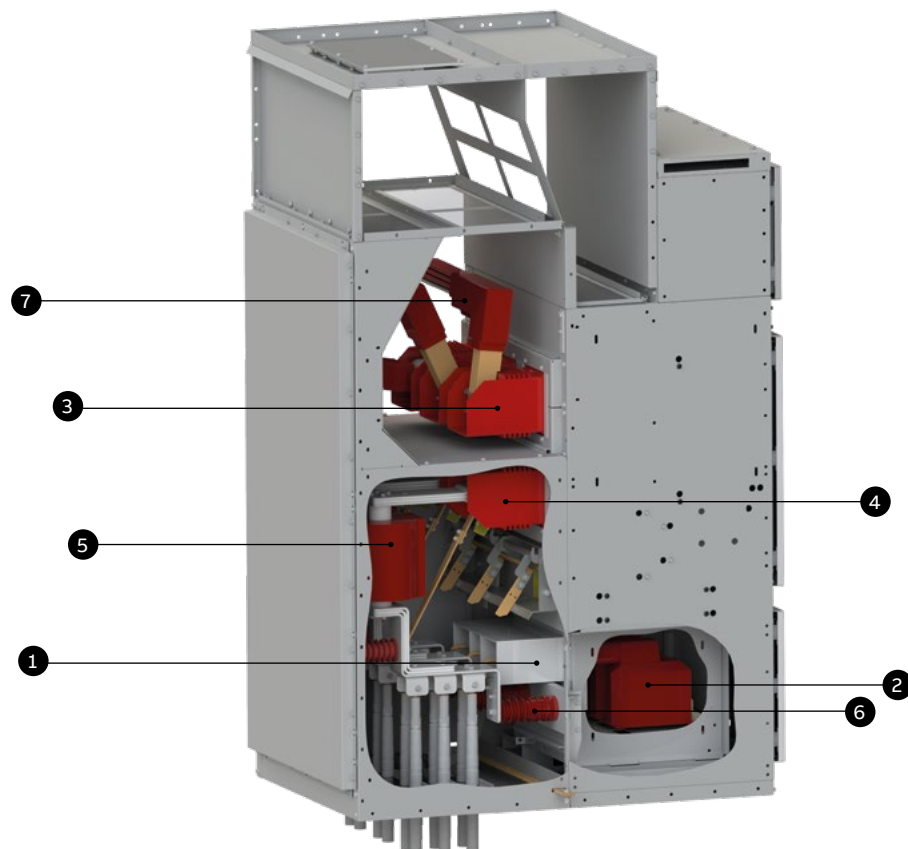
Type: Polycarbonate

Weight: 0.1 Kg

Use: Inspection window of CB door.

Caption

- 1 Withdrawable VT compartment monoblock
- 2 VT
- 3 Top monoblock
- 4 Bottom monoblock
- 5 CT
- 6 Insulator
- 7 Busbar insulating covering (when requested)



1.3 General electrical characteristics

Switchboard		12 kV	17.5 kV	24 kV
Rated voltage	kV	12	17.5	24
Rated insulation voltage	kV	12	17.5	24
Rated power frequency withstand voltage	kV (1 min)	28 ⁽¹⁾	38	50
Rated lightning impulse withstand voltage	kV	75	95	125
Rated short-time withstand current	kA (3s)	31.5 - 40 ⁽³⁾	31.5 - 40 ⁽³⁾	25 - 31.5 ⁽⁴⁾
Peak current	kA	80	80	80
Internal arc withstand current	kA (1s)	31.5-40 ⁽³⁾	31.5-40 ⁽³⁾	25 - 31.5 ⁽⁴⁾
Branch connectors rated currents	A	630	630	630
	A	1250	1250	1250
	A	1600	1600	1600
	A	2000	2000	2000
	A	2500	2500	2500 ⁽²⁾
	A	3150	3150	
	A	3600 ⁽²⁾	3600 ⁽²⁾	
	A	4000 ⁽²⁾	4000 ⁽²⁾	
Main busbars rated currents	A	1250	1250	1250
	A	1600	1600	1600
	A	2000	2000	2000
	A	2500	2500	2500 ⁽²⁾
	A	3150	3150	
	A	3600 ⁽²⁾	3600 ⁽²⁾	
	A	4000 ⁽²⁾	4000 ⁽²⁾	

(1) Also available at 42 kV (1 min)

(2) With forced ventilation in the circuit-breaker compartment: a further fan is required at the rear of the switchboard for 4000 A versions

(3) 31,5kA for LCA, 40kA only for TCA

(4) 25kA for LCA, 31,5kA only for TCA

For 50kA contact ABB

1.3.1 Earthing switch electrical characteristics

Earthing switch with making capacity		12 kV	17.5 kV	24 kV
Rated short-time withstand current	kA (3s)	31.5	31.5	31.5
	kA (1s)	40	40	–
Making capacity	kAp	80	80	80
		125	125	–

Mechanical and electrical performances

Electrical life of earth contact	Class	E2 - up to 5 closing operations
Mechanical life of earth contact	Class	M0 - 1000 mechanical operations

1. Description

1.4 Technical data

12 kV											
Unit width		600 mm		750 mm				1000 mm			
Type Panel \ Current		400-630 A	1250 A	630 A	1250 A	1600 A	2000 A	2500 A	3150 A	3600 A	4000 A
IF	Incoming feeder	2-3-4	3-4	3-4	3-4	3-4	3-4	3-4	3	3	3
IFM	Incoming feeder with measurement	2-3-4-6	3-4-6	3-4-6	3-4-6-7	3-4-6-7	3-4-6-7	3-4-6-7	3-6	3-6	3-6
BR	Bus-Riser	9	8	9	8	8	8	8	8	8	8
BRM	Bus-Riser with measurement	9	5	9	7	7	7	7	9	9	9
M	Measurement	5	9	9	5	9	9	9	9	9	9
BT	Bus-Tie	9	3-4	9	3-4	3-4	3-4	3-4	3	3	3
BTM	Bus-Tie with measurement	9	3-4-7	9	3-4-7	3-4-7	3-4-7	3-4-7	3	3	3

2 Available with ConVac

3 Available with HD4 and VD4

4 Available with VM1

5 With Metering truck

6 With VT compartment in the standard solution

7 With VT compartment in deeper solution

8 Available solution

9 Not available solution

17.5 kV											
Unit width		600 mm		750 mm				1000 mm			
Type Panel \ Current		400-630 A	1250 A	630 A	1250 A	1600 A	2000 A	2500 A	3150 A	3600 A	4000 A
IF	Incoming feeder	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3	3	3
IFM	Incoming feeder with measurement	3-4-6	3-4-6	3-4-6	3-4-6-7	3-4-6-7	3-4-6-7	3-4-6-7	3-6	3-6	3-6
BR	Bus-Riser	9	8	9	8	8	8	8	8	8	8
BRM	Bus-Riser with measurement	9	5	9	7	7	7	7	9	9	9
M	Measurement	5	9	9	5	9	9	9	9	9	9
BT	Bus-Tie	9	3-4	9	3-4	3-4	3-4	3-5	3	3	3
BTM	Bus-Tie with measurement	9	3-4-7	9	3-4-7	3-4-7	3-4-7	3-4-7	3	3	3

3 Available with HD4 and VD4

4 Available with VM1

5 With Metering truck

6 With VT compartment in the standard solution

7 With VT compartment in deeper solution

8 Available solution

9 Not available solution

24 kV						
Unit width		750 mm			1000 mm	
Type Panel \ Current		630 A	1250 A	1600 A	2000 A	2500 A
IF	Incoming feeder	1-2	1-2	1-2	1-2	1-2
IFM	Incoming feeder with measurement	1-2-4	1-2-4-5	1-2-4	1-2-4	1-2-4
BR	Bus-Riser	7	6	6	6	6
BRM	Bus-Riser with measurement	7	3	7	7	7
M	Measurement	3	7	7	7	7
BT	Bus-Tie	7	1-2	1-2	1-2	1-2
BTM	Bus-Tie with measurement	7	1-2-5	7	7	7

1 Available with HD4 and VD4

2 Available with VM1

3 With Metering truck

4 With VT compartment in the standard solution

5 With VT compartment in deeper solution

6 Available solution

7 Not available solution

Busbars applications ⁽⁴⁾					
Unit width		750 mm		750 - 1000 mm	
Type Panel \ Current		1250 A	1600 A	2000 A	2500 A
IF	Incoming feeder	1-2-3	1-2-3	1-2-3	1-2-3
IFM	Incoming feeder with measurement	1-2-3	1-2-3	1-2-3	1-2-3

1 Current transformers

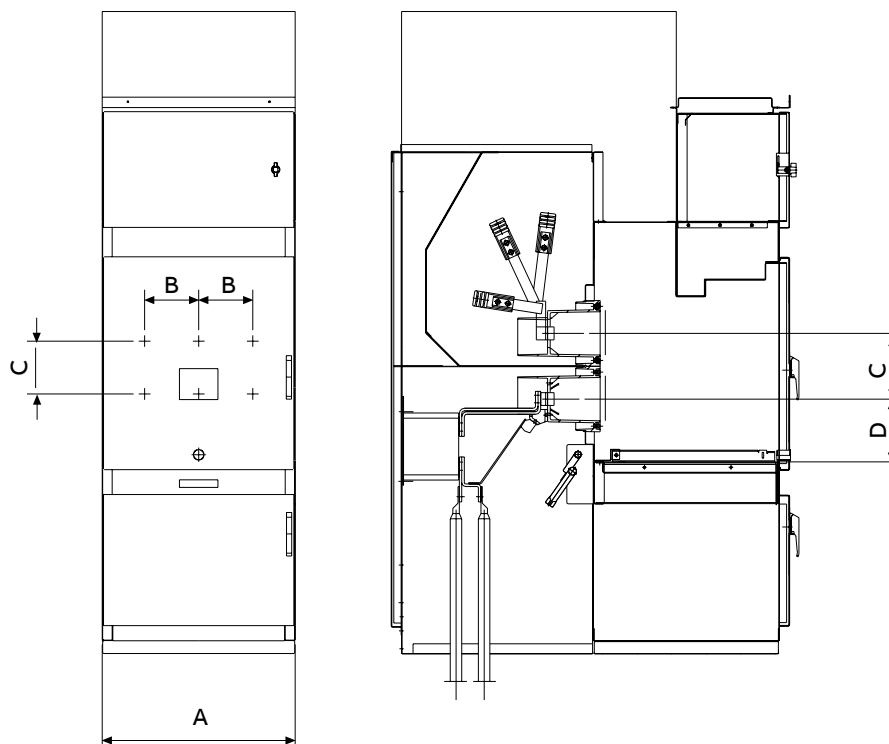
2 Voltage transformers

3 Incoming duct. Please contact ABB

4 Only for TCA type 12-17,5kV, up to 31,5kA

1. Description

1.5 Main dimensions and pole distances of apparatus



12 kV / 31,5 kA				
A	B	C	D	Apparatus
600	150	205	264	VD4 630-1250A / HD4 630-1250A / VM1 630-1250A / CONVAC
750	210	310	284	VD4 630-1250-1600-2000A / HD4 630-1250-1600-2000A / VM1 630-1250-1600-2000A
1000	275	310	284	VD4 2500-3150-3600-4000A / HD4 2500-3150-3600-4000A / VM1 2500A
17,5 kV / 31,5 kA				
A	B	C	D	Apparatus
600	150	205	264	VD4 630-1250A / HD4 630-1250A / VM1 630-1250A
750	210	310	284	VD4 630-1250-1600-2000A / HD4 630-1250-1600-2000A / VM1 630-1250-1600-2000A
1000	275	310	284	VD4 2500-3150-3600-4000A / HD4 2500-3150-3600-4000A / VM1 2500A
24 kV / 31,5 kA				
A	B	C	D	Apparatus
750	210	310	329	VD4 630-1250A / HD4 630-1250A / VM1 630-1250A ⁽¹⁾
1000	275	310	349	VD4 1600-2000-2500A / HD4 1600-200-2500A / VM1 1600-2000-2500A ⁽¹⁾
(1) VM1 25kA				
12 - 17,5 kV / 40 kA				
A	B	C	D	Apparatus
750	210	310	284	VD4 1250-1600-2000A / HD4 1250-1600-2000A
1000	275	310	284	VD4 2500-3150-3600-4000A / HD4 2500-3150-3600-4000A

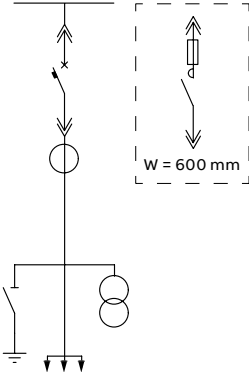
2. Typical conventional units

General notes

Each short size current transformer can be replaced by an ABB KEVCD sensor.
The earthing switch is an optional accessory.

2.1 Incoming-outgoing unit (IF)

2.1.1 Bottom cable entry

		12 - 17,5 kV			24 kV ⁽¹⁾		
	Width	mm	600 ⁽¹⁾	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	1550	1550	1550	1900	1900
	Rated current	A					
	630		•	• ⁽¹⁾	•		
	1250		•	•	•		
	1600			•		•	
	2000			•		•	
	2500				•	•	
	3150			• ⁽²⁾			
	3600			• ⁽²⁾			
	4000			• ⁽²⁾			
	Earthing switch		•	•	•	•	•
	Number of cables per phase	nr.	2	3	3	2	3
	Number of CT for phase (alternative combinations)						
	1 short size		•	•	• ^{(2) (3)}	•	•
	1 long size			•	• ^{(2) (3)}	•	•
	2 short size						
	1 short and 1 long size						
	Number of VT for phase (alternative combinations)						
	1 fixed		•	•			
	2 fixed						
	1 fixed with fuses						
	1 withdrawable with fuses						
	1 fixed and 1 withdrawable with fuses						

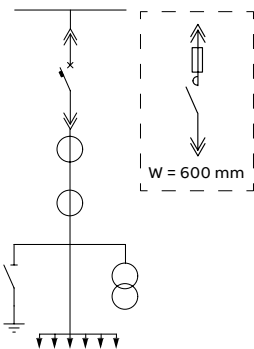
(1) ≤ 31.5 kA version

(2) Current transformers for range from 3150 A to 4000 A (KOKS type)

(3) Only for current range 2500 A

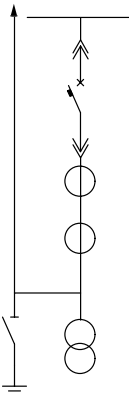
2. Typical conventional units

2.1.2 Bottom cable entry - deeper version

		12 - 17,5 kV			24 kV ⁽¹⁾	
	Width	mm	600 ⁽¹⁾	750	1000	
	Height	mm	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600
	Depth	mm	2000	2000	2000	2300
	Rated current	A				
	630		•			
	1250		•	•	•	
	1600			•		•
	2000			•		•
	2500				•	•
	3150					
	3600					
	4000					
	Earthing switch		•	•	•	•
	Number of cables per phase	nr.	4	4-6	4-6	4-7
	Number of CT for phase (alternative combinations)					
	1 short size		•	•	•	•
	1 long size		•	•	•	•
	2 short size		•	•	•	•
	1 short and 1 long size		•	•	•	•
	Number of VT for phase (alternative combinations)					
	1 fixed		•	•	•	•
	2 fixed		•	•	•	•
	1 fixed with fuses					
	1 withdrawable with fuses					
	1 fixed and 1 withdrawable with fuses					

(1) ≤ 31.5 kA version

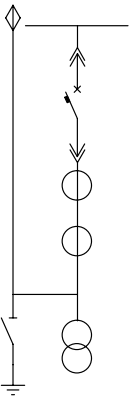
2.1.3 Top cable entry ⁽¹⁾ - deeper version

		12 - 17,5 kV			24 kV	
	Width	mm	600	750	1000	
	Height	mm	2700	2700	2700	2850
	Height with gas exhaust duct	mm	2700	2700	2700	2850
	Depth	mm	2235	2235	2235	2645
	Rated current	A				
	630					
	1250			•		
	1600			•		
	2000			•		
	2500				•	
	3150					
	3600					
	4000					
Earthing switch				•	•	
Number of cables per phase		nr.		4	4	
Number of CT for phase (alternative combinations)						
1 short size				•	•	
1 long size				•	•	
2 short size				•	•	
1 short and 1 long size				•	•	
Number of VT for phase (alternative combinations)						
1 fixed				•	•	
2 fixed				•	•	
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

(1) ≤ 31.5 kA version

2. Typical conventional units

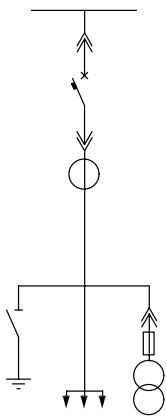
2.1.4 Top busbar entry⁽¹⁾ - deeper version

		12 - 17,5 kV			24 kV	
	Width	mm	600	750	1000	
	Height	mm	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600
	Depth	mm	2000	2000	2000	2300
	Rated current	A				
	630					
	1250			•		
	1600			•		
	2000			•		
	2500				•	
	3150					
	3600					
	4000					
Earthing switch				•	•	
Number of cables per phase		nr.				
Number of CT for phase (alternative combinations)						
1 short size				•	•	
1 long size				•	•	
2 short size				•	•	
1 short and 1 long size				•	•	
Number of VT for phase (alternative combinations)						
1 fixed				•	•	
2 fixed				•	•	
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

(1) ≤ 31.5 kA version

2.2 Incoming-outgoing unit with measurement (IFM)

2.2.1 Bottom cable entry

		12 - 17,5 kV			24 kV ⁽¹⁾	
	Width	mm	600 ⁽¹⁾	750	1000	
	Height	mm	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600
	Depth	mm	1550	1550	1550	2900
	Rated current	A				
	630		•	• ⁽¹⁾	•	
	1250		•	•	•	
	1600			•		•
	2000			•		•
	2500				•	•
	3150				• ⁽²⁾	
	3600				• ⁽²⁾	
	4000				• ⁽²⁾	
Earthing switch			•	•	•	•
Number of cables per phase		nr.	2	3	3	2
Number of CT for phase (alternative combinations)						
1 short size			•	•	• ^{(2) (3)}	•
1 long size			•	•	• ^{(2) (3)}	•
2 short size						
1 short and 1 long size						
Number of VT for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses			•	•	•	•
1 fixed and 1 withdrawable with fuses						

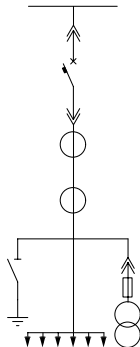
(1) ≤ 31.5 kA version

(2) Current transformers for range from 3150 A to 4000 A (KOKS type)

(3) Only for current 2500 A

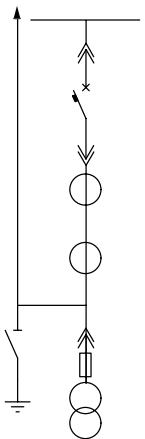
2. Typical conventional units

2.2.2 Bottom cable entry - deeper version

	12 - 17,5 kV				24 kV ⁽¹⁾		
	Width	mm	600 ⁽¹⁾	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	2000	2000	2000	2300	2300
	Rated current	A					
	630	•					
	1250	• •					
	1600	•					
	2000	•					
	2500	•					
	3150						
	3600						
4000							
Earthing switch		•	•	•	•	•	
Number of cables per phase	nr.	4	4-6	4-6	4-7	4-7	
Number of CT for phase (alternative combinations)							
1 short size		•	•	•	•	•	
1 long size		•	•	•	•	•	
2 short size		•	•	•	•	•	
1 short and 1 long size		•	•	•	•	•	
Number of VT for phase (alternative combinations)							
1 fixed							
2 fixed							
1 fixed with fuses							
1 withdrawable with fuses		•	•	•	•	•	
1 fixed and 1 withdrawable with fuses		•	•	•	•	•	
1 fixed with fuses and 1 withdrawable with fuses		•	•	•			

(1) ≤ 31.5 kA version

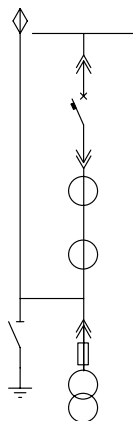
2.2.3 Top cable entry ⁽¹⁾ - deeper version

		12 - 17,5 kV			24 kV	
	Width	mm	600	750	1000	
	Height	mm	2700	2700	2700	2850
	Height with gas exhaust duct	mm	2700	2700	2700	2850
	Depth	mm	2235	2235	2235	2645
	Rated current	A				
	630					
	1250			•		
	1600			•		
	2000			•		
	2500				•	
	3150					
	3600					
	4000					
Earthing switch				•	•	
Number of cables per phase		nr.		4	4	
Number of CT for phase (alternative combinations)						
1 short size				•	•	
1 long size				•	•	
2 short size				•	•	
1 short and 1 long size				•	•	
Number of VT for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses				•	•	
1 fixed and 1 withdrawable with fuses				•	•	

(1) ≤ 31.5 kA version

2. Typical conventional units

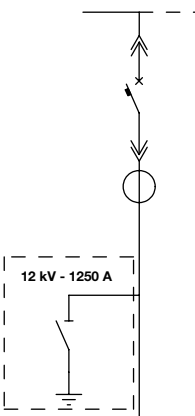
2.2.4 Top busbar entry⁽¹⁾ - deeper version

		12 - 17,5 kV			24 kV		
	Width	mm	600	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	2000	2000	2000	2300	2300
	Rated current	A					
	630						
	1250						
	1600						
	2000						
	2500						
	3150						
	3600						
	4000						
Earthing switch							
Number of cables per phase		nr.					
Number of CT for phase (alternative combinations)							
1 short size							
1 long size							
2 short size							
1 short and 1 long size							
Number of VT for phase (alternative combinations)							
1 fixed							
2 fixed							
1 fixed with fuses							
1 withdrawable with fuses							
1 fixed and 1 withdrawable with fuses							

(1) ≤ 31.5 kA version

2.3 Bus tie (BT)

2.3.1 Conventional

		12 - 17,5 kV			24 kV ⁽¹⁾		
	Width	mm	600 ⁽¹⁾	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	1550	1550	1550	1900	1900
	Rated current	A					
	630						
	1250		•	•		•	
	1600			•			•
	2000			•			•
	2500				•		•
	3150					• ⁽²⁾	
	3600					• ⁽²⁾	
	4000					• ⁽²⁾	
	Earthing switch			• ⁽⁴⁾	• ⁽⁴⁾		
	Number of cables per phase	nr.					
	Number of CT for phase (alternative combinations)						
	1 short size			•	•	• ^{(2) (3)}	•
1 long size				•	• ^{(2) (3)}	•	•
2 short size							
1 short and 1 long size							
Number of VT for phase (alternative combinations)							
1 fixed							
2 fixed							
1 fixed with fuses							
1 withdrawable with fuses							
1 fixed and 1 withdrawable with fuses							

(1) ≤ 31.5 kA version

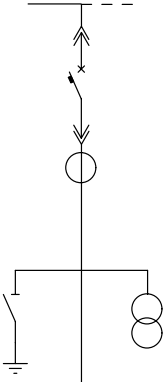
(2) Current transformers for range from 3150 A to 4000 A (KOKS type)

(3) Only for current 2500 A

(4) Only for 12 kV and 1250 A

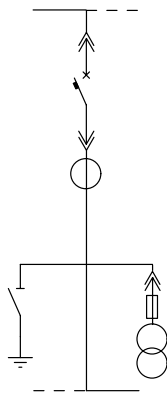
2. Typical conventional units

2.3.2 Deeper version

		12 - 17,5 kV			24 kV ⁽¹⁾	
	Width	mm	600 ⁽¹⁾	750	1000	
	Height	mm	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600
	Depth	mm	2000	2000	2000	2300
	Rated current	A				
	630					
	1250		•	•	•	
	1600			•		•
	2000			•		•
	2500				•	•
	3150					
	3600					
	4000					
Earthing switch			•	•	•	•
Number of cables per phase		nr.				
Number of CT for phase (alternative combinations)						
1 short size			•	•	•	•
1 long size			•	•	•	•
2 short size						
1 short and 1 long size						
Number of VT for phase (alternative combinations)						
1 fixed				•	•	•
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

(1) ≤ 31.5 kA version

2.4.1 Deeper version



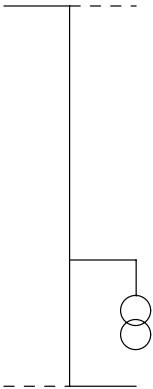
		12 - 17,5 kV			24 kV ⁽¹⁾	
Width	mm	600 ⁽¹⁾	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	2000	2000	2000	2300	2300
Rated current	A					
630						
1250		.	.		.	
1600			.			.
2000			.			.
2500				.		.
3150						
3600						
4000						
Earthing switch		.	.	.	.	.
Number of cables per phase	nr.					
Number of CT for phase (alternative combinations)						
1 short size		.	.	.	.	.
1 long size		.	.	.	.	.
2 short size						
1 short and 1 long size						
Number of VT for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses		.	.	.	.	.
1 fixed and 1 withdrawable with fuses						

(1) ≤ 31.5 kA version

2. Typical conventional units

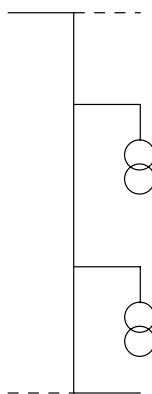
2.5 Bus riser (BR)

2.5.1 Conventional

		12 - 17,5 kV			24 kV ⁽¹⁾	
	Width	mm	600 ⁽¹⁾	750 ⁽¹⁾	1000	
	Height	mm	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600
	Depth	mm	1550	1550	1550	1900
	Rated current	A				
	630					
	1250		•	•	•	
	1600			•		•
	2000			•		•
	2500				•	•
	3150				•	
	3600				•	
	4000				•	
Earthing switch						
Number of cables per phase		nr.				
Number of CT for phase (alternative combinations)						
1 short size						
1 long size						
2 short size						
1 short and 1 long size						
Number of VT for phase (alternative combinations)						
1 fixed			•	•	•	•
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

(1) ≤ 31.5 kA version

2.5.2 Deeper version

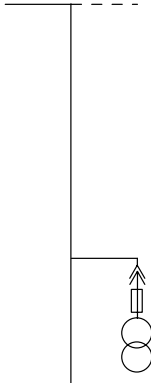
		12 - 17,5 kV			24 kV ⁽¹⁾				
	Width	mm	600	750	1000	750	1000		
	Height	mm	2160	2160	2160	2160	2160		
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600		
	Depth	mm	2000	2000	2000	2300	2300		
	Rated current	A							
	630								
	1250						•	•	
	1600						•	•	
	2000						•	•	
	2500						•	•	
	3150								
	3600								
	4000								
	Earthing switch								
	Number of cables per phase	nr.							
	Number of CT for phase (alternative combinations)								
	1 short size								
	1 long size								
	2 short size								
	1 short and 1 long size								
	Number of VT for phase (alternative combinations)								
	1 fixed						•	•	
	2 fixed						•	•	
	1 fixed with fuses								
	1 withdrawable with fuses								
	1 fixed and 1 withdrawable with fuses								

(1) ≤ 31.5 kA version

2. Typical conventional units

2.6 Bus riser with measurement (BRM)

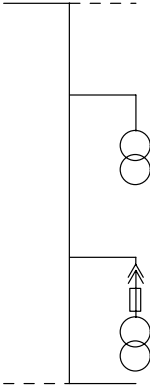
2.6.1 Conventional ⁽¹⁾

		12 - 17,5 kV			24 kV		
	Width	mm	600	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	1550	1550	1550	1900	1900
	Rated current	A					
	630						
	1250	•					•
	1600						
	2000						
	2500						
	3150						
	3600						
	4000						
Earthing switch							
Number of cables per phase		nr.					
Number of CT for phase (alternative combinations)							
1 short size							
1 long size							
2 short size							
1 short and 1 long size							
Number of VT for phase (alternative combinations)							
1 fixed							
2 fixed							
1 fixed with fuses							
1 withdrawable with fuses ⁽²⁾		•					
1 fixed and 1 withdrawable with fuses		•					

(1) ≤ 31.5 kA version

(2) Withdrawable VT in apparatus compartment

2.6.2 Deeper version

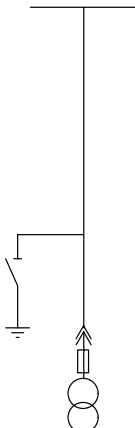
		12 - 17,5 kV			24 kV ⁽¹⁾				
	Width	mm	600	750	1000	750	1000		
	Height	mm	2160	2160	2160	2160	2160		
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600		
	Depth	mm	2000	2000	2000	2300	2300		
	Rated current	A							
	630								
	1250						•	•	
	1600						•	•	
	2000						•	•	
	2500						•	•	
	3150								
	3600								
	4000								
	Earthing switch								
	Number of cables per phase	nr.							
	Number of CT for phase (alternative combinations)								
	1 short size								
	1 long size								
	2 short size								
	1 short and 1 long size								
	Number of VT for phase (alternative combinations)								
	1 fixed								
	2 fixed								
	1 fixed with fuses								
	1 withdrawable with fuses						•	•	
	1 fixed and 1 withdrawable with fuses						•	•	

(1) ≤ 31.5 kA version

2. Typical conventional units

2.7 Measurement unit (M)

2.7.1 Conventional

		12 - 17,5 kV			24 kV ⁽¹⁾		
	Width	mm	600 ⁽¹⁾	750	1000	750	1000
	Height	mm	2160	2160	2160	2160	2160
	Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
	Depth	mm	1550	1550	1550	1900	1900
	Rated current ⁽³⁾	A					
	630						
	1250						
	1600						
	2000						
	2500						
	3150						
	3600						
	4000						
Earthing switch			•	•	•		
Number of cables per phase		nr.					
Number of CT for phase (alternative combinations)							
1 short size							
1 long size							
2 short size							
1 short and 1 long size							
Number of VT for phase (alternative combinations)							
1 fixed							
2 fixed							
1 fixed with fuses							
1 withdrawable with fuses ⁽²⁾			•	•	•		
1 fixed and 1 withdrawable with fuses							

(1) ≤ 31.5 kA version

(2) Withdrawable VT in apparatus compartment

(3) At 12-17,5kV, branches current value is 630A for main busbar current up to 1250A, 1250A for main busbar current from 1600A

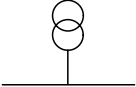
3. Busbar applications - Only TCA -

3.1 Current transformers⁽¹⁾ DIN type

	Width	mm	12 - 17,5 kV			24 kV	
			600	750	1000	750	1000
	Busbars rated current	A					
	1250			•			
	1600			•			
	2000			•			
	2500				•		
	3150						
	3600						
	4000						

(1) ≤ 31.5 kA version

3.2 Voltage transformers⁽¹⁾ DIN type

	Width	mm	12 - 17,5 kV			24 kV	
			600	750	1000	750	1000
	Busbars rated current	A					
	1250			•			
	1600			•			
	2000			•			
	2500				•		
	3150						
	3600						
	4000						

(1) ≤ 31.5 kA version

3.3 Incoming duct⁽¹⁾

	Width	mm	12 - 17,5 kV			24 kV	
			600	750	1000	750	1000
	Busbars rated current	A					
	1250			•			
	1600			•			
	2000			•			
	2500				•		
	3150						
	3600						
	4000						

(1) ≤ 31.5 kA version

4. General characteristics

4.1 IEC Reference Standards

AC metal-enclosed switchgear and controlgear	IEC 62271-200
Common specifications	IEC 62271-1
IEC 62271-200 Standard references of the tests the switchboard has been subjected to:	
Tests to verify the insulation level of the equipment	
Tests to prove the temperature rise of any part of the equipment and measurement of the resistance of circuits resistance	
Tests to prove the capability of the main and earthing circuits to be subjected to the rated peak and the rated short-time withstand currents	
Tests to prove the making and breaking capacity of the included switching devices	
Tests to prove the satisfactory operation of the included switching devices and removable parts	
Tests to verify the IP protection code	
Tests to verify auxiliary and control circuits	
Tests to assess the effects of arcing due to an internal arc fault (for switchgear and controlgear classification IAC)	
Circuit-breakers	IEC 62271-100
Contactors	IEC 62271-106
Fuses	IEC 282-1
SF ₆ gas	IEC 60376
Earthing switch	IEC 62271-102
Level of insulation (Co-ordination guide)	IEC 60071
Level of insulation (Values)	IEC 62271-1 Table 1a
Internal arc	IEC 62271-200
Degrees of protection	IEC 60529
Current transformers	IEC 61869-2
Voltage transformers	IEC 61869-3
Current sensors	IEC 60044-8
Voltage sensors	IEC 60044-7

4.2 Normal operation conditions

The rated characteristics of the switchgear are guaranteed under the following ambient conditions:

- minimum ambient temperature: – 5 °C
- maximum ambient temperature: + 40 °C

For different temperature ranges, please contact your ABB sales representative.

- Ambient humidity:
 - maximum 24 h average of relative humidity 95% RH
 - maximum 24 h average of water vapour pressure 2.2 kPa
 - maximum monthly average of relative humidity 90% RH
 - maximum monthly average of water vapour pressure 1.8 kPa

- The normal operational altitude is up to 1000 m above sea level. For higher altitude applications please contact your ABB sales representative.
- Presence of normal, non-corrosive and uncontaminated atmosphere.

4.3 Level of insulation

4.3.1 Reference Standard

IEC 62271-1 Table 1a.

4.3.2 Rated insulation levels for rated voltages of range

Rated voltage Ur kV (r.m.s. value)	Rated short-duration power- frequency withstand voltage Ud kV (r.m.s. value)	Rated lightning impulse withstand voltage Up kV (peak value)
	Common value	Common value
3.6	10	40
7.2	20	60
12	28	75
17.5	38	95
24	50	125

Voltage test at industrial frequency (installation altitude) $\geq$ Test voltage at industrial frequency (according to IEC 62271-1) $\times K_a$

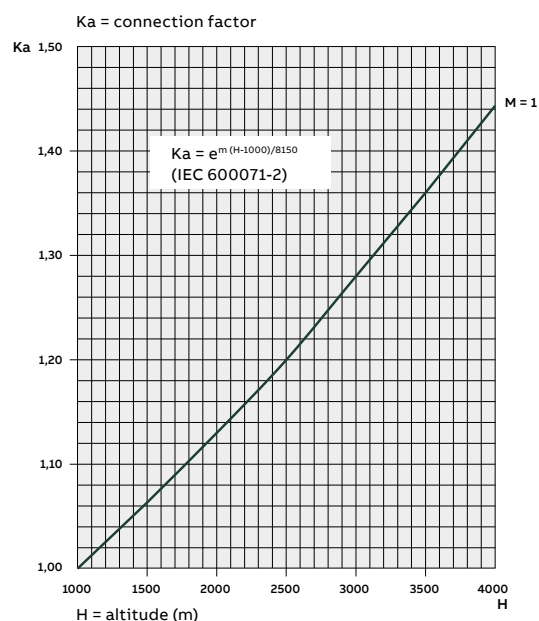
Impulse withstand voltage (installation altitude) $\geq$ Impulse withstand voltage (according to IEC 62271-1) $\times K_a$

The rated values are guaranteed at sea level and under normal atmospheric conditions (IEC 60071-2, pressure 1013 h Pa, temperature 20 °C, relative humidity 11 g/m³).

The degree of air insulation decreases progressively as the altitude increases; however, the rated values are guaranteed up to 1000 metres above sea level.

Above an altitude of 1000 m, a correction factor must be introduced which allows the required insulation levels to be guaranteed.

The graph aside shows the correction factors according to the altitude.



4.3.3 Example of calculation

The levels of insulation required are therefore guaranteed by the 17.5 kV (38 kV and 95 kV) switchboard.

Rated insulation voltage of the switchboard	12 kV
Test voltage at industrial frequency	28 kV
Impulse withstand voltage	75 kV
Altitude of the switchboard installation site	2000 meters
Corrective factor (K_a)	1.13
Test voltage at industrial frequency (altitude of installation)	28x1.13
Impulse withstand voltage (altitude of installation)	75x1.13
Test voltage at industrial frequency	31.6 kV
Impulse withstand voltage	84.7 kV

4. General characteristics

4.4 Degrees of protection

4.4.1 Reference Standard

IEC 60529.

4.4.2 Identification table

IP	Protection against foreign bodies	Protection against water
0	No protection	No protection
1	 Foreign bodies with diameter 50 mm or more	 Vertical rain
2	 Foreign bodies with diameter 12 mm or more	 Rain at 15°
3	 Foreign bodies with diameter 2.5 mm or more	 Rain at 60°
4	 Foreign bodies with diameter 1 mm or more	 Spray from all directions
5	 Deposit of dust	 Jets from all directions
6	 Entry of dust	 Flood
7	-	 Immersion of limited duration
8	-	 Immersion of indefinite duration

4.4.3 Degrees of protection

UniSafe 2.0 switchboards have the following standard degrees of protection:

- External housing IP4X
- Inside the compartments IP2X

4.5 Internal arc withstanding

4.5.1 Reference Standard

IEC 62271-200 Annex A.

Meaning of the criteria of the IEC 62271-200
Standard for carrying out the internal arc
withstand tests:

Criteria	Description
1	The switchgear doors must remain closed and there must be no opening of the covering sheets
2	No part of the switchgear which is a possible source of danger for personnel must become detached
3	No drilling holes on the external housing of the switchgear must be made in the parts accessible to personnel
4	The vertical and horizontal fabric indicators on the outside of the switchgear must not catch fire
5	All the switchgear earthing connections must remain efficient

4.5.2 Switchgear characteristics

The UniSafe 2.0 switchboard satisfies all the criteria from 1 to 5 for guaranteeing safety of the personnel in charge of the installation in the case of an internal arc.

4.5.3 Switchgear classification

UniSafe 2.0 is classified as IAC accessibility type A acc. to IEC 62271-200.

4.5.4 Installation of UniSafe 2.0 with gas ducts Introduction

The event of internal arc inside medium voltage switchgear occurs very rarely and generates overpressures inside the compartment affected by the arc, thereby causing exhaust of hot gases and material particles. This exhaust must be carefully checked in order to guarantee safety of people and avoid damage to the objects in the vicinity of the switchgear affected by the breakdown.

UniSafe 2.0 can be equipped with a metal sheet duct for collecting and exhausting the hot gases. This duct is mounted on the upper side of the switchgear and is normally extended on both the right and left extremities.

The minimum height of the switchgear room is 2,7 meters with standard duct and between 3,1 and 3,6 meters with top chimney. This solution is capable of guaranteeing safety of people standing in front of the switchgear, according to Annex A of the IEC 62271-200 Standard (criteria 1 to 5).



If the extremities of the gas duct are directed towards areas of the installation building that are accessible to personnel and/or dedicated to installation of other equipment, machines and plants, these extremities must be extended in order to permit the exhaust of the hot gases in zones that are not dangerous for people and machinery.



The extensions must be realized using metal sheet gas ducts with a cross section at least equal to the extended sections already applied to the switchgear. The extensions must be capable of withstanding a minimum pressure value of 80 kPa and must be properly supported. The presence of bends and curves in the ducts must be accepted only where strictly necessary: in this case, the bend must be realised with the maximum applicable bending radius.

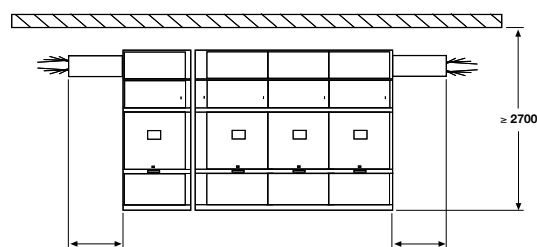
The solution recommended in order to avoid exhausting of gases and overpressures inside the switchgear installation room is to extend the exhaust duct outside the substation (from left and right sides or front and rear sides). In this case, pay attention to accessibility of people to the gas exhausting zone and protect the gas exhaust channel's extremity in order to avoid entry of water, dust, small animals and any foreign bodies.

4. General characteristics

4.5.5 Standard duct arrangement

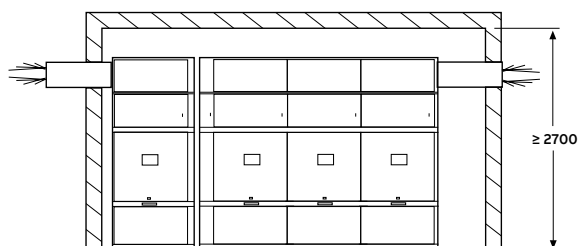
Evacuation from the room of the exhausted gas produced by the internal arc fault must normally be carried out. The following solutions can be used when it is possible to exhaust the gases outside the switchgear room:

Standard duct

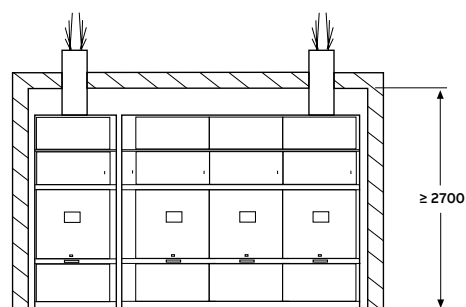


The following drawings illustrate some construction examples for exhaust gas evacuation from the room:

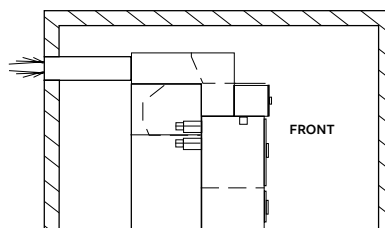
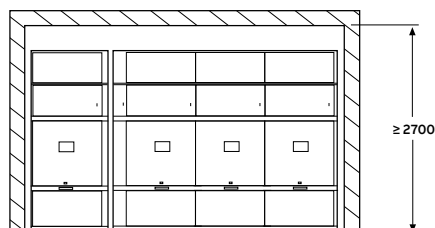
Example 1



Example 2



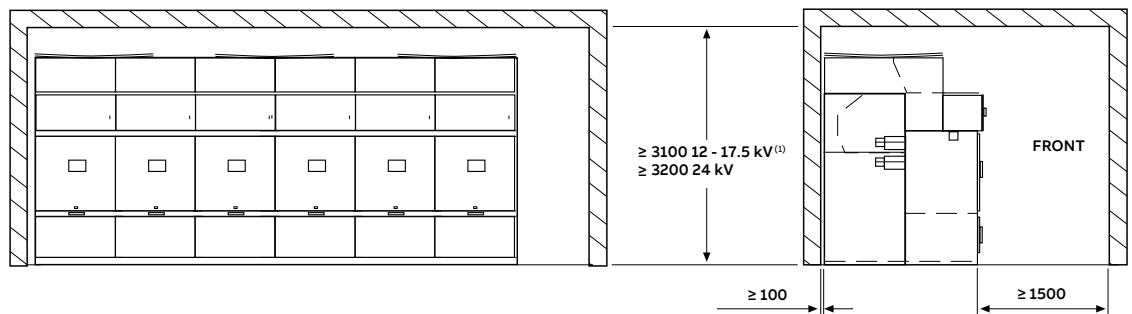
Example 3



4.5.6 Alternative solutions

Standard duct with top chimneys

The following solution can be used when it is not possible to exhaust the gases outside the switchgear room:



(1) at 40kA: h≥3600

Internal Arc Classified: general considerations



UniSafe 2.0 is a metal enclosed internal arc proof switchgear. It has been type tested according to IEC 62271-200 Standard, Annex A fulfilling criteria 1 to 5.

The tested switchgears were equipped with the standard exhaust gas duct, placed on the topside of the units. All the type test certificates refer to that configuration.

As far as the protection of personnel is concerned, the correct performance of the metal-enclosed switchgear in case of an internal arc is not only a matter of design of the equipment itself, but also of the installation conditions.

For indoor installations, arcing due to an internal fault in the metal enclosed switchgear may cause overpressure within the switchgear room; this effect should be taken into consideration when designing the installation at site.



When selecting a metal enclosed switchgear, the possibility of the occurrence of internal faults should be properly addressed, with the aim of providing an acceptable protection level for operators.

In the present document, ABB suggests how to install a Medium Voltage Switchgear into a switchgear room.

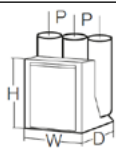
5. Apparatus



5.1 VD4 withdrawable circuit breaker for PowerCube type PB

5.1 Withdrawable circuit-breakers for PowerCube models (12 kV) ⁽⁵⁾

Circuit breaker	PowerCube module	VD4/P 12		VD4/W 12 ⁽⁶⁾			
		PB1		PB2			
Standard	IEC 62271-100	•		•			
Rated voltage	Ur [kV]	12 ⁽⁴⁾		12			
Rated insulation voltage	Us [kV]	12		12			
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28		28			
Impulse withstand voltage	Up [kV]	75		75			
Rated frequency	fr [Hz]	50-60		50-60			
Rated thermal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	630	1250	1250	1250
Rated breaking capacity (rated symmetrical short-circuit current)	Isc [kA]	16	16	16	16	-	-
		20	20	20	20	-	-
		25	25	25	25	-	-
		31.5	31.5	31.5	31.5	-	-
		-	-	-	-	40	-
		-	-	-	-	-	50
Admissible rated short-time withstand current (3s)	Ik [kA]	16	16	16	16	-	-
		20	20	20	20	-	-
		25	25	25	25	-	-
		31.5	31.5	31.5	31.5	-	-
		-	-	-	-	40	-
		-	-	-	-	-	50
Making capacity	Ip [kA]	40	40	40	40	-	-
		50	50	50	50	-	-
		63	63	63	63	-	-
		80	80	80	80	-	-
		-	-	-	-	100	-
		-	-	-	-	-	125
Operation sequence	[O-0.3 s-CO-15 s-CO]	•		•		•	
Opening time	[ms]	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75
Closing time	[ms]	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60
Maximum overall dimensions	H [mm]	628	628	691	691	691	691
	W [mm]	503	503	653	853	653	681
	D [mm]	662	662	642	642	641	643
	Pole center distance P [mm]	150	150	210	210	210	210
Weight	[kg]	116	116	135	135	174	180
Standardized dimensions table	TN	7412 ⁽³⁾	7412 ⁽³⁾	7420 ⁽³⁾	7420 ⁽³⁾	-	-
	1VCD	-	-	-	-	601243 ⁽³⁾	003444
Operating temperature	[°C]	-5 ... +40		-5 ... +40			
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•		•			
Electromagnetic compatibility	IEC 62271-1	•		•			



VD4/P 12					VD4/W 12				
PB2					PB3				
•					•				
12 ⁽⁴⁾					12 ⁽⁴⁾				
12					12				
28					28				
75					75				
50-60					50-60				
1600	1600	1600	2000	2000	2500	2500	3 150 ⁽²⁾	3 150 ⁽²⁾	
-	-	-	-	-	-	-	-	-	
20	-	-	20	-	20	-	20	-	
25	-	-	25	-	25	-	25	-	
31.5	-	-	31.5	-	31.5	-	31.5	-	
-	40	-	40	-	40	-	40	-	
-	-	50	-	50	-	50	-	50	
-	-	-	-	-	-	-	-	-	
20	-	-	20	-	20	-	20	-	
25	-	-	25	-	25	-	25	-	
31.5	-	-	31.5	-	31.5	-	31.5	-	
-	40	-	40	-	40	-	40	-	
-	-	50	-	50	-	50	-	50	
-	-	-	-	-	-	-	-	-	
50	-	-	50	-	50	-	50	-	
63	-	-	63	-	63	-	63	-	
80	-	-	80	-	80	-	80	-	
-	100	-	100	-	100	-	100	-	
-	-	125	-	125	-	125	-	125	
•					•				
33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	
10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	
43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	
30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	
691	691	691	690	691	691	691	730	691	
653	653	681	653	681	853	853	853	853	
642	641	643	642	643	640	643	640	643	
210	210	210	210	210	275	275	275	275	
160	174	180	160	190	186	225	221	240	
7415 ⁽³⁾	-	-	7415 ⁽³⁾	-	7417 ⁽³⁾	-	-	-	
-	003284 ⁽³⁾	003444	-	003444	-	003445	000152 ⁽³⁾	003596	
-5 ... +40					-5 ... +40		-5 ... +40		
•					•				
•					•				

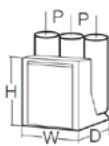
- (1) Rated current guaranteed with circuit breaker installed in PowerCube enclosure and with 40 °C ambient temperature
- (2) Up to 4000 A with forced ventilation.
- (3) Poles in polyamide
- (4) Available in 10 kV voltage version to GOST standards
- (5) On request, the closing spring can be loaded by means of a removable crank handle outside the operating mechanism (instead of linear loading, only possible with the door open, by means of a lever built into the front of the operating mechanism).
- (6) VD4/W does not need insulation for the feedthrough and tulip contacts in module PB2. On request, the same circuit breaker with insulated feedthrough and tulip contacts is available for installation in enclosures not produced by ABB (version VD4/PW)

5. Apparatus



5.1 Withdrawable circuit-breakers for PowerCube models (17.5 kV) ⁽⁴⁾

Circuit breaker	PowerCube module	VD4/P 17		VD4/W 17 ⁽⁵⁾			
		PB1		PB2			
Standard	IEC 62271-100	•		•			
Rated voltage	Ur [kV]	17.5		17.5			
Rated insulation voltage	Us [kV]	17.5		17.5			
Withstand voltage at 50 Hz	Ud (1 min) [kV]	38		38			
Impulse withstand voltage	Up [kV]	95		95			
Rated frequency	fr [Hz]	50-60		50-60			
Rated thermal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	630	1250	1250	1250
Rated breaking capacity (rated symmetrical short-circuit current)	Isc [kA]	16	16	16	16	-	-
		20	20	20	20	-	-
		25	25	25	25	-	-
		31.5	31.5	31.5	31.5	-	-
		-	-	-	-	40	-
		-	-	-	-	-	50
Admissible rated short-time withstand current (3s)	Ik [kA]	16	16	16	16	-	-
		20	20	20	20	-	-
		25	25	25	25	-	-
		31.5	31.5	31.5	31.5	-	-
		-	-	-	-	40	-
		-	-	-	-	-	50
Making capacity	Ip [kA]	40	40	40	40	-	-
		50	50	50	50	-	-
		63	63	63	63	-	-
		80	80	80	80	-	-
		-	-	-	-	100	-
		-	-	-	-	-	125
Operation sequence	[O-0.3 s-CO-15 s-CO]	•	•	•	•	•	•
Opening time	[ms]	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75
Closing time	[ms]	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60
Maximum overall dimensions	H [mm]	628	628	691	691	691	691
	W [mm]	503	503	653	653	653	681
	D [mm]	662	662	642	642	641	643
	Pole center distance P [mm]	150	150	210	210	210	210
Weight	[kg]	116	116	135	135	174	180
Standardized dimensions table	TN	7412 ⁽³⁾	7412 ⁽³⁾	7420 ⁽³⁾	7420 ⁽³⁾	-	-
	1VCD	-	-	-	-	601243 ⁽³⁾	003444
Operating temperature	[°C]	-5 ... +40		-5 ... +40			
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•		•			
Electromagnetic compatibility	IEC 62271-1	•		•			



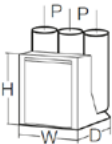
VD4/P 17					VD4/W 17				
PB2					PB3				
.	.	.	.	.	.	.	.	.	.
17.5					17.5			17.5	
17.5					17.5			17.5	
38					38			38	
95					95			95	
50-60					50-60			50-60	
1600	1600	1600	2000	2000	2500	2500	3 150 ⁽²⁾	3 150 ⁽²⁾	
-	-	-	-	-	-	-	-	-	
20	-	-	20	-	20	-	20	-	
25	-	-	25	-	25	-	25	-	
31.5	-	-	31.5	-	31.5	-	31.5	-	
-	40	-	40	-	40	-	40	-	
-	-	50	-	50	-	50	-	50	
-	-	-	-	-	-	-	-	-	
20	-	-	20	-	20	-	20	-	
25	-	-	25	-	25	-	25	-	
31.5	-	-	31.5	-	31.5	-	31.5	-	
-	40	-	40	-	40	-	40	-	
-	-	50	-	50	-	50	-	50	
-	-	-	-	-	-	-	-	-	
50	-	-	50	-	50	-	50	-	
63	-	-	63	-	63	-	63	-	
80	-	-	80	-	80	-	80	-	
-	100	-	100	-	100	-	100	-	
-	-	125	-	125	-	125	-	125	
.	.	.	.	.	.	.	.	.	.
33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60	
10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15	
43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75	
30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60	
691	691	691	690	691	691	691	730	691	
653	653	681	653	681	853	853	853	853	
642	641	643	642	643	640	643	640	643	
210	210	210	210	210	275	275	275	275	
160	174	180	160	190	186	225	221	240	
7415 ⁽³⁾	-	-	7415 ⁽³⁾	-	7417 ⁽³⁾	-	-	-	
-	003284 ⁽³⁾	003444	-	003444	-	003445	000152 ⁽³⁾	003596	
-5 ... +40					-5 ... +40		-5 ... +40		
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

- (1) Rated current guaranteed with circuit breaker installed in PowerCube enclosure and with 40 °C ambient temperature
- (2) Up to 4000 A with forced ventilation
- (3) Poles in polyamide
- (4) On request, the closing spring can be loaded by means of a removable crank handle outside the operating mechanism (instead of linear loading, only possible with the door open, by means of a lever built into the front of the operating mechanism)
- (5) VD4/W does not need insulation for the feedthrough and tulip contacts in module PB2. On request, the same circuit breaker with insulated feedthrough and tulip contacts is available for installation in enclosures not produced by ABB (version VD4/PW)

5. Apparatus



5.1 Withdrawable circuit-breakers for PowerCube models (24 kV) ⁽⁴⁾

Circuit breaker	PowerCube module	VD4/P 24				
		PB4		PB5		
Standard	IEC 62271-100	•		•		
Rated voltage	Ur [kV]	24		24		
Rated insulation voltage	Us [kV]	24		24		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	50		50		
Impulse withstand voltage	Up [kV]	125		125		
Rated frequency	fr [Hz]	50-60		50-60		
Rated thermal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	1600	2000	2500 ⁽²⁾
Rated breaking capacity (rated symmetrical short-circuit current)	Isc [kA]	16	16	16	16	16
		20	20	20	20	20
		25	25	25	25	25
		-	31.5	31.5	31.5	31.5
Admissible rated short-time withstand current (3s)	Ik [kA]	16	16	16	16	16
		20	20	20	20	20
		25	25	25	25	25
		-	31.5	31.5	31.5	31.5
Making capacity	Ip [kA]	40	40	40	40	40
		50	50	50	50	50
		63	63	63	63	63
		-	80	80	80	80
Operation sequence	[O-0.3 s-CO-15 s-CO]	•	•	•	•	•
Opening time	[ms]	33 ... 60	33 ... 60	33 ... 60	33 ... 60	33 ... 60
Arcing time	[ms]	10 ... 15	10 ... 15	10 ... 15	10 ... 15	10 ... 15
Total breaking time	[ms]	43 ... 75	43 ... 75	43 ... 75	43 ... 75	43 ... 75
Closing time	[ms]	30 ... 60	30 ... 60	30 ... 60	30 ... 60	30 ... 60
Maximum overall dimensions		H [mm]	794	794	838	838
		W [mm]	653	653	853	853
		D [mm]	802	802	790	790
		Pole center distance P [mm]	210	210	275	275
Weight	[kg]	140	140/146 ⁽³⁾	228	228	228
Standardized dimensions table	TN	7413	7413	7418	7418	7418
	1VCD	000173 ⁽³⁾	-	-	-	-
Operating temperature	[°C]	-5 ... +40				
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•				
Electromagnetic compatibility	IEC 62271-1	•				

(1) Rated current guaranteed with circuit breaker installed in PowerCube enclosure and with 40 °C ambient temperature

(2) 2300 A rated uninterrupted current guaranteed with natural ventilation; 2500 A rated uninterrupted current guaranteed with forced ventilation

(3) 31.5 kA version

(4) On request, the closing spring can be loaded by means of a removable crank handle outside the operating mechanism (instead of linear loading, only possible with the door open, by means of a lever built into the front of the operating mechanism)



5.2 HD4 withdrawable circuit breaker for PowerCube type PB

5.2 General characteristics of withdrawable circuit breakers for PowerCube units (12 kV)

Circuit breaker	PowerCube module	HD4/P 12		HD4/W 12				HD4/P 12				
		PB1	PB1	PB2	PB2	PB2	PB2	PB2	PB3	PB2	PB2	PB3
Standard	IEC 62271-100	•		•						•		
Rated voltage	Ur [kV]	12		12						12		
Rated insulation voltage	Us [kV]	12		12						12		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28		28						28		
Impulse withstand voltage	Up [kV]	75		75						75		
Rated frequency	fr [Hz]	50-60		50-60						50-60		
Rated normal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	630	1250	1250	1600	2000	3150 ⁽³⁾	1600	2000	2500
Rated breaking capacity	Isc [kA]	16	16	16	16	-	16	16	-	-	-	-
		25	25	25	25	-	25	25	-	-	-	25
		31.5	31.5	31.5	31.5	-	31.5	31.5	31.5	-	-	31.5
		-	-	-	-	40	-	-	40	40	40	40
		-	-	-	-	50	-	-	50	50	50	50
Rated short-time withstand current (3s)	Ik [kA]	16	16	16	16	-	16	16	-	-	-	-
		25	25	25	25	-	25	25	-	-	-	25
		31.5	31.5	31.5	31.5	-	31.5	31.5	31.5	-	-	31.5
		-	-	-	-	40	-	-	40	40	40	40
		-	-	-	-	50	-	-	50	50	50	50
Making capacity	Ip [kA]	40	40	40	40	-	40	40	-	-	-	-
		63	63	63	63	-	63	63	-	-	-	63
		80	80	80	80	-	80	80	80	-	-	80
		-	-	-	-	100	-	-	100	100	100	100
		-	-	-	-	125	-	-	125	125	125	125
Operation sequence	[O-0.3 s-CO-15 s-CO]	•		•						•		
Opening time	[ms]	35 ... 60		35 ... 60						35 ... 60		
Arcing time	[ms]	10 ... 15		10 ... 15						10 ... 15		
Total breaking time	[ms]	45 ... 75		45 ... 75						45 ... 75		
Closing time	[ms]	≤85		≤85						≤85		
Overall dimensions	H [mm]	633		702		702	702		742	702	702	702
	W [mm]	531		681		681	681		882	682	682	882
	D [mm]	661		640		640	640		643	640	640	643
	Pole center distance P [mm]	150		210		210	210		275	210	210	275
Weight	[kg]	120		120		177	177		230	177	177	220
Standardized table of dimensions	TN					7421	7239		7350	7351	7352	
	1VCD	000227		000228					000053			
Absolute SF ₆ gas pressure ⁽²⁾	[kPa]	380 (430 to 31.5 kA)				380				380		
Operating temperature	[°C]	-5 ... +40								-5 ... +40		
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•								•		
Electromagnetic compatibility	IEC 62271-1	•								•		

(1) Rated normal current with withdrawable circuit breaker in switchgear

(2) Rated service value

(3) There are higher currents with forced ventilation: 3600 A with a fan installed in the PB3 and 4000 A with a further fan in the rear of the switchgear (provided by the customer); see the PowerCube Instruction Manual

(4) 2500 A with forced ventilation

(5) 480 to 25 kA and 40 kA



5.2 General characteristics of withdrawable circuit breakers for PowerCube units (17.5 kV)

Circuit breaker	PowerCube module	HD4/P 17		HD4/W 17				HD4/P 17				
		PB1	PB1	PB2	PB2	PB2	PB2	PB2	PB3	PB2	PB2	PB3
Standard	IEC 62271-100	•		•						•		
Rated voltage	Ur [kV]	17.5		17.5						17.5		
Rated insulation voltage	Us [kV]	17.5		17.5						17.5		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	38		38						38		
Impulse withstand voltage	Up [kV]	95		95						95		
Rated frequency	fr [Hz]	50-60		50-60						50-60		
Rated normal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	630	1250	1250	1600	2000	3150 ⁽³⁾	1600	2000	2500
Rated breaking capacity	Isc [kA]	16	16	16	16	-	16	16	-	-	-	-
		25	25	25	25	-	25	25	-	-	-	25
		31.5	31.5	31.5	31.5	-	31.5	31.5	31.5	-	-	31.5
		-	-	-	-	40	-	-	40	40	40	40
		-	-	-	-	50	-	-	50	50	50	50
Rated short-time withstand current (3s)	Ik [kA]	16	16	16	16	-	16	16	-	-	-	-
		25	25	25	25	-	25	25	-	-	-	25
		31.5	31.5	31.5	31.5	-	31.5	31.5	31.5	-	-	31.5
		-	-	-	-	40	-	-	40	40	40	40
		-	-	-	-	50	-	-	50	50	50	50
Making capacity	Ip [kA]	40	40	40	40	-	40	40	-	-	-	-
		63	63	63	63	-	63	63	-	-	-	63
		80	80	80	80	-	80	80	80	-	-	80
		-	-	-	-	100	-	-	100	100	100	100
		-	-	-	-	125	-	-	125	125	125	125
Operation sequence	[O-0.3 s-CO-15 s-CO]	•		•						•		
Opening time	[ms]	35 ... 60		35 ... 60						35 ... 60		
Arcing time	[ms]	10 ... 15		10 ... 15						10 ... 15		
Total breaking time	[ms]	45 ... 75		45 ... 75						45 ... 75		
Closing time	[ms]	≤85		≤85						≤85		
Overall dimensions	H [mm]	633		702		702	702		742	702	702	702
	W [mm]	531		681		682	682		882	682	682	882
	D [mm]	661		640		640	640		643	640	640	643
	Pole center distance P [mm]	150		210		210	210		275	210	210	275
Weight	[kg]	120		120		177	177		230	177	177	220
Standardized table of dimensions	TN					7421	7239		7350	7351	7352	
	1VCD	000227		000228					000053			
Absolute SF ₆ gas pressure ⁽²⁾	[kPa]	380 (430 to 31.5 kA)				380				380		
Operating temperature	[°C]	-5 ... +40								-5 ... +40		
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•								•		
Electromagnetic compatibility	IEC 62271-1	•								•		

(1) Rated normal current with withdrawable circuit breaker in switchgear

(2) Rated service value

(3) There are higher currents with forced ventilation: 3600 A with a fan installed in the PB3 and 4000 A with a further fan in the rear of the switchgear (provided by the customer); see the PowerCube Instruction Manual

(4) 2500 A with forced ventilation

(5) 480 to 25 kA and 40 kA



5.2 General characteristics of withdrawable circuit breakers for PowerCube units (24 kV)

Circuit breaker	PowerCube module	HD4/P 24		HD4/P 24			
		PB4	PB4	PB4	PB5	PB5	PB5
Standard	IEC 62271-100	•		•	•		
Rated voltage	Ur [kV]	24		24	24		
Rated insulation voltage	Us [kV]	24		24	24		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	50		50	50		
Impulse withstand voltage	Up [kV]	125		125	125		
Rated frequency	fr [Hz]	50-60		50-60	50-60		
Rated normal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	1250	1600	2000	2500 ⁽⁴⁾
Rated breaking capacity	Isc [kA]	16	16	-	16	16	16
		20	20	-	20	20	20
		25	25	-	25	25	25
		-	-	31.5	31.5	31.5	31.5
		-	-	40	40	40	-40
Rated short-time withstand current (3s)	Ik [kA]	16	16	-	16	16	16
		20	20	-	20	20	20
		25	25	-	25	25	25
		-	-	31.5	31.5	31.5	31.5
		-	-	40	40	40	-40
Making capacity	Ip [kA]	40	40	-	40	40	40
		50	50	-	50	50	50
		63	63	-	63	63	63
		-	-	80	80	80	80
		-	-	100	100	100	100
Operation sequence	[O-0.3 s-CO-15 s-CO]	•	•		•		
Opening time	[ms]	35 ... 60		35 ... 60	35 ... 60		
Arcing time	[ms]	10 ... 15		10 ... 15	10 ... 15		
Total breaking time	[ms]	45 ... 75		45 ... 75	45 ... 75		
Closing time	[ms]	≤85		≤85	≤85		
Overall dimensions	H [mm]	792		792	821	821	
	W [mm]	682		641	842	842	
	D [mm]	799		799	788	788	
	Pole center distance P [mm]	210		210	275	275	
Weight	[kg]	125		177	177	220	
Standardized table of dimensions	TN				7355	7356	
	1VCD	000236		000099			
Absolute SF ₆ gas pressure ⁽²⁾	[kPa]	380		380	380 ⁽⁵⁾		
Operating temperature	[°C]	-5 ... +40		-5 ... +40	-5 ... +40		
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•		•	•		
Electromagnetic compatibility	IEC 62271-1	•		•	•		

(1) Rated normal current with withdrawable circuit breaker in switchgear

(2) Rated service value

(3) There are higher currents with forced ventilation: 3600 A with a fan installed in the PB3 and 4000 A with a further fan in the rear of the switchgear (provided by the customer); see the PowerCube Instruction Manual

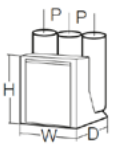
(4) 2500 A with forced ventilation

(5) 480 to 25 kA and 40 kA



5.3 VM1 withdrawable circuit breaker for PowerCube type PB

5.3 General characteristics of VM1 withdrawable circuit breakers for PowerCube modules (12 - 17.5 - 24 kV)

Circuit breaker	PowerCube module	VM1/P 12					VM1/P 17				
		PB1	PB1	PB2	PB2	PB3	PB1	PB1	PB2	PB2	PB3
Standard	IEC 62271-100	•					•				
	CEI 17-1 (File 1375)	•					•				
Rated voltage	Ur [kV]	12					17.5				
Rated insulation voltage	Us [kV]	12					17.5				
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28					38				
Impulse withstand voltage	Up [kV]	75					95				
Rated frequency	fr [Hz]	50-60					50-60				
Rated thermal current (40 °C) ⁽¹⁾	Ir [A]	630	1250	1600	2000	2500	630	1250	1600	2000	2500
Rated breaking capacity (rated symmetrical short-circuit current)	Isc [kA]	16	16	-	-	-	16	16	-	-	-
		20	20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
		-	-	-	-	-					
Rated short-time withstand current (3s)	Ik [kA]	16	16	-	-	-	16	16	-	-	-
		20	20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25	25
		31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
Making capacity	Ip [kA]	40	40	-	-	-	40	40	-	-	-
		50	50	50	50	50	50	50	50	50	50
		63	63	63	63	63	63	63	63	63	63
		80	80	80	80	80	80	80	80	80	80
Operation sequence	[O-0.3 s-CO-15 s-CO]	•					•				
Opening time	[ms]	35 ... 45					35 ... 45				
Arc time	[ms]	10 ... 15					10 ... 15				
Total interruption time	[ms]	45 ... 60					45 ... 60				
Closing time	[ms]	50 ... 60					50 ... 60				
Mechanical operations (cycles)	Actuator	... 100,000					... 100,000				
	Interrupters	... 30,000					... 30,000				
Electrical operations (cycles)	Rated current	... 30,000					... 30,000				
	Under short-circuit	... 50					... 50				
Maximum overall dimensions 	H [mm]	628	628	690	690	690	628	628	690	690	690
	W [mm]	503	503	653	653	683	503	503	653	653	853
	D [mm]	662	662	642	642	642	662	662	642	642	642
	Pole center distance I [mm]	150	150	210	210	275	150	150	210	210	275
Weight	≤25 kA [kg]	137	137	192	192	196	137	137	192	192	196
	≤31.5 kA [kg]	144	144	192	192	196	144	144	192	192	196
Standardized dimensions table	1VCD	00008	00008	00009	00009	00011	00008	00008	00009	00009	00011
Operating temperature	[°C]	-5 ... +40					-5 ... +40				
Tropicalization	IEC 60068-2-30, IEC 60721-2-1	•					•				
Electromagnetic compatibility	IEC 62271-1	•					•				

VM1/P 24					VM1/W 12 ⁽³⁾		VM1/W 17 ⁽³⁾	
PB4	PB4	PB5	PB5	PB5	PB2	PB2	PB2	PB2
•					•		•	
•					•		•	
24					12		17.5	
24					12		17.5	
50					28		38	
125					75		95	
50-60					50-60		50-60	
630	1250	1600	2000	2500	630	1250	630	1250
16	16	-	-	-	16	16	16	16
20	20	20	20	20	20	20	20	20
25	25	25	25	25	25	25	25	25
-	-	-	-	-	31.5	31.5	31.5	31.5
16	16	-	-	-	16	16	16	16
20	20	20	20	20	20	20	20	20
25	25	25	25	25	25	25	25	25
-	31.5	31.5	31.5	31.5	31.5	31.5	31.5	31.5
40	40	-	-	-	40	40	40	40
50	50	50	50	50	50	50	50	50
63	63	63	63	63	63	63	63	63
-	-	-	-	-	80	80	80	80
•					•		•	
35 ... 45					35 ... 45		35 ... 45	
10 ... 15					10 ... 15		10 ... 15	
45 ... 60					45 ... 60		45 ... 60	
50 ... 60					50 ... 60		50 ... 60	
... 100,000					... 100,000		... 100,000	
... 30,000					... 30,000		... 30,000	
... 30,000					... 30,000		... 30,000	
... 50					... 50		... 50	
790	790	834	834	834	632	632	632	632
653	653	853	853	853	503	503	503	503
802	802	790	790	790	664	664	664	664
210	210	275	275	275	210	210	210	210
148	148	255	255	255	141	141	141	141
-	-	-	-	-	148	148	148	148
00012	00012	00014	00014	00014	00074	00074	00074	00074
-5 ... +40					-5 ... +40			
•					•			
•					•			

- (1) Rated uninterrupted currents guaranteed with withdrawable circuit breaker installed in switchgear with 40 °C air temperature
- (2) The 2300 A rated uninterrupted current is guaranteed with natural ventilation. The 2500 A rated uninterrupted current is guaranteed with forced ventilation
- (3) The circuit breakers up to 17.5 kV - 1250 A – 31.5 kA, are made with polyamide poles

5. Apparatus



5.4 ConVac withdrawable contactor for PowerCube units type PB

5.4 Identification table

kV	I _{sc} (kA) ⁽¹⁾	I _{cw} (kA)	Rated current of contactors [A] (40 °C)						Contactor	PowerCube
			W=600 p=150 u/l=205 H=260 Ø=35	W=750 p=210 u/l=310 H=280 Ø=35	W=750 p=210 u/l=310 H=280 Ø=79	W=1000 p=275 u/l=310 H=280 Ø=109	W=750 p=210 u/l=310 H=325 Ø=35	W=1000 p=275 u/l=310 H=345 Ø=79		
12	16	6	400 ⁽²⁾						ConVac 12/P	PB1/M
	20	6	400 ⁽²⁾							PB1/F
	25	6	400 ⁽²⁾							
	31.5	6	400 ⁽²⁾							
7.2	16	6	400 ⁽²⁾						ConVac 7/P	PB1/M
	20	6	400 ⁽²⁾							PB1/F
	25	6	400 ⁽²⁾							
	31.5	6	400 ⁽²⁾							

W = Width of PowerCube Units type PB

P = Horizontal center distance between the circuit-breaker poles

U/L = Distance between the upper and lower terminals

H = Distance between the lower terminal and earth

Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB

(1) Guaranteed, using suitable fuses

(2) The rated current is liable to be derated depending on the rated current of the fuses

5.5 Trucks for VT measuring busbars - type TJP X.0-F

(to measure busbars. It is placed in breaker compartment for Measurement panels)

5.5 Identification table

kV	Isc/Icw (kA)	Dimensions	Truck type	PowerCube
12	16	W ^(*) =600mm	PTT1/W	PB1/TM
17.5	20	P=150mm		
	25	h=470mm		
	31.5			
	40	W ^(*) =750mm	PTT2/W	PB2/TM
		P=210mm		
		h=594mm		
24	16	W ^(*) =750mm	PTT4/W	PB4/TM
	20	P=210mm		
	25	h=639mm		
	31.5			

(*) of panel

5.6 Trucks for VT measuring cables - type TJP X.0-F

5.6 Identification table

kV	Isc/Icw (kA)	Dimensions	Truck type	PowerCube
12	16	W ^(*) =600mm	PTT1/WL	PB1/MWL
17.5	20	P=150mm		
	25	h=329mm		
	31.5			

(*) of panel

5.7 Cell for VT measuring cables - type TJP X.3

5.7 Identification table

kV	Isc/Icw (kA)	Dimensions	Cell type	PowerCube
12	16	W ^(*) =750mm, 1000mm	Type F	PB2/M
17.5	20	P=150mm		PB3/M
	25	h=453mm		
	31.5			
	40			
12	16	W ^(*) =750mm, 1000mm	Type F	PB2/RM
17.5	20	P=150mm		PB3/RM
(only for Riser panel)	25	h=453mm		
	31.5			
	40			
24	16	W ^(*) =750mm, 1000mm	Type W	PB4/M
	20	P=200mm		PB4/RM
	25	h=416mm		PB5/M
	31.5			PB5/RM

(*) of panel

5. Apparatus

5.8 PowerCube Units type PB without apparatus (PB/RM for BR, BR deeper, BRM deeper panel, PB/TM for BRM std depth panel)

5.8 Identification table

Characteristics of the enclosure/module				Configuration
Rated voltage (kV)	Width (mm)	Rated current (A)	Isc (kA) ⁽¹⁾	Icw (kA x 3s/1s) ⁽¹⁾
12 17.5	600 ⁽²⁾	1250	31.5	31.5
	750	2000	31.5	31.5
	750	2000	40	40
	1000	4000	31.5	31.5
	1000	4000	40	40
24	750	1250	31.5	31.5
	1000	2500	31.5	31.5

(1) On earthing switch, if requested

(2) VT cell F type not available

5.9 Value of the rated currents

Value of the rated currents according to different ambient temperature.

The values in the table are the maximum ones and may be lower under actual conditions.

Ambient temperature °C	IP4X							
	630	1250	1600	2000	2500	3150	3600	4000
40	630	1250	1600	2000	2500	3150	3600	4000
45	600	1100	1500	1900	2300	3000	3400	3800
50	500	1100	1400	1800	2200	2800	3200	3600
55	500	1000	1300	1700	2100	2700	3100	3400
60	500	1000	1300	1600	2000	2500	2900	3200
65	400	900	1200	1530	1900	2400	2700	3000

6. Measuring instruments

ABB offers wide range of conventional instrument transformers (IT) as well as Electronic instrument transformers, also known as sensors.

The portfolio of instrument transformers includes various types of products for medium voltage system and covers whole range of switchgear applications and many others applications.

IT are designed also in accordance to DIN standard thus fit into ABB portfolio as well as into OEM switchgear manufacturers products.

Our long experience gathered from our own development, production and testing of instrument transformers gives us the possibility to offer customer a broad range of products that fully complies with the various customer requirements.

The basic role of IT is to transform a voltage or a current from the high levels in electrical transmission and distribution systems to the low values that can be utilized by low voltage measuring and metering devices.

Typical output levels of instrument transformers are 1 or 5 amperes and $100/\sqrt{3}$ - $120/\sqrt{3}$, $100/3$ - $120/3$ and 100-120 volts. Transformers are of various types, which are divided by transformed physical values, design and use of the primary conductor.

There are two primary applications for which IT are used – metering and protection control.

Our whole portfolio meets global and local requirements, such as certification, which allows worldwide usage.

ABB IT are part of the switchgear during type testing, which means that use of genuine parts ensures the same results within any installation as well as during type tests.

Instrument transformers are part of the primary current conducting path, so we take very special care to every detail in their designs.

Thanks to this quality design and production it is possible to achieve higher temperatures during temperature rise tests.

Temperature rise test limit as per switchgear standard with ABB IT is 75 K instead of 50 K which could be with other IT manufacturer.

It's recommended to use original ABB IT not only for type testing, but also for all regular projects. Replacement of ABB IT to other brand may result in non-validity of switchgear Type tests!

Our offering includes also sensors as an alternative to a conventional inductive transformers technology.

The range of ABB sensors covers main ABB switchgear applications and brings new possibilities in a system solutions.



6. Measuring instruments

6.1 Accuracy classes

Accuracy class is a designation assigned to a transformer ratio error and phase displacement error, which remains within specified limits under prescribed conditions of use and according to the standard. Measuring classes are used for measuring and protection classes are used for protection purposes. It is possible to have measuring class or protection class in one core or combination of both.

Current transformers

FS (Security factor) is a CT parameter for metering purposes and it is defined as the ratio of limit primary current (beyond this current transformer's core becomes saturated) to the rated primary current.

Standard knows FS5 or FS10.

E.i.: FS5 at 5 times rated current the CT may be saturated at least 10%.

Measuring classes according to IEC 61869-2

Accuracy class	Ratio error [%] At current (% of rated)					Phase displacement [minutes] At current (% of rated)				
	1	5	20	100	120	1	5	20	100	120
0.2	–	0.75	0.35	0.2	0.2	–	30	15	10	10
0.5	–	1.5	0.75	0.5	0.5	–	90	45	30	30
1	–	3.0	1.5	1.0	1.0	–	180	90	60	60
0.2 s	0.75	0.35	0.2	0.2	0.2	30	15	10	10	10
0.5 s	1.5	0.75	0.5	0.5	0.5	90	40	30	30	30

Protection classes according to IEC 61869-2

Accuracy class	Ratio error [%] At current (% of rated)	Phase displacement [minutes] At current (% of rated)
	100	100
5P	1	60
10P	3	–

ALF (Accuracy limit factor) is a parameter of CT for protection purposes and it is defined as the ratio of accuracy limit current for which the error is guaranteed (less than 5 or 10% depending on whether 5P or 10P) to the rated primary current. E.i.: 5P10 at 10 times rated current has a maximum error of 5%, 1% at nominal current. 10P15 at 15 times rated current – max. error of 10%, 3% at nominal current.

Voltage transformers

Measuring classes according to IEC 61869-3

Accuracy class	Ratio error [%] At current (% of rated)	Phase displacement [minutes] At current (% of rated)
	100	100
0.2	0.2	10
0.5	0.5	20
1	1.0	40
3	3.0	–

Protection classes according to IEC 61869-3

Accuracy class	Ratio error [%] At current (% of rated)	Phase displacement [minutes] At current (% of rated)
	100	100
3P	3.0	120
6P	6.0	240

We can also produce CT with other accuracy classes, for example PX, TPS, TPX, TPY and TPZ.

The over voltage factor is the factor by which the rated primary voltage must be multiplied in order to determine the maximum voltage for which the transformer must attain the required levels of heating and accuracy.

ABB single pole VT are designed with standard over voltage factor $1.9 \times U_n / 8h$.

6.2 Advantages of ABB instrument transformers

Thanks to the use of the original ABB equipment and components, the excellent stability of the whole system is guaranteed.

Current transformers

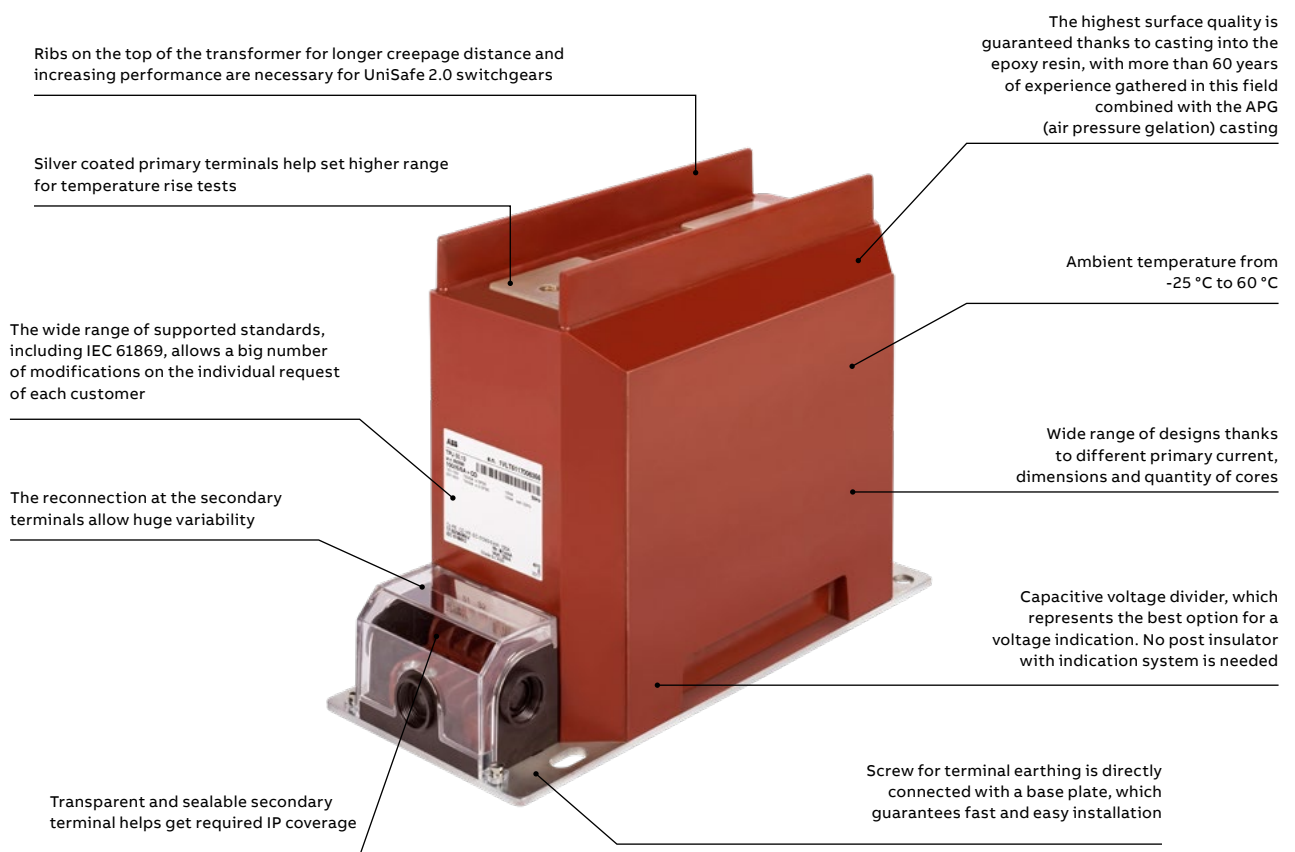


ABB current transformers fulfill insulation class E, which guarantees better performance during whole life cycle of switchgear as well as switchgears' temperature rise test in comparison to non-ABB products with insulation class B

6. Measuring instruments

Voltage transformers

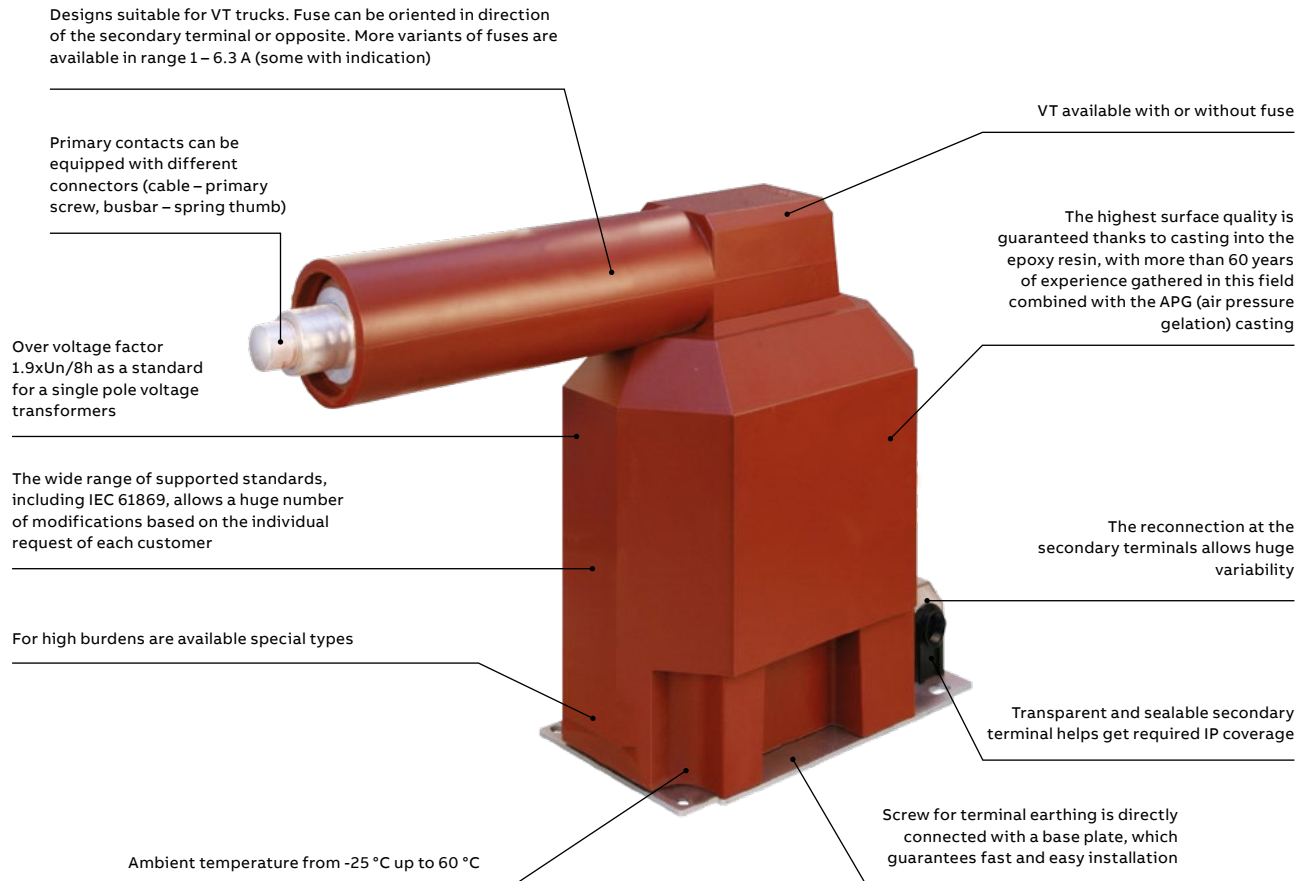


ABB voltage transformers fulfill insulation class E, which guarantees better performance during whole life cycle of switchgear as well as switchgears' temperature rise test in comparison to non-ABB products with insulation class B

6.3 ABB Current transformers (CT) portfolio

ABB offers wide range of current transformers of various types, such as support type (TPU), bus type (KOKS), bar primary type (TTR) or transformers installed around the cable (cable current transformers, see chapter 6.6).

ABB transformers can be installed in any position **with respect to UniSafe 2.0 drawings.**

This feature has been verified by seismic tests.

Above mentioned types represent only small fraction of ABB CT portfolio, for more information contact us or visit our webpages.

All our CT are type tested according to IEC 61869.



KOKS

The KOKS transformers are cast in epoxy resin.

These bus type current transformers are designed for measurement and protection purposes at an insulation level from 3.6 kV up to 17.5 kV and primary current up to 4000 A.

KOKS is without a primary conductor, but with primary insulation, which can be fitted directly over a conductor or a busbar.

Main characteristics

- For measuring and protection with up to 6 cores
- Secondary reconnectable
- Available in most electrical standard (IEC, GOST, AS, BS, ANSI, etc.)

Ratings

- Highest voltage for equipment: 3.6 kV – 17.5 kV
- Primary current: 3 150 – 4 000 A
- Rated short-time thermal current: up to 40 kA/ 3 s and 50 kA/1 s

The individual types

Type	Voltage	Length
KOKS 12A31	Up to 12 kV	Short 260 mm
KOKS 12A41	Up to 12 kV	Long 310 mm
KOKS 17.5A31	Up to 17.5 kV	Short 260 mm
KOKS 17.5A41	Up to 17.5 kV	Long 310 mm

6. Measuring instruments

For TPU dimensional drawings see chapter 6.3.1 Dimensional drawings of Current transformers

TPU

The TPU transformers are cast in epoxy resin and equipped with the ribs on the top. The ABB portfolio contains version without ribs too, but in UniSafe 2.0 must be used only version **with ribs**. Wide range of ABB TPU types fit to many various applications for measurement and protection purposes at an insulation level from 3.6 kV up to 25 kV and primary currents up to 2500 A. Transformers are designed as a support for the conductors and are suitable for the Switchgear portfolio, OEM partners and many other installations.

Main characteristics

- For measuring and protection with up to 5 cores (depending on parameters and configuration)
- Secondary reconnectable
- Capacitive divider build in TPU transformers helps indicate presence of voltage
- Available in most electrical standard (IEC, GOST, AS, BS, ANSI, etc.)
- Transparent and sealable sec. terminal cover
- DIN dimension according to 42600 part 8 is available

Ratings

- Highest voltage for equipment: 3.6 kV – 25 kV
- Primary current: 10 – 2500 A
- Rated short-time thermal current: up to 40 kA/3 s and 50 kA/1 s

The individual types

Type	Voltage
TPU 4X.XX	up to 12 kV
TPU 5X.XX	up to 17.5 kV
TPU 6X.XX	up to 25 kV

Torque moments

Type	Max	Min
M5	3.5 Nm	2.8 Nm
M8	20 Nm	16 Nm
M12	70 Nm	56 Nm



CAUTION!

Never leave the secondary circuit of the current transformer open with the primary terminals energized. High voltages could be produced in the secondary circuit causing damage to people or to the transformer itself



Numbering system of TPU

Each instrument transformer, especially TPU type, has its own unique code that defines its parameters and helps to identify what dimension type it is.

The table below describes this numbering system for the TPU type and illustrates the number of configurations for the individual instrument transformers, e.g. TPU 43.23, TPU 50.13, TPU 64.23.

TPU XX.XX			
Voltage	Current	Dimension	Ribs
4...up to 12 kV	0...up to 600 A	1...short 148 mm DIN	3...with ribs
5...up to 17.5 kV	3...up to 1250 A	2...long 148 mm DIN	
6...up to 24 kV	4...up to 1500 A	3...short, wide 184 mm ^(*)	
	5...up to 2000 A	4...long, wide 184 mm ^(*)	
	6...up to 2500 A	5...middle, 148 mm DIN ^(*)	

(*) For a transformer TPU 6 (up to 24 kV) at dimension position is only available choice 1 or 2 at third column (TPU 6X.13 or 6X.23)



CAUTION!

For 60 Hz and I_{pn} above 600 A, the primary winding of TPU must have a particular primary winding to comply with Unisafe 2.0 switchgear type test

Selection table

12-17.5 kV (TPU 4X.XX = 12 kV, TPU 5X.XX = 17.5 kV)				
Type of transformer (see drawings)	In [A]	Switchboard [mm]		
		600	750	1000
Short types				
TPU 40.13, TPU 43.13, TPU 50.13, TPU 53.13	≤1250	•	•	
TPU 40.53, TPU 43.53, TPU 50.53, TPU 53.53	≤1250	•	•	
TPU 40.33, TPU 43.33, TPU 50.33, TPU 53.33	≤1250		•	
TPU 44.13, TPU 45.13, TPU 54.13, TPU 55.13	≤2000		•	
TPU 44.33, TPU 45.33, TPU 54.33, TPU 55.33	≤2000		•	
TPU 46.13, TPU 56.13	≤2500			•
TPU 46.33, TPU 56.33	≤2500			•
KOKS 12A31, KOKS 17.5A31	≥3150 ≤4000			•
Long types				
TPU 40.23, TPU 43.23, TPU 50.23, TPU 53.23	≤1250	•	•	
TPU 40.43, TPU 43.43, TPU 50.43, TPU 53.43	≤1250		•	
TPU 44.23, TPU 45.23, TPU 54.23, TPU 55.23	≤2000		•	
TPU 44.43, TPU 45.43, TPU 54.43, TPU 55.43	≤2000		•	
TPU 46.23, TPU 56.23	≤2500			•
TPU 46.43, TPU 56.43	≤2500			•
KOKS 12A41, KOKS 17.5A41	≥3150 ≤4000			•
24 kV (TPU 6X.XX = 24 kV)				
Type of transformer (see drawings)	In [A]	Switchboard [mm]		
			750	1000
Short types				
TPU 60.13, TPU 63.13	≤1250		•	
TPU 64.13, TPU 65.13	≤2000		•	
TPU 66.13	≤2500			•
Long types				
TPU 60.23, TPU 63.23	≤1250		•	
TPU 64.23, TPU 65.23	≤2000		•	
TPU 66.23	≤2500			•

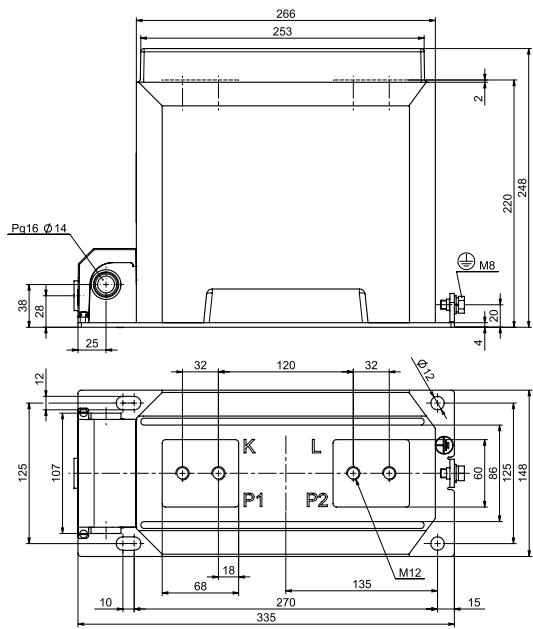
6. Measuring instruments

6.3.1 Dimensional drawings of the current transformers

12-17.5 kV Short types

TPU 40.13, TPU 43.13, TPU 50.13, TPU 53.13

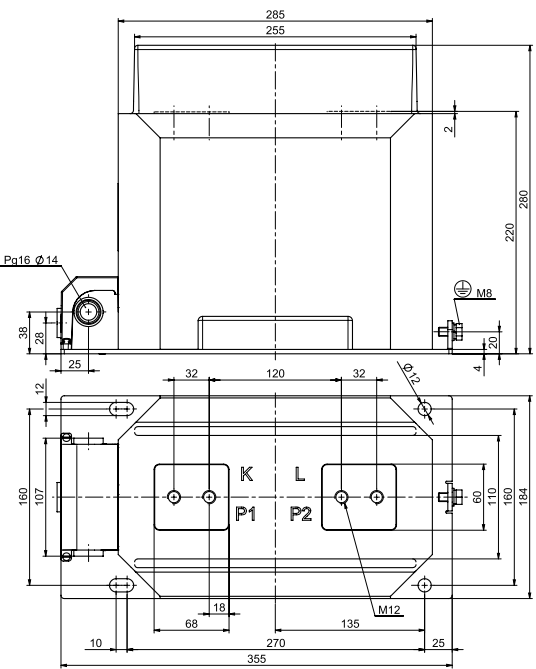
- Weight: 20-24 kg
- Creepage distance: 214 mm



Drawing number		Polarity
TPU 4	TPU 5	
44614040	44614590	P1 to secondary terminal
44614050	44614600	P2 to secondary terminal

TPU 40.33, TPU 43.33, TPU 50.33, TPU 53.33

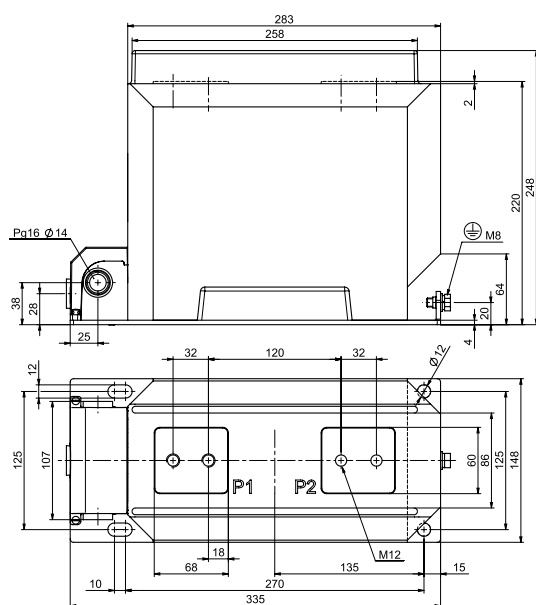
- Weight: 31-39 kg
- Creepage distance: 215 mm



Drawing number		Polarity
TPU 4	TPU 5	
44614180	44614730	P1 to secondary terminal
44614190	44614740	P2 to secondary terminal

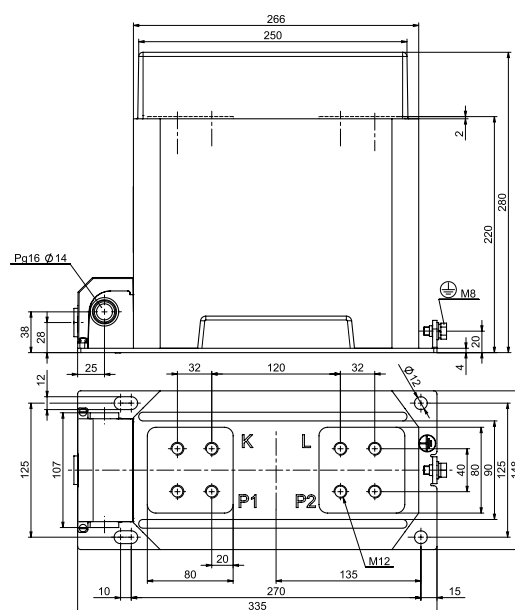
TPU 40.53, TPU 43.53, TPU 50.53, TPU 53.53

- Weight: 28 kg
- Creepage distance: 214 mm



TPU 44.13, TPU 45.13, TPU 46.13,
TPU 54.13, TPU 55.13, TPU 56.13

- Weight: 25-31 kg
- Creepage distance: 201 mm

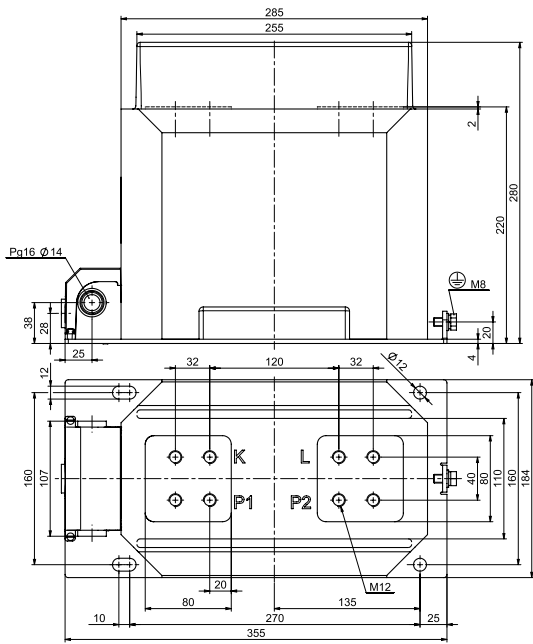


Drawing number		Polarity
TPU 4	TPU 5	
1VL4600921R0101	1VL4600921R0201	P1 to secondary terminal
1VL4600921R0102	1VL4600921R0202	P2 to secondary terminal

Drawing number		Polarity
TPU 4	TPU 5	
44614260	1VL4600500P0101	P1 to secondary terminal
44614270	1VL4600500P0102	P2 to secondary terminal

6. Measuring instruments

- TPU 44.33, TPU 45.33, TPU 46.33,
TPU 54.33, TPU 55.33, TPU 56.33
- Weight: 34-42 kg
 - Creepage distance: 210 mm

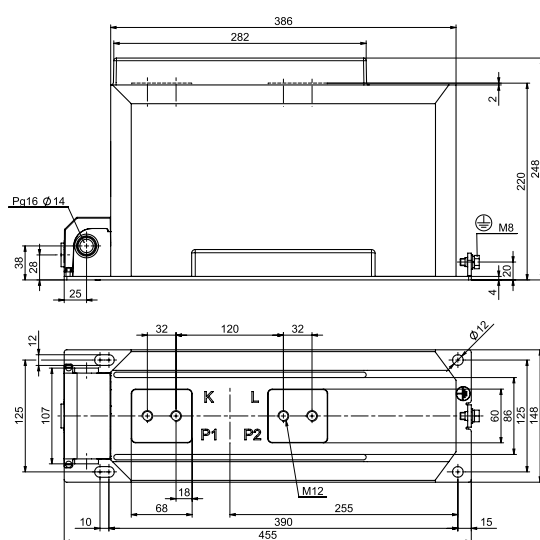


Drawing number		Polarity
TPU 4	TPU 5	
44614340	44614810	P1 to secondary terminal
44614350	44614820	P2 to secondary terminal

12-17.5 kV Long types

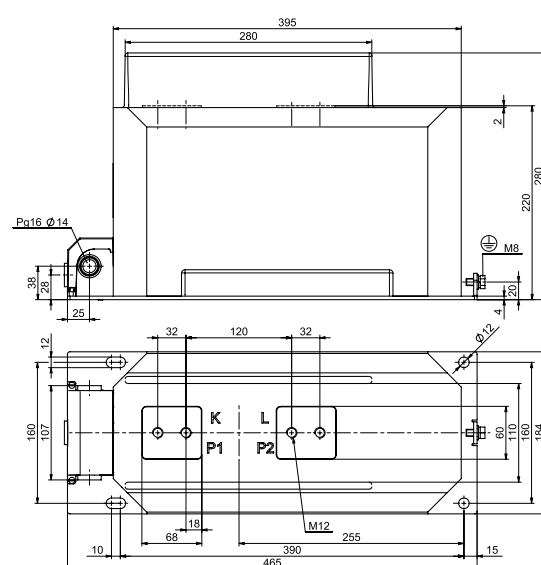
TPU 40.23, TPU 43.23, TPU 50.23, TPU 53.23

- Weight: 29-37 kg
- Creepage distance: 214 mm



TPU 40.43, TPU 43.43, TPU 50.43, TPU 53.43

- Weight: 45-55 kg
- Creepage distance: 215 mm

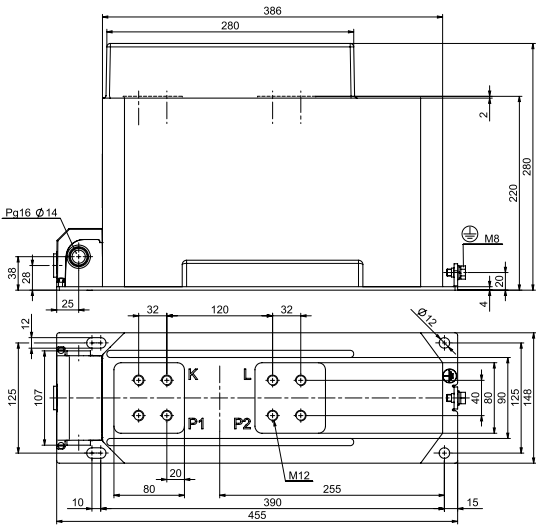


Drawing number		Polarity
TPU 4	TPU 5	
44614120	44614670	P1 to secondary terminal
44614130	44614680	P2 to secondary terminal

Drawing number		Polarity
TPU 4	TPU 5	
44614220	44614770	P1 to secondary terminal
44614230	44614780	P2 to secondary terminal

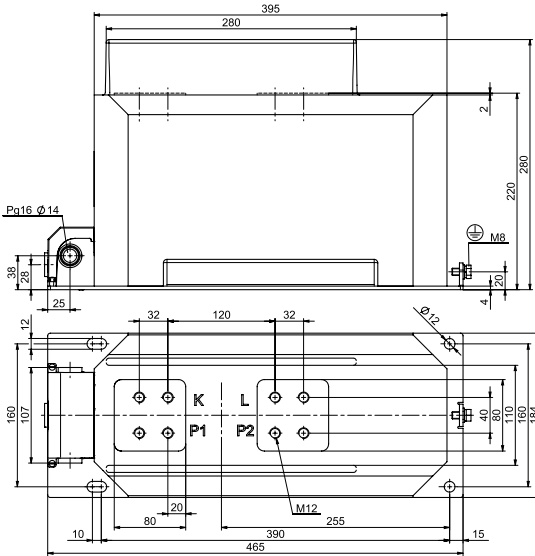
6. Measuring instruments

- TPU 44.23, TPU 45.23, TPU 46.23,
TPU 54.23, TPU 55.23, TPU 56.23
- Weight: 40-45 kg
 - Creepage distance: 201 mm



Drawing number		Polarity
TPU 4	TPU 5	
44614300	1VL4600502P0101	P1 to secondary terminal
44614310	1VL4600502P0102	P2 to secondary terminal

- TPU 44.43, TPU 45.43, TPU 46.43,
TPU 54.43, TPU 55.43, TPU 56.43
- Weight: 46-58 kg
 - Creepage distance: 210 mm

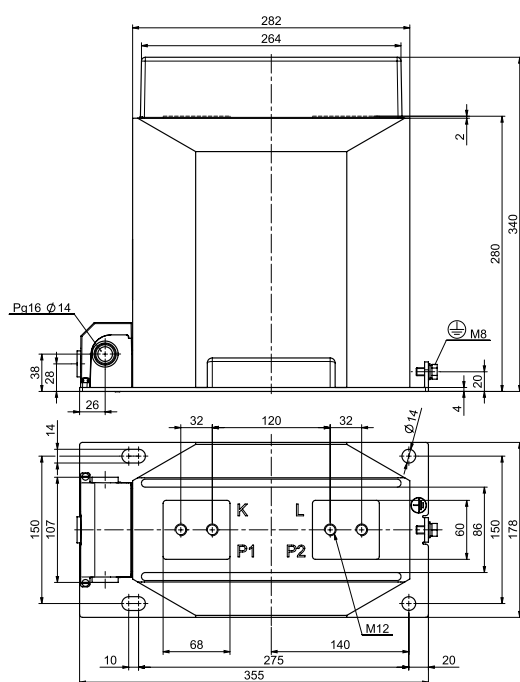


Drawing number		Polarity
TPU 4	TPU 5	
44614380	44614850	P1 to secondary terminal
44614390	44614860	P2 to secondary terminal

24 kV Short types

TPU 60.13, TPU 63.13

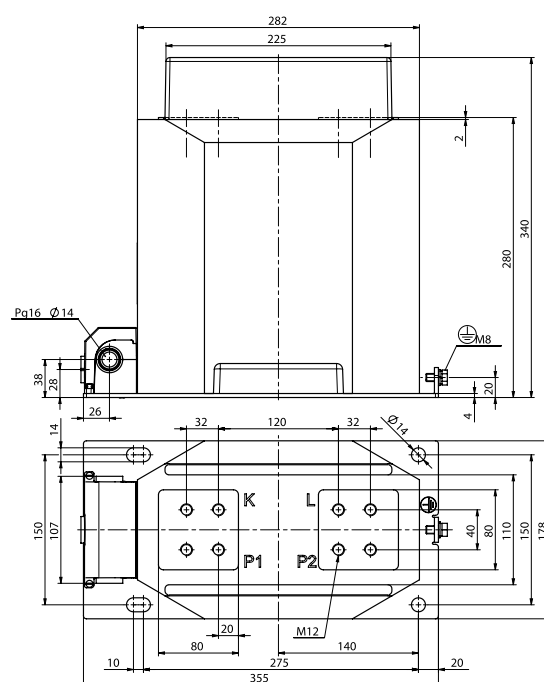
- Weight: 31-35 kg
- Creepage distance: 280 mm



Drawing number	Polarity
TPU 6	
44615040	P1 to secondary terminal
44615050	P2 to secondary terminal

TPU 64.13, TPU 65.13, TPU 66.13

- Weight: 36-41 kg
- Creepage distance: 270 mm



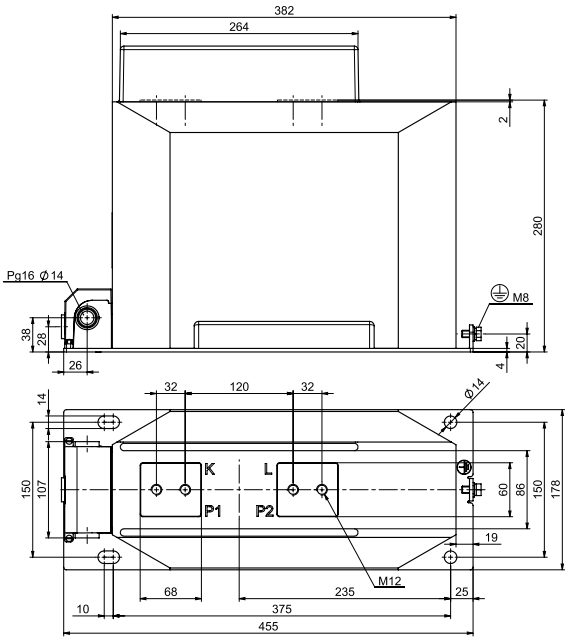
Drawing number	Polarity
TPU 6	
44615180	P1 to secondary terminal
44615190	P2 to secondary terminal

6. Measuring instruments

24 kV Long types

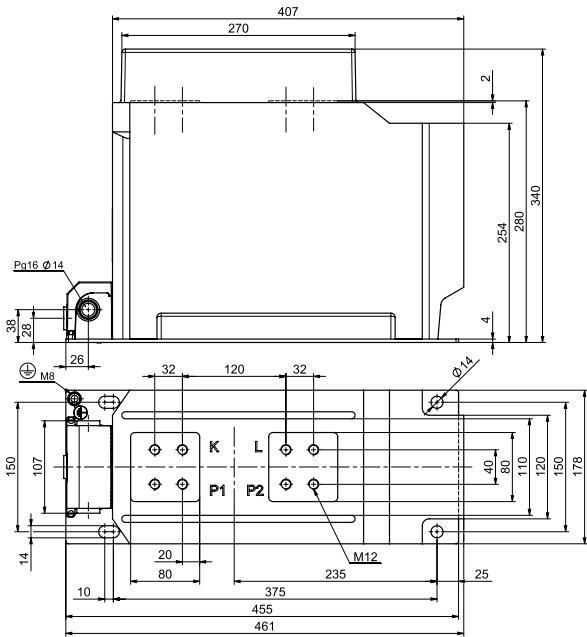
TPU 60.23, TPU 63.23

- Weight: 43-49 kg
- Creepage distance: 280 mm



TPU 64.23, TPU 65.23, TPU 66.23

- Weight: 50-57 kg
- Creepage distance: 272 mm



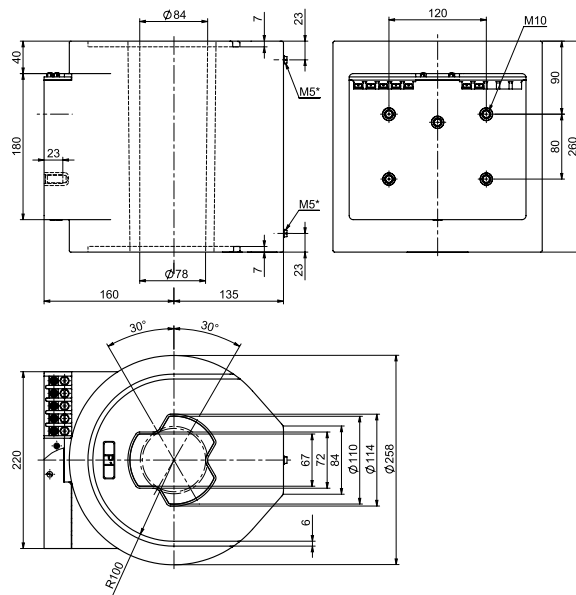
Drawing number	Polarity
TPU 6	
44615120	P1 to secondary terminal
44615130	P2 to secondary terminal

Drawing number	Polarity
TPU 6	
44615220	P1 to secondary terminal
44615230	P2 to secondary terminal

12-17.5 kV Bus types

KOKS 12A31, KOKS 17.5A31

- Weight: 35 kg

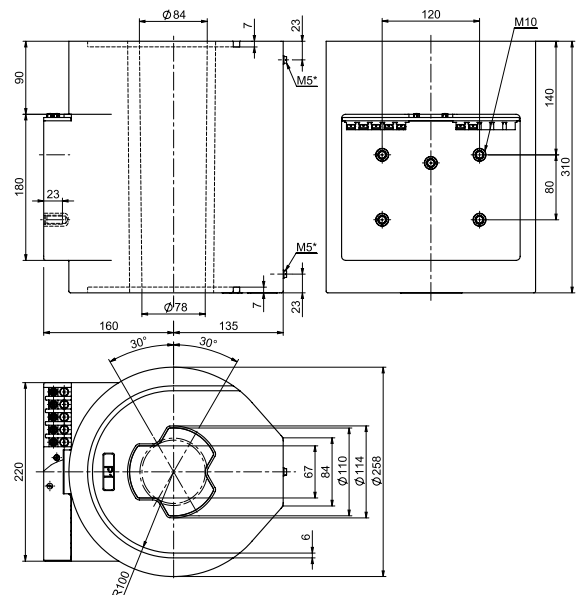


* M5 TERMINAL MUST BE CONNECTED TO THE PRIMARY BAR

Drawing number	Polarity
44402520	P1 to secondary terminal
44402530	P2 to secondary terminal

KOKS 12A41, KOKS 17.5A41

- Weight: 42 kg



* M5 TERMINAL MUST BE CONNECTED TO THE PRIMARY BAR

Drawing number	Polarity
44402540	P1 to secondary terminal
44402550	P2 to secondary terminal

6. Measuring instruments

6.4 ABB Voltage transformers (VT) portfolio

Voltage transformers are divided into version without fuses (TJC, TDC) and with fuses (TJP). The fuse is installed in the transformer body and its rated current is from 1 A to 6.3 A. The transformers can be mounted and installed in any position **with respect to UniSafe 2.0 drawings**.

This feature has been verified by seismic tests. These mentioned types represent only small fraction of ABB portfolio, for more information contact us or visit our webpages. All our VT are type tested according to IEC 61869. For protection of single pole VT (with open delta winding) against ferroresonance oscillation we recommend to use **VT Guard Pro**, see the chapter 6.5.

TJC, TJCH

The TJC and TJCH single-pole insulated voltage transformers are cast in epoxy resin and designed mostly for insulation voltages from 3.6 kV up to 25 kV. If no other value is required, transformers are manufactured with an overvoltage factor $1.9 \times U_n / 8h$. TJC and TJCH is suitable for the Switchgear portfolio, OEM partners and many others. The TJCH types are suitable for bigger burdens.

Main characteristics

- For measuring and protection with up to 3 secondary windings
- Reconnectable version available
- Available in most electrical standard (IEC, GOST, AS, BS, ANSI, etc.)
- Transparent secondary terminal cover
- Sealable secondary terminal cover
- DIN dimension according to 42600 part 9 is available.

Ratings

- Highest voltage for equipment: 3.6 kV – 25 kV
- Primary voltage: up to 25 / $\sqrt{3}$ kV
- Secondary voltage: 100 / $\sqrt{3}$ – 120 / $\sqrt{3}$, 100 / 3 – 120 / 3 V
- Frequency: 50 or 60 Hz



The individual types

Type	Voltage	Max. rated burden [VA]/class (star or star/open delta)
TJC 4	Up to 12 kV	25 / 0.2 – 75 / 0.5 – 150 / 1
TJCH 4	Up to 12 kV	30 / 0.2 – 100 / 0.5 – 200 / 1
TJC 5	Up to 17.5 kV	25 / 0.2 – 75 / 0.5 – 150 / 1
TJCH 5	Up to 17.5 kV	30 / 0.2 – 100 / 0.5 – 200 / 1
TJC 6	Up to 25 kV	50 / 0.2 – 150 / 0.5 – 200 / 1



CAUTION!

Never short-circuit the secondary of the voltage transformer with the primary circuit energized to avoid it being damaged within a few seconds.

Maximum allowed torque for primary screw connection of voltage transformer is 20 Nm.

TJP

Single phase voltage transformer which is intended to have one end of its primary winding directly earthed.

TJP transformer is equipped with fuse connected to primary winding. These epoxy insulated voltage transformers are cast in epoxy resin and designed mostly for insulation voltages from 3.6 kV up to 25 kV.

Voltage transformers TJP can be supplied with or without fuse, it is depending on customer requirement.

Main characteristics

- For measuring and protection with up to 3 secondary windings
- Fuses available from 1 A up to 6.3 A
- Available in most electrical standard (IEC, GOST, AS, BS, ANSI, etc.)
- DIN dimensions according to standard 42600 part 9 is available
- Various primary contacts available (spring thumb or screw for cable connection)
- Optional transparent secondary terminal cover
- Sealable secondary terminal cover based on type.

Ratings

- Highest voltage for equipment: 3.6 kV – 25 kV
- Primary voltage: up to 25 / $\sqrt{3}$ kV
- Secondary voltage: 100 / $\sqrt{3}$ – 120 / $\sqrt{3}$, 100 / 3 – 120 / 3 V
- Frequency: 50 or 60 Hz



The individual types

Type	Voltage	Max. rated burden [VA]/class (star or star/open delta)
TJP 4.0-F ⁽¹⁾ , TJP 4.3 ⁽²⁾	Up to 12 kV	25 / 0.2 – 75 / 0.5 – 150 / 1
TJP 5.0-F ⁽¹⁾ , TJP 5.3 ⁽²⁾	Up to 17.5 kV	25 / 0.2 – 75 / 0.5 – 150 / 1
TJP 6.0 ⁽¹⁾ , TJP 6.3 ⁽²⁾	Up to 25 kV	50 / 0.2 – 150 / 0.5 – 200 / 1

(1) TJP 4.0-F and TJP 5.0-F types are with detachable fuse holder. The position of a fuse holder must be specified. Exists two variants: in the direction of the secondary terminal or opposite direction

(2) TJP 4.3, TJP 5.3 and TJP 6.3 - secondary windings are lead out into a cast secondary terminal board orientated on the bottom side (see the drawings on page 68)

TJP selection table

Type	Installation location
TJP 4.3, TJP 5.3, TJP 6.3	Withdrawable voltage VT compartment
TJP 4.0-F ⁽³⁾ , TJP 5.0-F ⁽³⁾ , TJP 6.0	PTT/W VT trucks (used with PB/T measuring units)

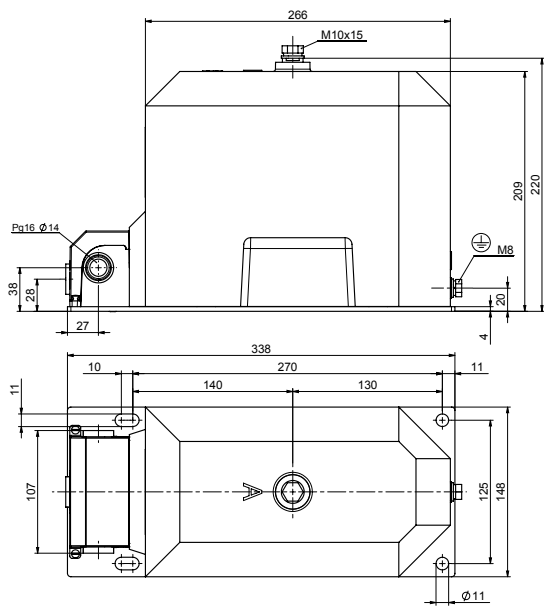
(3) Fuse holder direction of TJP 4.0-F and TJP 5.0-F types used in UniSafe 2.0 must be in opposite direction of secondary terminals

6. Measuring instruments

6.4.1 Dimensional drawings of the voltage transformers

TJC 4, TJCH 4, TJC 5, TJCH 5

- Weight: 20 kg
- Creepage distance: 280 mm

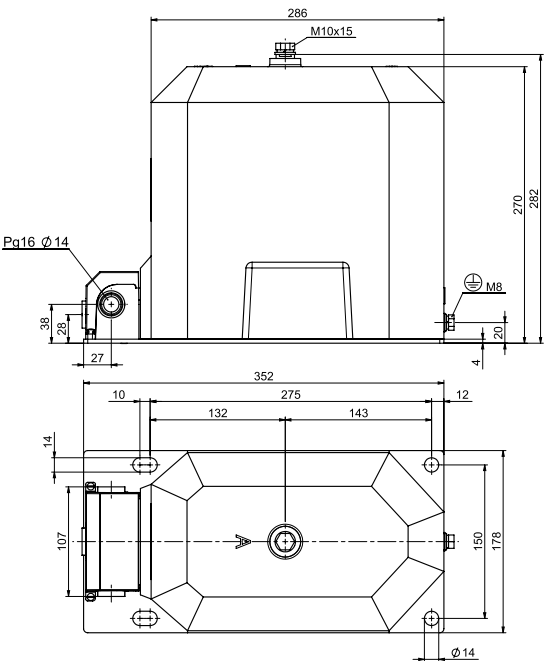


Drawing number

44203570

TJC 6

- Weight: 38 kg
- Creepage distance: 338 mm

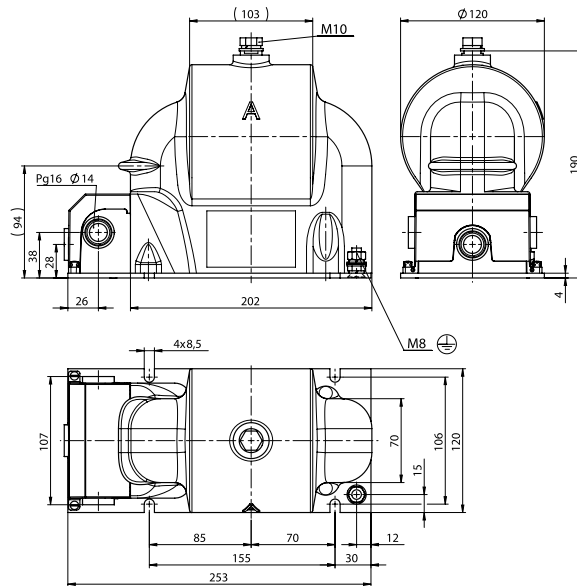


Drawing number

44203580

TJE 3

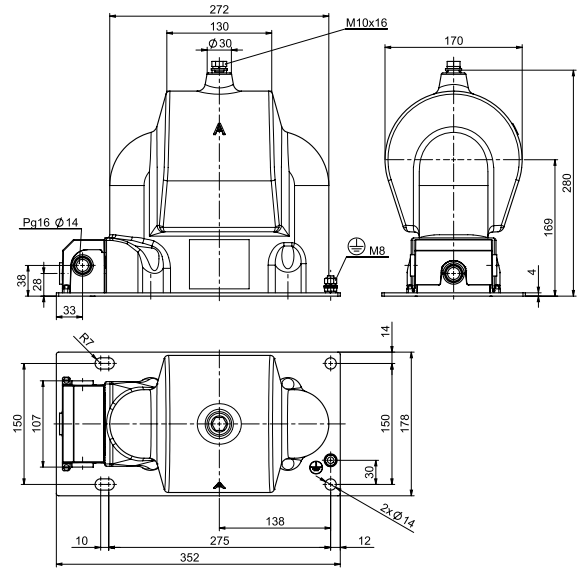
- Weight: 10 kg
- Creepage distance: 245 mm

**Drawing number**

1VL4200252R0101

TJCL 6

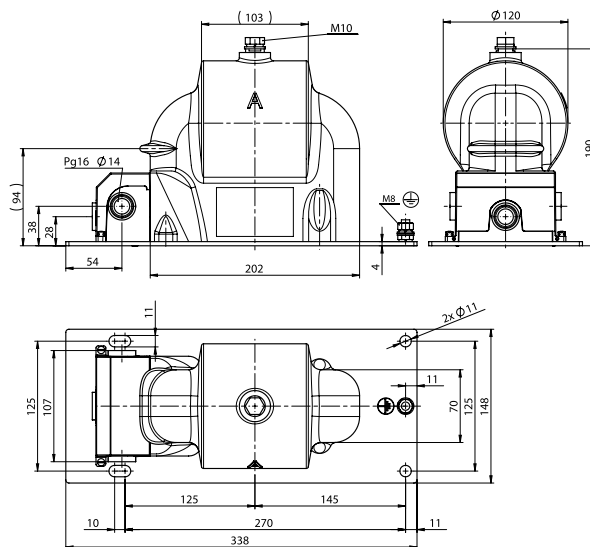
- Weight: 24 kg
- Creepage distance: 335 mm

**Drawing number**

1VL4200291R0101

TJE 3.1

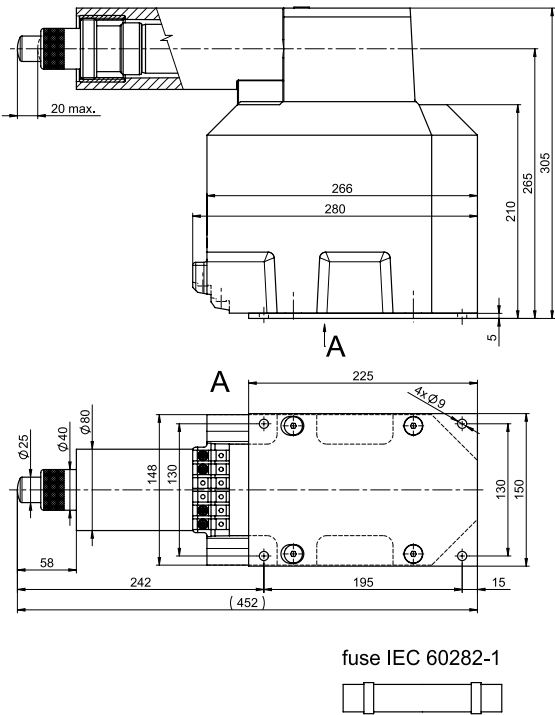
- Weight: 11.5 kg
- Creepage distance: 245 mm

**Drawing number**

1VL4200271R0101

6. Measuring instruments

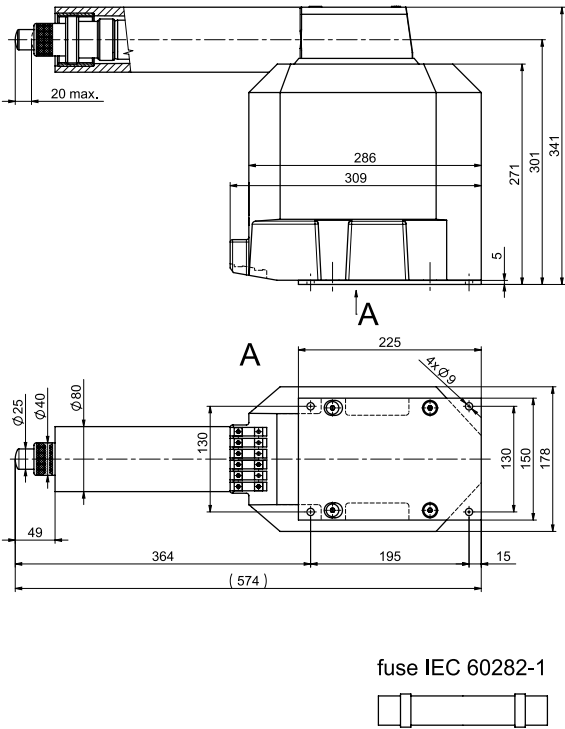
- TJP 4.3, TJP 5.3
- Weight: 28 kg
 - Creepage distance: 385 mm



Drawing number

1VL4200314R0101

- TJP 6.3
- Weight: 42 kg
 - Creepage distance: 547 mm

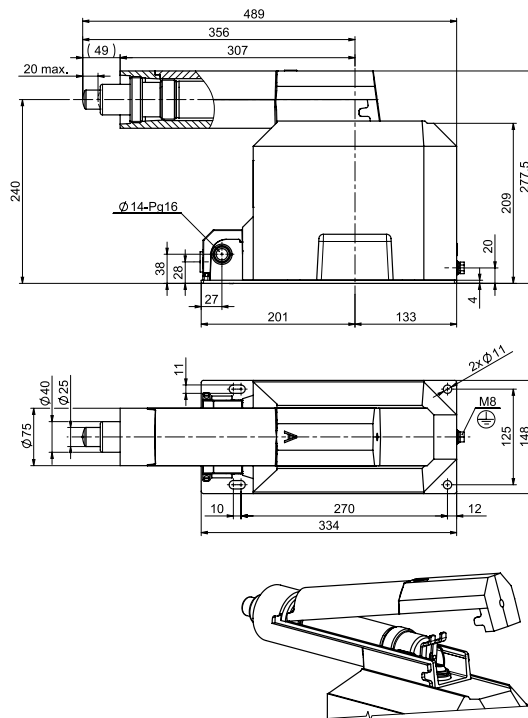


Drawing number

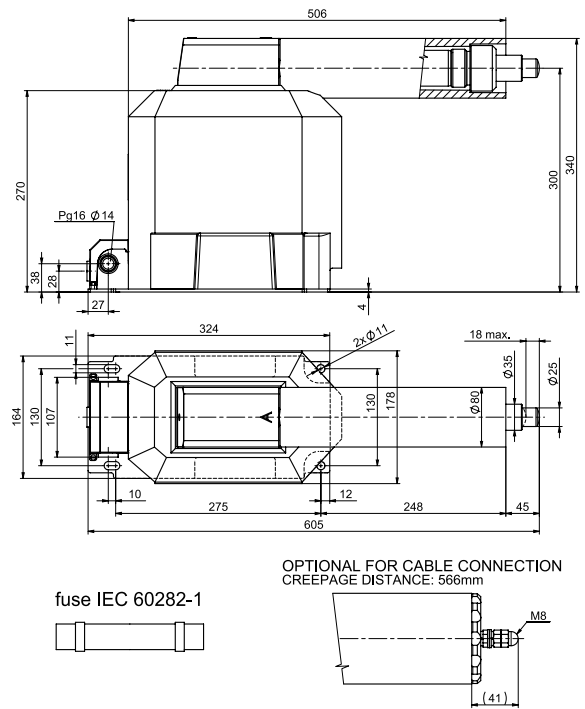
1VL4200315R0101

TJP 4.0-F, TJP 5.0-F

- Weight: 24 kg
- Creepage distance: 403 mm

**TJP 6.0**

- Weight: 42 kg
- Creepage distance: 548 mm



OPTIONAL FOR CABLE CONNECTION
CREEPAGE DISTANCE: 568mm

fuse IEC 60282-1

Drawing number

TJP 4.0-F 1VL4200300R0101

TJP 5.0-F 1VL4200355R0101

Drawing number

TJP 6.0 44204070

TJP 6.0 1VL4200419R0101

cable connection

6. Measuring instruments

6.5 VT Guard PRO, PRO-D

VT Guard Pro is a security device that protects medium voltage inductive voltage transformers against ferroresonant oscillation. Ferroresonance can arise in ungrounded power networks or in the networks where is not directly grounded neutral point. It is designed to be used in open- delta connection of three single-phase voltage transformers. VT Guard PRO-D offers additional functions as device status indicated by LED + auxiliary contact and is possible to cooperate with superior system.

VT Guard Pro (PRO-D) fully replace dumping resistor and save space in customer application.



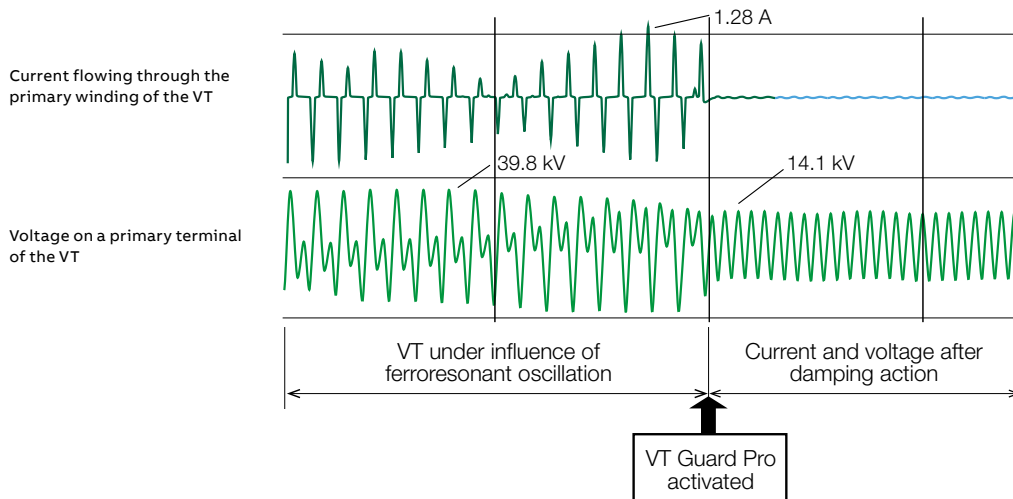
Main characteristics

- Rated operational voltage: 100 /110 V AC
- Voltage range: 0 - 110 V AC
- Maximal operational current: 10 A /0.2 s
- Nominal frequency: 50 or 60 Hz

Advantages

- Mounting in low voltage compartment
- Lower resistance than in standard damping resistor (provides better damping ability)
- Small compact size
- VT Guard Pro protects all 3 VT in open delta connection
- High reliability (redundancy circuits)
- Advanced setting (time delay, threshold voltage)

Experimental demonstration of VT Guard Pro effectiveness



6.6 ABB Cable current transformers portfolio

Cable current transformers, also known as ring core current transformers (RCCT) are suitable for residual current measurement and phase current measurement.

KOLMA, KOLA

KOLMA (multi ratio type) and KOLA (split core type) cable current transformers are used to measure the sum of 3-phase currents in a 3-phase cable. Under normal operating conditions this sum is zero. In the event of an earth-fault it is equal to the earth-fault current and a corresponding current flows in the secondary winding.

KOLMA characteristics

- Available inner diameters: 90, 180 mm
- Test winding available
- **Multi ratio type** (12 ratios per one CT)

KOLA characteristics

- Available inner diameters:
 - 100, 180 mm ring type
 - 497 x 300 mm rectangular type
- Split core
- Protection classes only

Ratings (KOLMA, KOLA)

- Highest voltage for equipment: 0.72 kV
- Primary current: up to 1 250 A (higher on demand)
- Rated short-time thermal current: up to 100 kA/1 s

KOKM 06

KOKM 06 current transformers are suitable for measuring phase currents. A busbar or cable serves as the primary conductor. Thanks to its wide variants of inner dimensions, KOKM 06 is suitable for majority of the switchgear applications especially for the measurement of the 3-phase current (multiple cables).

Characteristics

- Available inner diameters: from 150x500 mm to 450x650 mm.
- Exists 6 dimension designs
- Up to 4 secondary terminals

Ratings (KOKM 06)

- Highest voltage for equipment: 0.72 kV
- Primary current: up to 2 000 A (higher on demand)
- Rated short-time thermal current: up to 100 kA/1 s



6. Measuring instruments

KOKM 1

KOKM 1 current transformers are suitable for measuring phase currents as well as the KOKM 06. The main difference between these two types is in a shape, maximal primary current and highest voltage for equipment.

KOKM 1 are suitable thanks to its wide variants of inner dimensions for majority of the switchgear applications especially for the measurement of the 3-phase current in cables.

Characteristics

- Diameters: 33 – 500 mm (see table below)
- Sealable secondary terminal available
- Up to 6 secondary terminals (3 cores)

Ratings

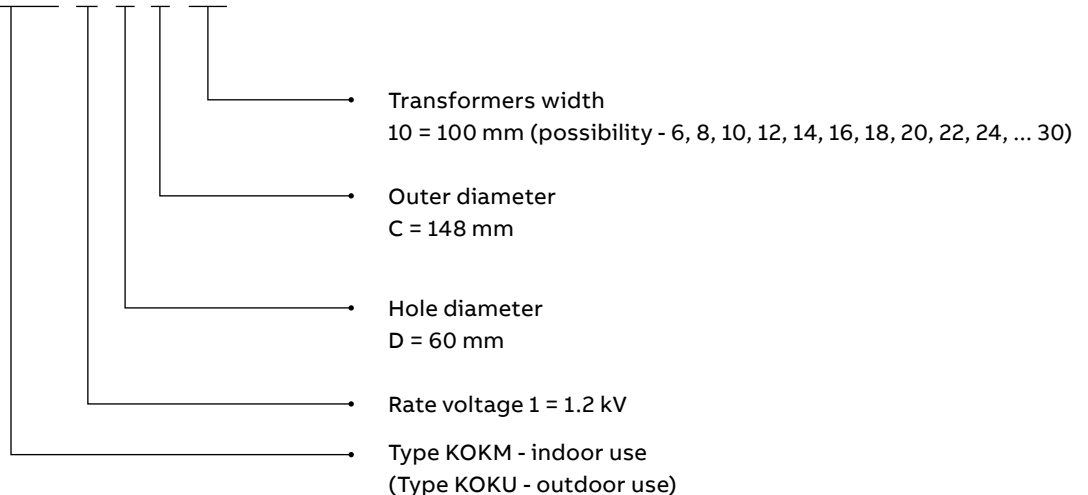
- Highest voltage for equipment: 1.2 kV
- Primary current: up to 10000 A
- Rated short-time thermal current:
up to 100 kA/1 s



Dimension table

Outer diameter [mm]	Hole diameter [mm]																	Drawing	Casting height [mm]	Total height [mm]	Hole center height
	A	B	D	E	F	G	H	K	N	R	S	U	V	W	X	Y	Z				
	33	42	60	70	85	90	100	120	155	180	200	250	315	350	400	450	500				
C 148	60	60	60	60	60													KOKM 1_C_	183	227	112
	160	160	160	160	160																
F 186	60	60	60	60	60	60	60	← Range of transformer width										KOKM 1_F_	212	256	130
	160	160	160	160	160	160	160														
H 200	80	80	80	80	80	80	80	80									KOKM 1_H_	235	279	138	
	180	180	180	180	180	180	180	180													
J 235	80	80	80	80	80	80	80	80									KOKM 1_J_	265	323	158	
	300	300	300	300	300	300	300	300													
K 250	80	80	80	80	80	80	80	80	80								KOKM 1_K_	274	332	158	
	200	200	200	200	200	200	200	200	200	200											
L 270	80	80	80	80	80	80	80	80	80	80	80						KOKM 1_L_	296	354	158	
	200	200	200	200	200	200	200	200	200	200	200	200									
M 280	80	80	80	80	80	80	80	80	80	80	80						KOKM 1_M_	298	356	158	
	240	240	240	240	240	240	240	240	240	240	240	240									
P 340	80	80	80	80	80	80	80	80	80	80	80	80					KOKM 1_P_	379	423	204	
	200	200	200	200	200	200	200	200	200	200	200	200	200								
S 400	80	80	80	80	80	80	80	80	80	80	80	80	80	80				KOKM 1_S_	415	459	225
	200	200	200	200	200	200	200	200	200	200	200	200	200	200							
T 450					80	80	80	80	80	80	80	80	80					KOKM 1_T_	465	504	225
					200	200	200	200	200	200	200	200	200	200							
W 590					80	80	80	80	80	80	80	80	80	80	80	80	80	KOKM 1_W_	605	645	300
					200	200	200	200	200	200	200	200	200	200	200	200	200				

Example of code designation

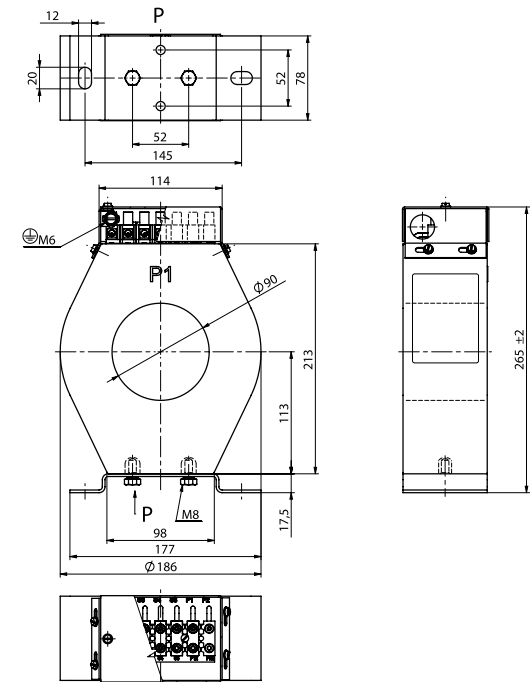
KOKM 1 D C 10

6. Measuring instruments

6.6.1 Dimensional drawings of the RCCT transformers

KOLMA 06 A1

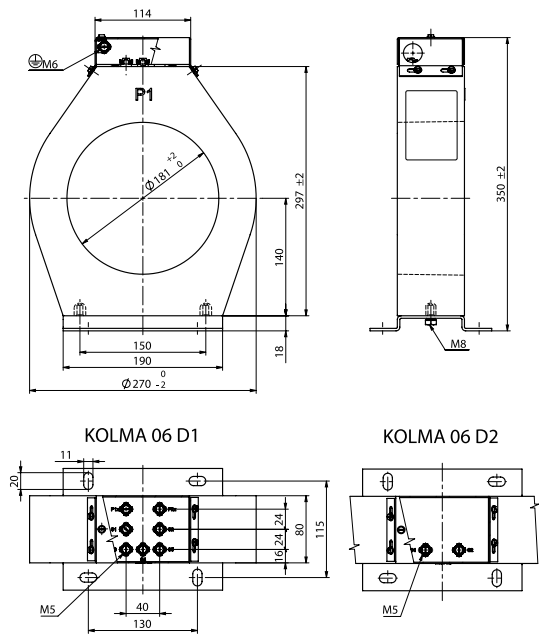
- Weight: app. 7.5 kg



Drawing number
1VL4900386R0101

KOLMA 06 D1, D2

- Weight: app. 13 kg



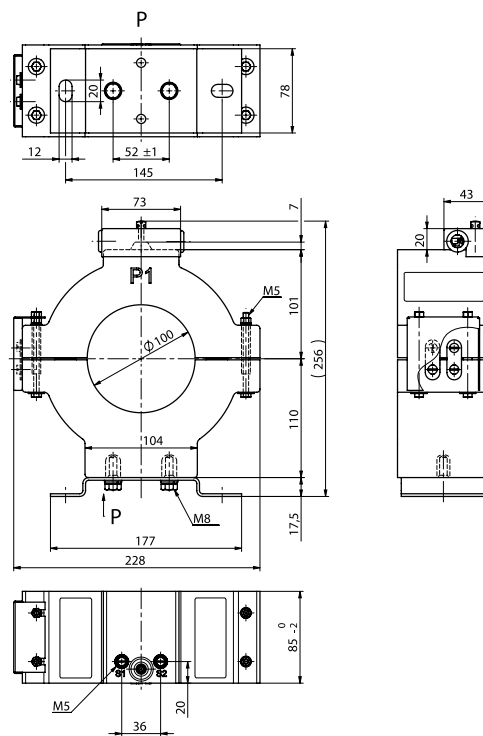
Drawing number
KOLMA 06 D1
KOLMA 06 D2

1VL4600888R0101

1VL4600888R0102

KOLA 06 B2

- Weight: app. 8 kg

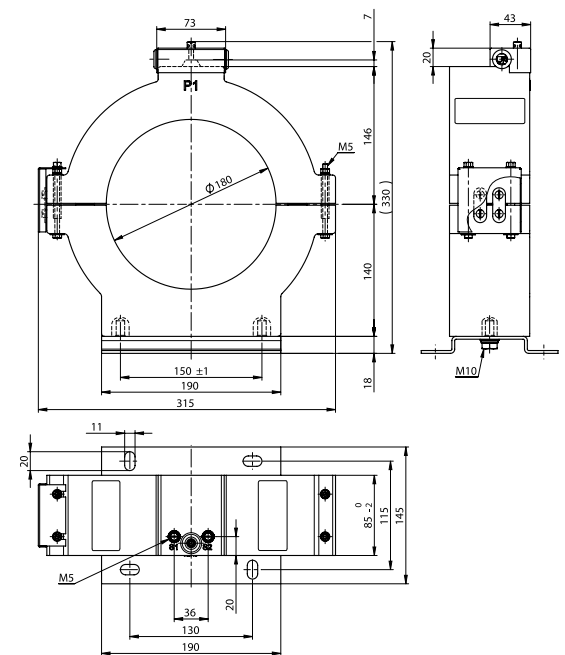


Drawing number

1VL4900381R0101

KOLA 06 D2

- Weight: app. 12,5 kg

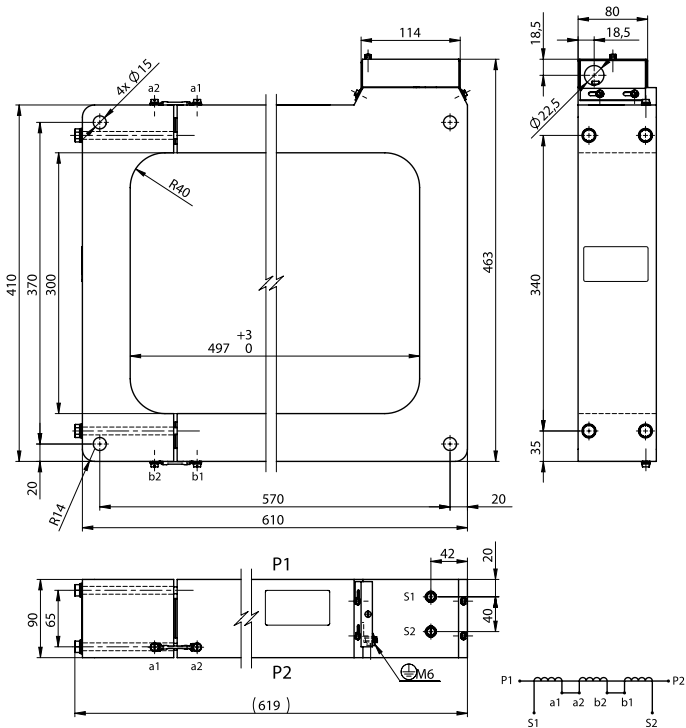


Drawing number

1VL4900382R0101

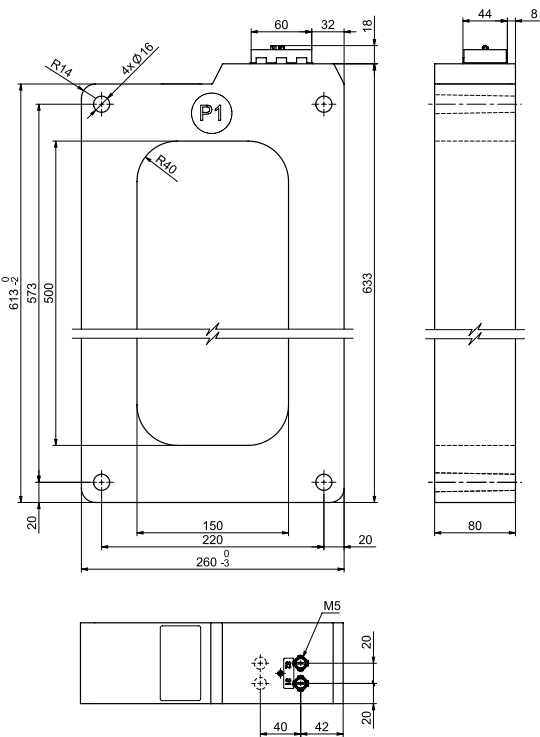
6. Measuring instruments

KOLA 06 J2 (split core)
• Weight: app. 32 kg



Drawing number
1VL4900383R0101

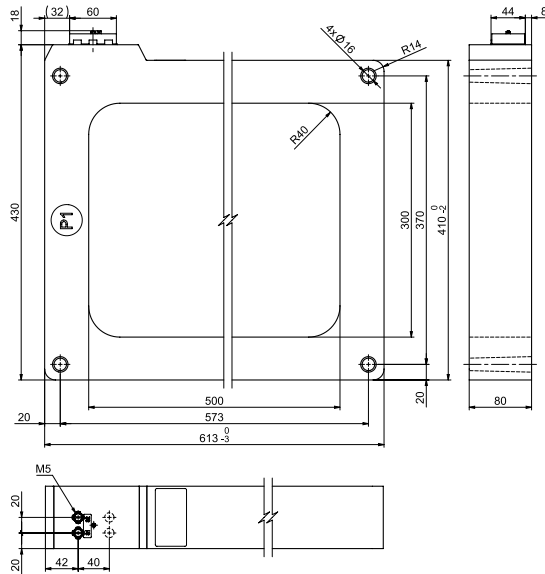
KOKM 06 J21
• Weight: 20 kg



Drawing number
1VL4900437R0101

KOKM 06 J2

- Weight: 25 kg

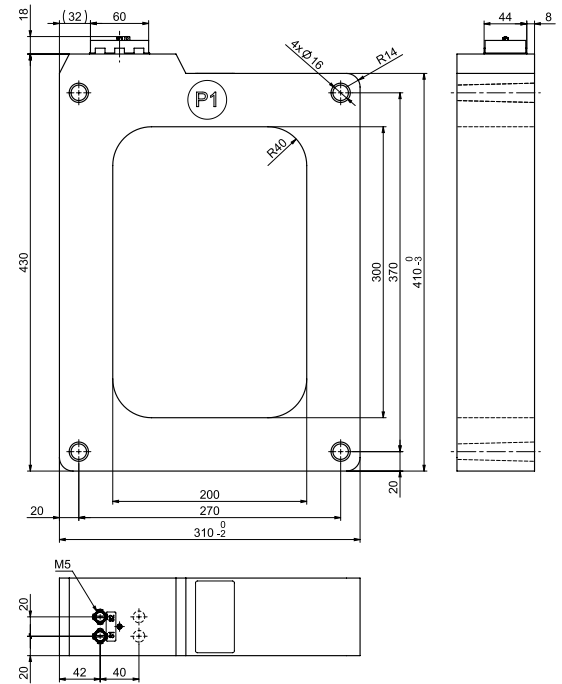


Drawing number

1VL4900436R0101

KOKM 06 J22

- Weight: 19 kg

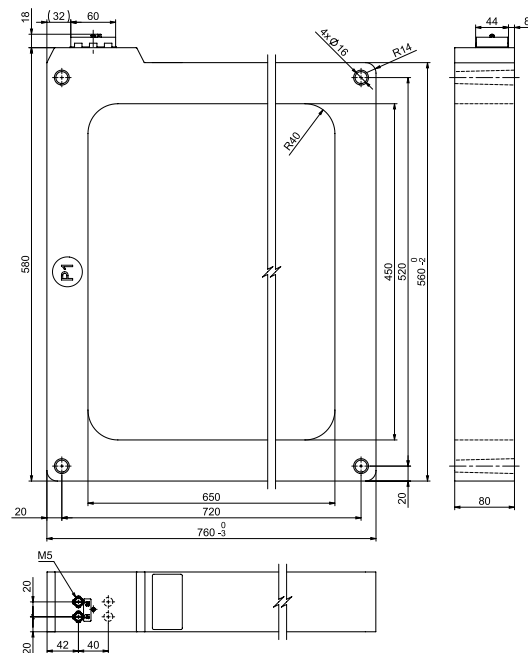


Drawing number

1VL4900438R0101

KOKM 06 J29

- Weight: 39 kg



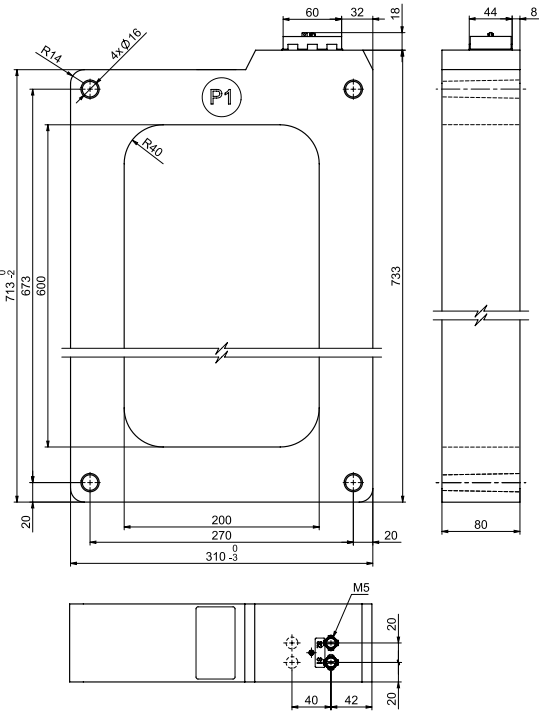
Drawing number

1VL4900441R0101

6. Measuring instruments

KOKM 06 J23

- Weight: 28 kg

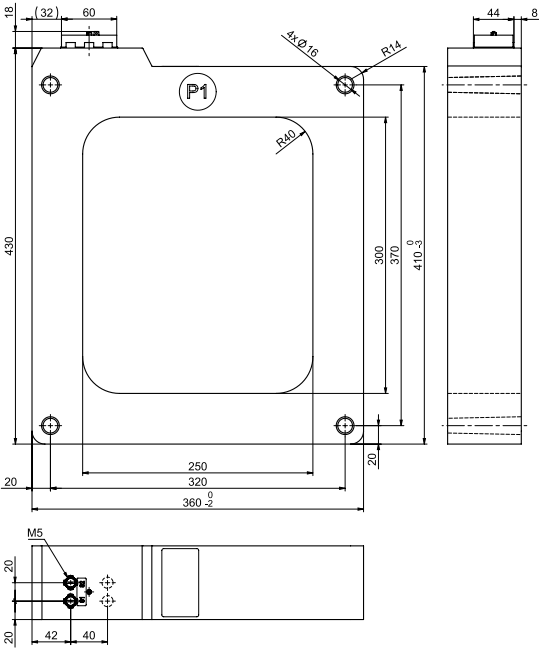


Drawing number

1VL4900439R0101

KOKM 06 J24

- Weight: 22 kg



Drawing number

1VL4900440R0101

6.7 ABB Sensors portfolio

Electronic Instrument Transformers (sensors) offer an alternative way of making the current and voltage measurements needed for the protection and monitoring of medium voltage power systems.

Sensors based on alternative principles have been introduced as successors to conventional instrument transformers in order to significantly reduce size, increase safety, and to provide greater rating standardization and a wider functionality range.

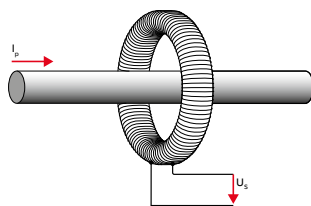
These well-known principles can be fully utilized in combination with ABB relays with sensor inputs. All our sensors are type tested according to IEC 60044-7 and IEC 60044-8.

Measuring principles

Current sensor

Current measurement is based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer.

However, the output signal from a Rogowski coil is not a current, but a voltage where nominal value for 50 Hz is 150 mV and for 60 Hz is 180 mV.

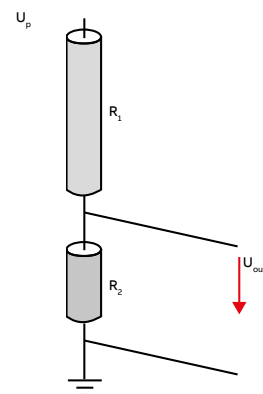


In all cases, a signal that represents the actual primary current waveform is easily obtained by integrating the transmitted output signal.

Voltage sensor

Voltage measurement in sensors is based on the resistive divider principle or could be based on capacitive divider principle.

The output voltage is directly proportional to the input voltage where rated transformation ratio is 10,000:1.



In all cases, the transmitted output signal reproduces the actual waveform of the primary voltage signal.

Compatible relays

ABB sensors are compatible with wide range of ABB IEDs.

Examples of suitable Fault Passage Indicators and Protection relays are:

- RIO 600,
- REF/J/M 601,
- REF/M/D/C 615
- REF 620
- REX 640



RIO 600



REF/J/M 601



REF/M/D/C 615



REF 620



REX 640



6. Measuring instruments

6.7.1 Advantages of ABB sensors



KEVCD

KEVCD is indoor combined current and voltage sensor or only current sensor. The current sensor is based on the principle of Rogowski-coil.

The sensor consists of an air-core winding, immune to any risk of saturation as it has no ferromagnetic core. It is linear over the whole measuring range. The voltage sensor is based on a resistive divider. Also this sensor is non-saturable and linear over the whole measuring range. In the KEVCD sensor a coupling electrode is integrated inside the same compact body and act as voltage indication.

Main characteristics

- Metering and protection classes in one winding
- Applicable for Air insulated switchgears
- DIN dimensions according to standard 42600 part 9 is available
- Light weight comparing to inductive CT and VT

Ratings

- Highest voltage for equipment: up to 24 kV
- Primary current of application: up to 3200 A
- Rated primary voltage: 11 / $\sqrt{3}$, 15/ $\sqrt{3}$, 22/ $\sqrt{3}$
- Cable lengths: 5, 6.5, 7.5 m
- Current accuracy class: up to 0.5/5P630
- Voltage accuracy class: up to 0.5/3P

Type	Sensors	Voltage	Current
KEVCD 12 AE3	•	•	•
KEVCD 12 AG3		•	•
KEVCD 12 BE2	•	•	•
KEVCD 12 BG 2		•	•
KEVCD 17.5 AE3	•	•	•
KEVCD 17.5 AG3		•	•
KEVCD 17.5 BE2	•	•	•
KEVCD 17.5 BG2		•	•
KEVCD 24 AE3	•	•	•
KEVCD 24 AG3		•	•
KEVCD 24 BE2	•	•	•
KEVCD 24 BG2		•	•

- KEVCD A has rated primary current up to 1250 A.
- KEVCD B has rated primary current from 1250 A up to 3200 A.



6. Measuring instruments

KECA 250 B1

(weight: 1 kg)

KECA is indoor current sensor. The current sensor is based on the principle of the Rogowski-coil. The sensor consists of an air-core winding, immune of any risk of saturation as it has no ferromagnetic core. It is linear over the whole measuring range. Sensor is intended for use in current measurement in medium voltage switchgears.

Main characteristics

- Metering and protection classes in one winding
- Small dimension and light weight
- Applicable for air insulated switchgears

Ratings

- Highest voltage for equipment: 0.72 kV
- Rated primary current: up to 2000 A
- Nominal primary current: 250 A
- Continuous thermal current: 2000 A
- Cable lengths: 5 m
- Current accuracy class: 0.5/5P125

Sensor connection with ABB relay

ABB package solution of sensor and relay allows to measure and protect your switchgear in reliable and accurate way.

Sensor output cable is integral part of sensor, it is connected directly to the IED and subsequently neither burden calculation nor secondary wiring is needed.



For KECA dimensional drawings see chapter 6.7.2 Dimensional drawings of sensors



KEVCD 24 connected to REF615

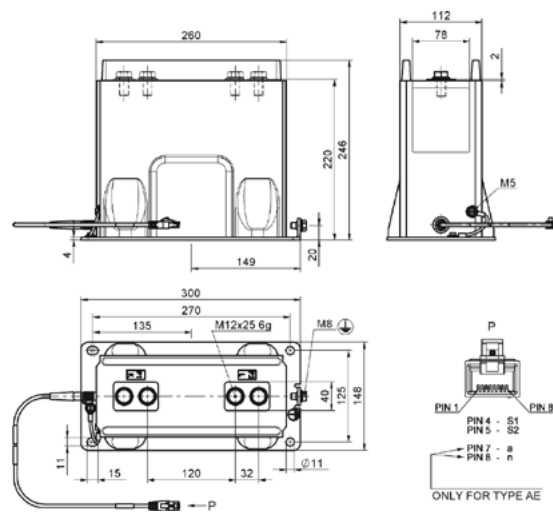


KECA 250 B1 connected to REF601

6.7.2 Dimensional drawings of sensors

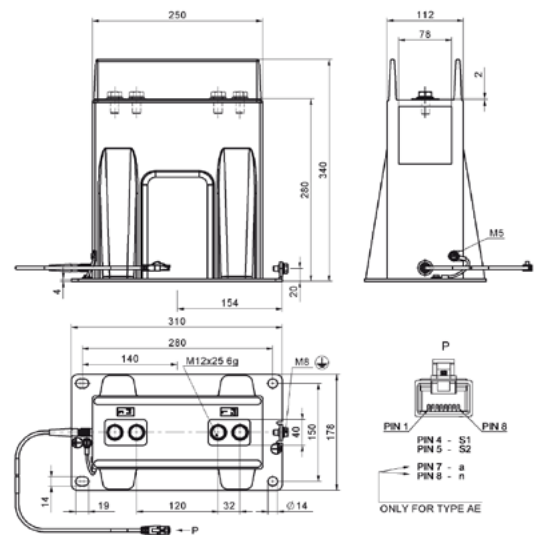
KEVCD A 12, 17.5 kV

- Weight: 12.5 kg



KEVCD A 24 kV

- Weight: 15.6 kg



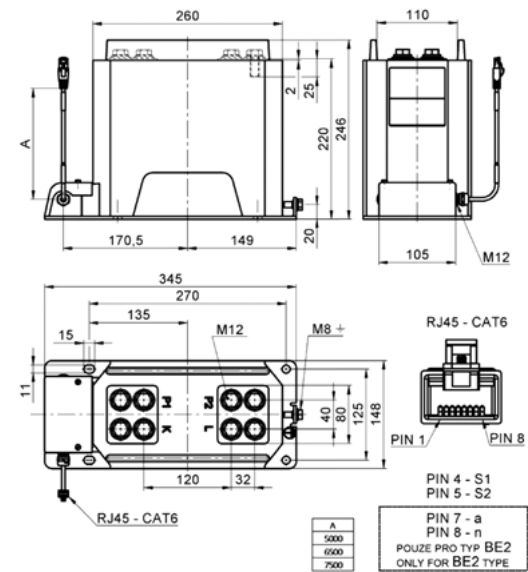
Type	Description
KEVCD 12 AE3 KEVCD 17.5 AE3	Current/Voltage sensor
KEVCD 12 AG3 KEVCD 17.5 AG3	Current sensor

Type	Description
KEVCD 24 AE3	Current/Voltage sensor
KEVCD 24 AG3	Current sensor

6. Measuring instruments

KEVCD B 12, 17.5 kV

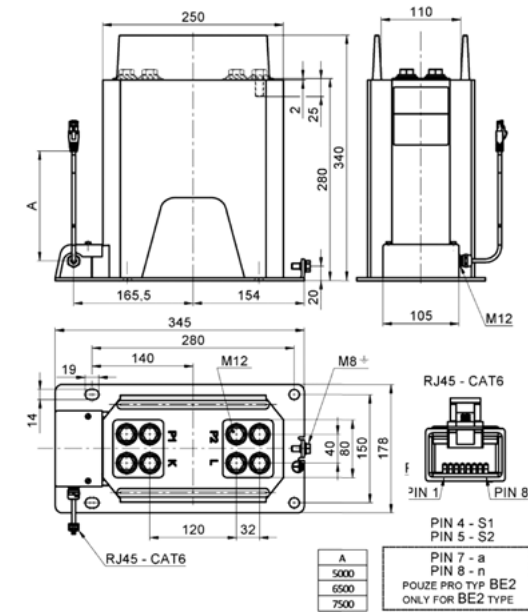
- Weight: 20 kg



Type	Description
KEVCD 12 BE2 KEVCD 17.5 BE2	Current/Voltage sensor
KEVCD 12 BG2 KEVCD 17.5 BG2	Current sensor

KEVCD B 24 kV

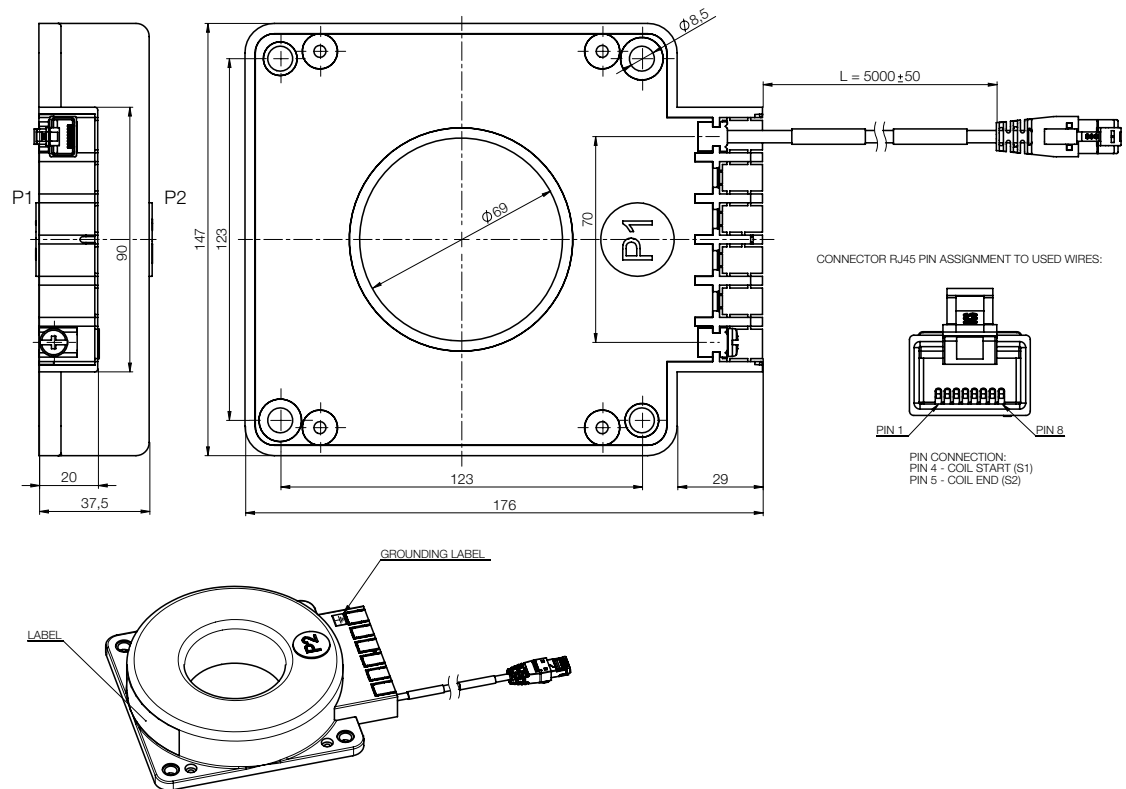
- Weight: 24 kg



Type	Description
KEVCD 24 BE2	Current/Voltage sensor
KEVCD 24 BG2	Current sensor

KECA 250 B1

- Weight: 1 kg



7. Relays

7.1 ABB power protection philosophy

Having delivered protection relays to more than 100 countries, ABB fully understands the need for diverse protection philosophies that meet local legislation, safety requirements and engineering practice. Therefore, ABB has developed a power protection philosophy that not only serves the specific needs and requirements of diverse power systems, but also creates confidence and peace of mind for both the power system owners and users.

The main purpose of a protection relay system is to recognize any abnormal power system condition(s), or abnormally operating system component(s). Based on the information gathered, the protection system will initiate corrective actions that return the system to its normal operating state.

This provides a safe environment for all. Protection relays are activated when something abnormal has happened in the power system; they do not prevent network faults from arising. Selecting the right protection functions and methods improves the performance and the reliability of the protection system, thus minimizing the effects of network faults and preventing the disturbance from spreading to the healthy parts of the network.

Advantages of a complete protection system

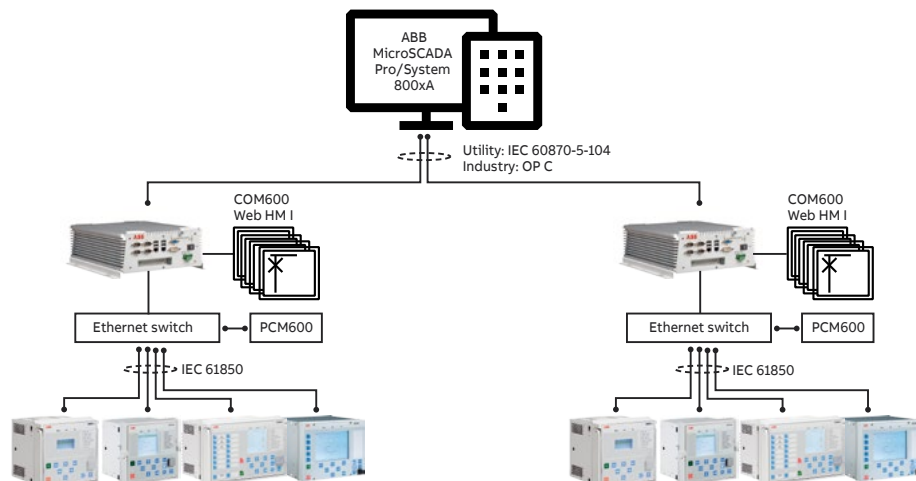
Close attention must be paid to operating speed, sensitivity, selectivity and reliability of the protection system.

There is a strong correlation between the operating speed of the protection system and the damage and danger caused by a network fault. Substation automation provides remote control and monitoring capabilities, which speed up the location of faults and the restoration of the power supply. Fast operation of the protection relays also minimizes post-fault load peaks. Together with voltage dips, post-fault load peaks increase the risk of the disturbance spreading to healthy parts of the network.

The sensitivity of the protection must be adequate to detect relatively high resistance earth faults and short-circuits in the most distant parts of the network. Reliable selectivity is essential to limit the loss of power supply to the smallest possible part of the network, and to allow the faulted part to be reliably located. Corrective actions can then be directed to the faulty part of the network, so that the power supply can be restored as quickly as possible. The protection system must have a high degree of reliability. This also means that if, for example, the circuit breaker (CB) fails to operate, the back-up protection will clear the fault. Substation automation (SA) puts the operator in complete control of the substation. In addition, SA improves the power quality of the transmission and distribution network under normal operation, but especially in a disturbance situation and during substation maintenance activities. An SA or SCADA brings the full benefits of digital technology into protection and control of the networks.

The protection relays are easily set-up and parameterized through easy and safe access from the operator's workplace.

Example of ABB power system using Relion protection relays, all-in-one communication gateway COM600 and MicroSCADA Pro/System 800xA



7.2 Relion® protection and control relays

The Relion® product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications – from generation and interconnected transmission grids over primary distribution to secondary distribution kiosks.

The Relion® protection relays are deeply rooted in ABB's vast experience of developing successful protection and control relays. These relays have been developed during many years and are built on the experience gathered from wide ranging application and functionality requirements of ABB's customers globally.

To ensure interoperable and future-proof solutions, Relion® products have been designed to implement the core values of the IEC 61850 standard.

The genuine implementation of the IEC 61850 substation modelling and communication standard covers both vertical and horizontal information exchange between protection relays and external systems.

The protection and control IED manager PCM600 provides versatile functionality throughout the life cycle of all Relion® protection and control relays. PCM600 is IEC 61850 compliant, which ensures smooth engineering of the relays and enables information exchange with other IEC 61850 compliant tools.

With these products, you benefit from ABB's leading-edge technology, global application knowledge and experienced support network. The Relion technology is leading the way and setting the future trends in the field of protection and control systems.

Relion protection and control product family



7. Relays

7.3 Safety

The safety of the personnel is of prime importance when modern medium voltage switchgear is developed.

This is why UniSafe 2.0 switchgear has been designed and tested to withstand the internal arc produced by a short-circuit current of the same level as the maximum permissible short-time withstand current.

Tests have shown that the metal enclosure of UniSafe 2.0 switchgear is able to protect personnel working near the switchgear itself if a fault evolves until an internal arc ignites.

An internal arc is a very improbable fault although theoretically it can be caused by various factors, such as:

- defective insulation owing to deteriorated components. This can be due to adverse environmental conditions and a strongly polluted atmosphere
- over-voltage of atmospheric origin or caused by the operation of some components or other
- inadequately trained personnel
- breakage or tampering with the safety interlocks
- overheating in the contact zones due to the presence of corrosive substances or loose connections
- intrusion of small animals into the switchgear (e.g. through the cable input)
- materials left inside the switchgear during maintenance work

The characteristics of UniSec switchgear strongly reduce the probability of these faults occurring. However, some faults cannot be completely prevented.

The energy produced by the internal arc produces the following phenomena:

- increase in the internal pressure
- temperature increase
- visual and acoustic effects
- mechanical stress on the switchgear structure
- melting, decomposition and vaporization of the materials

Unless they are adequately kept under control, these phenomena can affect the personnel in a very serious way, causing injuries (due to shock waves, parts that are thrown up and doors that open) and burns (due to the emission of hot gas).

The purpose of the internal arc resistance test is to make sure that the cubicle doors remain closed, that none of the components detach from the switchgear even when the pressure is very high, and that incandescent gas or flames are unable to escape, thereby guaranteeing safe conditions for the personnel who work in the vicinity of the switchgear.

The test is also performed in order to ensure that holes are not made in the accessible external parts of the enclosure and, lastly, that all the connections to the earthing circuit continue to be efficient and able to guarantee safe conditions for persons who access the switchgear after a fault.

Standard IEC 62271-200 establishes the methods for performing the test and the criteria with which the switchgear must comply.

UniSafe 2.0 switchgear fully conforms to all the five criteria indicated by the IEC standard. The parameters of each specific installation establish that the elimination of hot gas and incandescent particles must be checked with particular care so as to guarantee and maintain safe conditions for the personnel.

Fault limiting systems

The structure of UniSafe 2.0 switchgear provides complete passive protection against the effects of internal arc faults for 1 second up to 25 kA for 24 kV and up to 31.5 kA for 12-17.5 kV.

ABB has also developed active protection systems able to provide the following important benefits:

- fault detection and extinguishing, generally within less than 100 ms, which improves the stability of the network
- less damage to the equipment
- the switchgear remains out of service for a shorter time

Active internal arc protection can be achieved by installing various types of sensors in the different compartments.

These devices are able to detect the immediate effects of the fault and release the circuit-breakers in the selective mode.

The fault limiting systems are based on sensors that take advantage of the pressure or light generated by the internal arc fault to allow the faulty line to disconnect.

7. Relays

REA

This system provides the same functions as the TVOC system.

It consists of a central unit (REA 101) and an optional extension unit (REA 103, 105, 107), allowing customized selective release solutions to be created.

The total release time is 62.5 ms (2.5 ms REA + 60 ms the circuit-breaker).

RE- 615, RE- 620 and REX 640 Arc sensor

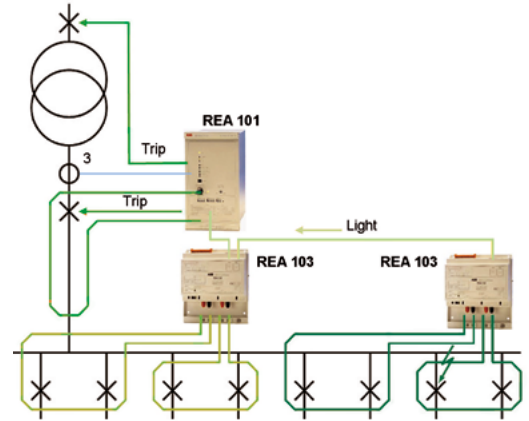
Electric arc protection with IED

On request, the IED (Intelligent Electronic Devices) REF615, REF620 and REX 640 can be equipped with rapid and selective electric arc protection.

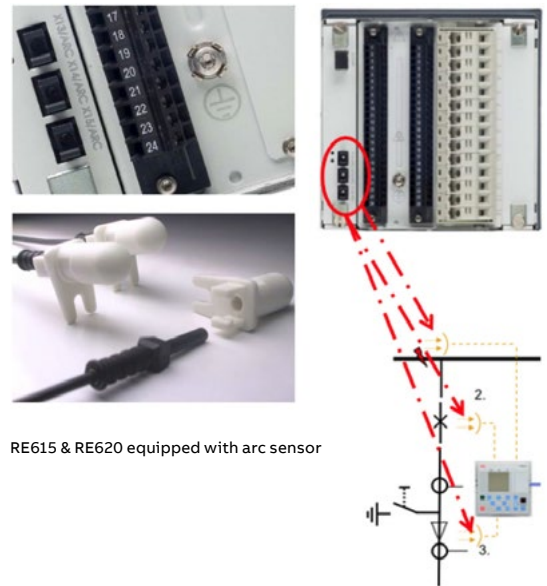
This arc fault protection system has two or three channels for supervising electric arcs in the circuit-breaker cubicles, line and busbars of the switchgear.

The arc-fault protection sensor interface is available on the optional communication module. Fast tripping increases staff safety and security and limits material damage in an arc fault situation.

The total release time is 72 ms (12 ms IED + 60 ms the circuit-breaker).

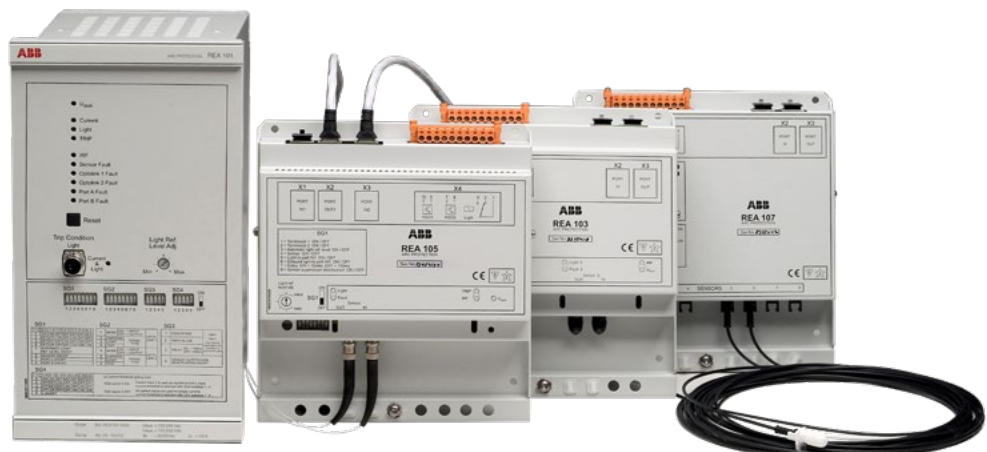


Typical configuration with REA 101 and subunit 103



RE615 & RE620 equipped with arc sensor

REA 101 electric arc protection unit with REA 103, REA 105 and REA 107 extensions



RE- 615 Series

- **REF615** provides general protection for overhead lines, cable feeders and distribution substation busbar systems. It can be adapted for both isolated neutral networks and networks with the neutral earthed by means of resistance or impedance.
- **REM615** is a dedicated motor protection and control IED, perfectly aligned for protection, control, measurement and monitoring of asynchronous motors in the manufacturing and process industry.
- **RET615** is a dedicated IED for protection and control of transformers designed for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industrial power distribution systems.
- **RED615** is a line residual current IED which can, in particular, be used for applications requiring highly selective feeder protection (unit protection).
RED615 maintains selectivity even in cases where the fault current has a variable magnitude and can be fed from several sources.
- **REU615** is an IED available in two predefined configurations called A and B, destined for two of the most common applications.
Configuration A is preset for protections based on voltage and frequency. Configuration B is preset for automatic voltage adjustment functions for transformers fitted with an on load tap changer.
- **REV615** is a dedicated capacitor bank protection and control IED (intelligent electronic device) designed for the protection, control, measurement and supervision of H-bridge single Y and double Y and connected capacitor banks used for compensation of reactive power in utility substations and industrial power systems.
REV615 can also be used to protect harmonic filter circuits, when no significant harmonic component higher than the 11th.
- **REG615** is a dedicated generator and interconnection protection relay designed for protection, control, measurement and supervision of power generators and interconnection points of distributed generation units in utility and industrial power distribution systems.



Auxiliary power supply voltage	
High	100 - 110 - 120 - 220 - 240 V 50/60 Hz 46 - 60 - 115 - 220 - 250 V DC
Low	24 - 30 - 48 - 60 V DC

7. Relays

RE- 620 Series

- **REF620** is a dedicated feeder IED perfectly aligned for the protection, control, measurement and supervision of utility and industrial power distribution systems, including radial, looped and meshed distribution networks.
REF620 is a member of ABB's Relion® protection and control product family and its 620 series.
The 620 series IED are characterized by their functional scalability and withdrawable unit design. The 620 series has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability of substation automation devices.
- **REM620** is a dedicated motor IED perfectly aligned for the protection, control, measurement and supervision of medium-sized and large asynchronous motors, requiring also differential protection, in the manufacturing and process industry.
REM620 is a member of ABB's Relion® protection and control product family and its 620 series. The 620 series IED are characterized by their functional scalability and withdrawable-unit design.
- **RET620** is a dedicated transformer IED perfectly aligned for the protection, control, measurement and supervision of both power and step-up transformers, including power generator-transformer blocks, in utility and industrial power distribution systems.
RET620 is a member of ABB's Relion® protection and control product family and its 620 series. The 620 series IED are characterized by their functional scalability and withdrawable-unit design.



Auxiliary power supply voltage	
High	48 - 250 V DC 100 - 240 V AC
Low	24...60 V DC

RE- 630 Series

- REF630 line protection and monitoring unit:** this unit provides important protection functions for overhead lines and cable lines in power distribution networks. REF630 adapts to both networks with isolated neutral and networks with neutral earthed by means of a resistor or impedance.
The four pre-engineered configurations available are designed to comply with the typical requirements for line monitoring and protection.
- RET630 transformer protection and monitoring terminal:** this is a complete IED for controlling transformers. It has been designed to protect, monitor, measure and supervise power transformers, unit and set-up transformers including transformer-generator units in utility and industrial distribution networks. This terminal provides the main protection for power transformers with two windings and generator-power transformer units.
- REM630 motor protection and monitoring unit:** complete with motor management functions, this IED has been designed to protect, monitor, measure and supervise medium-large asynchronous motors in medium-voltage industrial electrical systems. Characterized by functional scalability and flexible configuration, the REM630 unit belongs to ABB's Relion® family of products and to the 630 product series. It also possesses the monitoring functions required for managing industrial motor control switchgear.
REM630 provides the main protection for asynchronous motors and the relative transmissions.
- REG630** is a comprehensive generator management relay for protection, control, measurement and supervision of small and medium-sized power generators and generator-transformer units in utility and power distribution systems.



Auxiliary power supply voltage

High	100 - 110 - 120 - 220 - 240 V 50/60 Hz
	46 - 60 - 115 - 220 - 250 V DC
Low	48 - 60 V DC

7. Relays

REX- 640 Protection and control

All-in-one performance and flexibility for advanced power distribution and generation applications.

Complete application coverage with one device for optimal cost-effectiveness

REX640 is the outcome of a long-standing evolution, building on ABB's strong heritage of freely configurable multifunctional relays. The ability to cover the full range of utility and industrial applications and manage multiple applications simultaneously, with the same device, guarantees flexible, versatile and cost-efficient protection solutions. REX640 has been designed to support the increasing digitalization of substations. REX640 thereby supports a variety of digital switchgear solutions and is suitable for both single and double-busbar applications. REX640 offers as many as 20 current and voltage measurement channels in total, supporting both conventional instrument transformers and sensors, not to mention the ability to receive four streams of sampled measured values (SMV) via IEC 61850-9-2 LE-based process bus communication.

As the newest member of ABB's Relion® protection and control family of relays, REX640 further reinforces Relion's position as the range of relays to rely on.



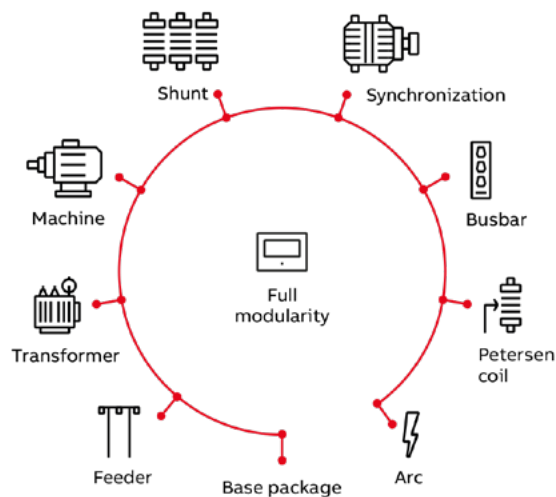
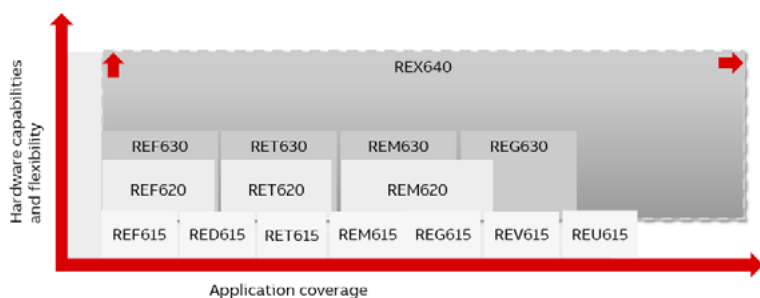
Auxiliary power supply voltage

High	100 - 110 - 120 - 220 - 240 V 50/60 Hz
	46 - 60 - 115 - 220 - 250 V AC
Low	48...60 V DC

New application package concept for maximum convenience and flexibility

REX640 introduces an entirely new application package concept, by offering a variety of ready-made application packages to choose from.

The application packages include various protection and control functions, which can be flexibly combined to create protection solutions that meet your unique protection requirements.



7.4 ABB Ability™ Electrification Monitoring and Control, ABB ZEE600

Unlocking digitalization and integration in electrification process

The ABB Ability™ Electrification Monitoring and Control for distribution networks, ABB zenon Electrification Edition - ZEE600 fulfills the role of a seamless integrator of diverse devices such as ABB and 3rd party make protection relays, meters, substation equipment condition monitoring units, Programmable Logic Controllers (PLC) and Remote Terminal Units (RTUs), deployed in digital electrification solutions. In doing so, it harnesses their real-time, near-real time and diagnostics data to facilitate digitalization objectives set by the customer across diverse segment domains.

While fully supporting predominant communication standards deployed are IEC 61850, IEC 60870-5 and Modbus-TCP across electrification automation systems across the world, the ABB ZEE600 also supports standards like DNP, Profinet, Profibus and other open / proprietary protocols. Also covered is IEC 62349 Parallel-Redundancy Protocol (PRP) to handle and resolve identical communication messages from two separate LAN networks.

The ABB ZEE600 is an advantageous combination of zenon Electrification Edition with ABB's latest user experience standards and a seamless integration to ABB's electrification products offering and associated applications. Needless to mention, the ABB ZEE600 emerges as a centerpiece offering in ABB's electrification and distribution solutions.

It helps realize system integration in Electrification Control System (ECS) solutions and can be deployed in a mix of brownfield and greenfield installations in primary and secondary distribution substations across utilities, industries, infrastructure and renewable segments.

7. Relays

Scope

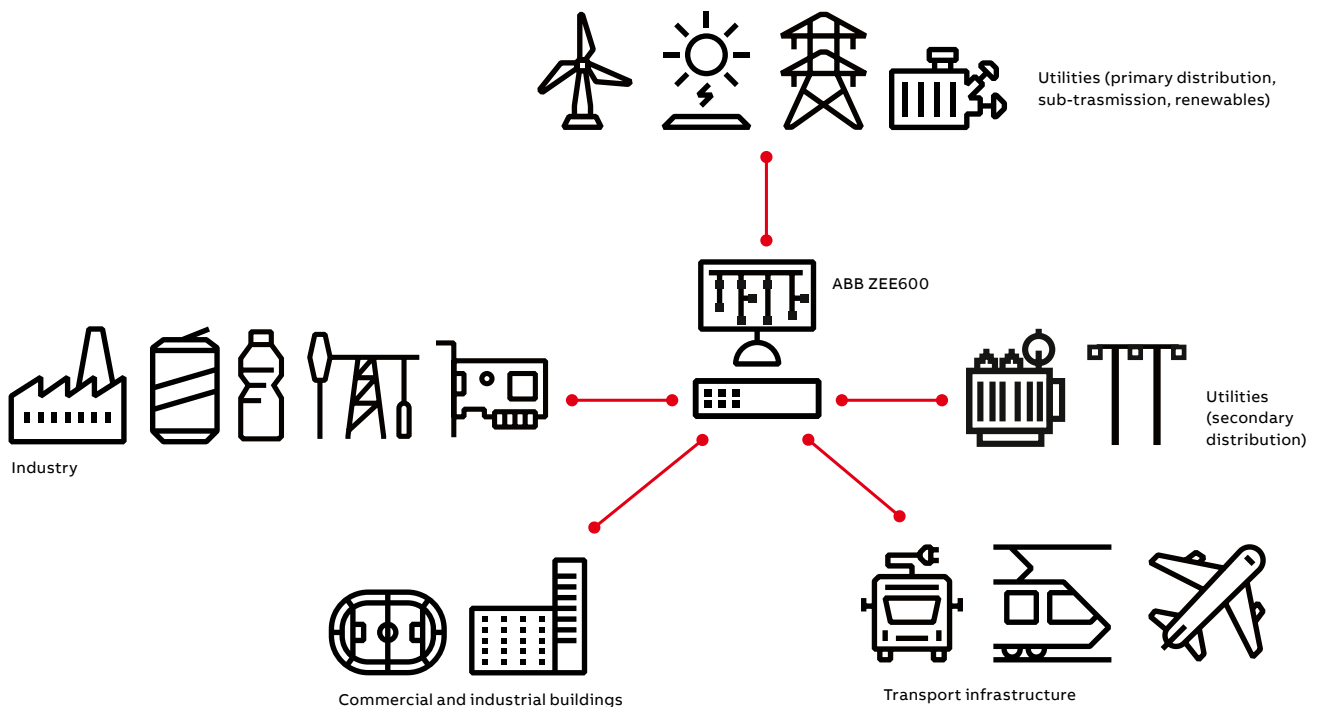
- Process Awareness, Control, Monitoring
- Secure access and operation
- Device and systems connectivity
- Network handling
- ABB Electrification libraries for engineering, operations and applications
- Enabling next-level digitization solutions

Features

- Collects, analyzes, visualizes and manages data
- Provides valuable process insights for better decisions
- Minimizes downtime
- Optimizes energy efficiency
- Fast, dependable, agile automation
- Maximum data security and powerful reporting
- Easy and seamless integration
- Global service and support

Benefits

- Turns data into information
- Communication protocols
- Key component in Industrial IoT, cloud interface capabilities
- Securing information integrity
- Integrated data and cyber security management
- Creating insight for better business decisions
- Audit trail, batch and production scheduling
- Certified load/energy management system module, reporting
- Low total cost of ownership
- Extensive life cycle
- Simple and cost-effective extensions



7.5 Remote I/O concept

ABB's remote I/O concept introduces a new way of extending the I/O capabilities of protection relays. The concept is aimed at increasing the hardware functionality of the protection relays, while still maintaining the relay's compact design. This way remote I/O can be used, when it is needed. The information between the remote I/O units and the main protection relay is exchanged over the latest communication standard IEC 61850. This enables easy integration into the systems and is in line with the latest standards.

The remote I/O concept also benefits from installing the I/O units as close as possible to the place where the signals need to be digitalized, thus limiting extensive wiring within the switchgear, substation or plant.

Digitalization of the signals allows users to use information wherever needed, without the need of installing additional auxiliary relays or terminals. IEC 61850 enables signals supervision, thus faster recognition of any errors and proactive operation, if these conditions happen during a critical process.

Product offering

The remote I/O unit RIO600 is designed to expand the digital and analog I/O of ABB's Relion® series protection relays and to provide I/O for the COM600 series devices using IEC 61850 communication.

RIO600 is designed using a modular architecture where the amount and type of I/O ports can be added through modules.

The RIO600 modules can be stacked on a standard DIN rail to achieve the required configuration.



Remote I/O unit RIO600

RIO600 is built on an industrial hardware platform, which provides the same reliability, performance and real-time functionality as ABB's protection relays, withstanding extreme temperatures, electromagnetic interference and stringent industry standards.

RIO600 provides an additional I/O within the switchgear itself by using the Ethernet-based IEC 61850 horizontal GOOSE communication. The signals can be transmitted within the switchgear and to the automation systems. Similarly, signals from the automation systems can be executed through RIO600 connected to numerical protection relays.

For more information, please refer to the following documentation:

- Remote I/O unit RIO600 Product Guide

Standard											
ANSI	X	X		X							
IEC	X	X	X	X	X	X	X	X	X	X	X
Application											
Arc fault protection application									X		X
Busbar application					X						
Back-up application	X	X			O	X			X		
Capacitor bank application											
Feeder application	X	X	X			X		X	X	X	
Generator application											
Motor application				X	O		X				X
Power management/load-shedding application											
Transformer application					O					X	
Functionality											
Autorecloser	X	X		X		X			X	X	
Circuit breaker controllability	X			X	X	X	X	X	X	X	X
Condition monitoring	X			X	X	X	X		X	X	X
Current-based protection	X	X	X	X	X	X	X		X	X	X
Distance protection											
Fault locator									X	X	
Generator differential protection					X						
LCD display with Single Line Diagram (SLD)									X	X	X
Line differential protection (in-zone transformer support)										X	
Load-shedding											
Motor differential protection					X						
On-load tap changer control											
Power quality									X	X	
Self-powered protection relay			X								
Synchro-check									X		
Transformer differential protection					X						
Voltage based protection								X	X	X	X
Withdrawable release mechanism					X	X	X	X	X	X	X
Hardware											
Analog inputs (CT/VT)	4/0	4/0	4/0	4/0	4/0	4/1	4/0	0/5	4/5	4/5	4/5
Analog inputs (sensor channels/CT)	3/1	3/1		3/1					3/1	3/1	3/1
Binary inputs/outputs	4/6	4/6	0/2	4/6	4/6	10/9	4/6	4/6	18/13	18/13	16/12
RTD/mA inputs									2/1	2/1	6/2
mA outputs											
Communication protocols											
DNP 3.0									X	X	X
IEC 60870-5-103	X	X		X					X	X	X
IEC 61850					X	X	X	X	X	X	X
Modbus	X	X		X	X	X	X	X	X	X	X
Profibus					x	x	x	x	X	X	X
Communication media											
Ethernet (RJ-45)					X	X	X	X	X	X	X
Ethernet (LC)					X	X	X	X	X	X	X
Ethernet redundant solutions (HSR/PRP/RSTP)					X	X	X	X	X	X	X
Serial (RS 232/485, ST conn.)	X	X		X	X	X	X	X	X	X	X

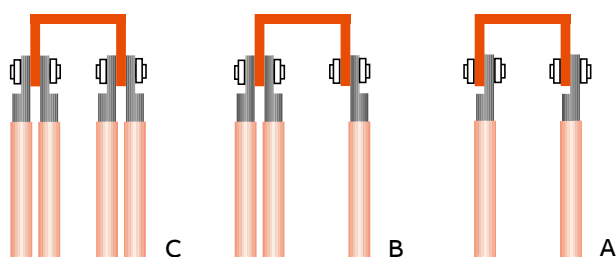
[illegible]

8. Accessories

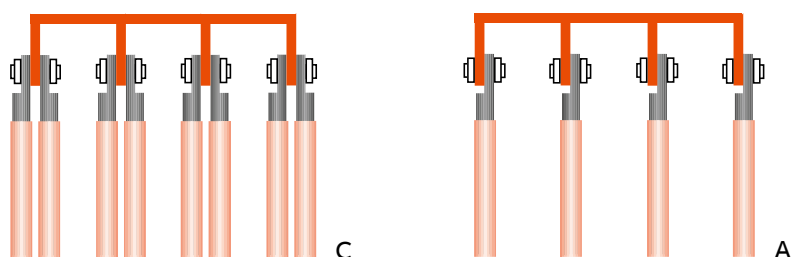
8.1 Cables

UniSafe 2.0 switchboard can be connected with cables with copper or aluminium conductors. The cables can be single-core, three-core and three-core armored type. Cable terminals are usually used for screw connection. Tables below give the maximum external diameter of the XLPE cable (DIN 0273) and solutions for connecting cables to the switchboard.

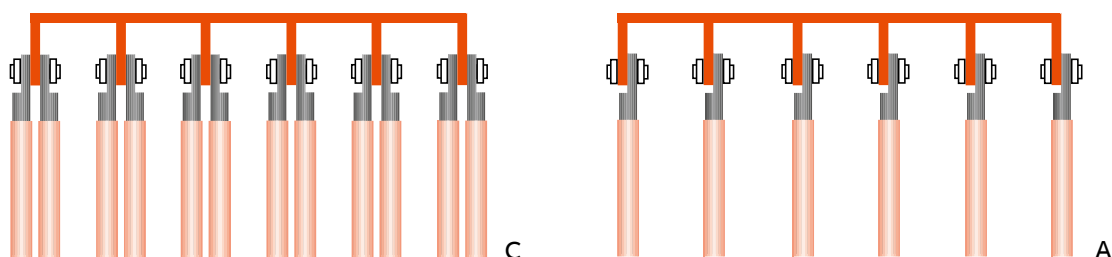
Unit with 2 cable connections per phase (standard depth)



Unit with 4 cable connections per phase (deeper depth)



Unit with 6 cable connections per phase (deeper depth)



- (1) Solution C covers the A and B ranges of application. Solution B covers the A ranges of application.
- (2) The solutions shown in the figures refer to one phase.
- (3) The application range limits are also valid for different diameters than the shown ones.

8.2 Cables diameters

Single-core					
Nominal cross-section [mm²]	3.6 kV	7.2 kV	12 kV	17.5 kV	24 kV
10	14.0	16.5	19.7	–	–
16	15.0	17.5	21.1	23.4	–
25	16.7	18.8	22.4	24.7	27.8
35	17.6	20.1	23.3	25.6	27.7
50	18.9	21.4	24.6	26.9	29.0
70	21.1	23.6	26.4	28.7	31.0
95	23.1	25.2	28.0	30.3	33.1
120	24.7	26.8	29.6	32.6	34.6
150	26.1	28.1	31.2	33.9	36.0
185	27.8	29.9	33.4	35.7	37.8
240	30.2	32.6	35.8	38.1	40.2
300	32.8	35.3	38.5	40.8	42.9
400	35.6	37.7	40.9	43.6	45.7
500	39.6	41.7	44.9	47.2	49.7
630	43.9	46.0	49.4	52.1	54.2

Three-core					
Nominal cross-section [mm²]	3.6 kV	7.2 kV	12 kV	17.5 kV	24 kV
10	25.6	30.3	36.5	–	–
16	27.7	32.4	39.2	44.6	–
25	30.7	35.3	42.0	47.4	54.5
35	33.1	37.4	44.5	49.8	54.7
50	35.6	40.7	47.2	52.9	57.4
70	40.0	44.5	51.4	56.7	62.0
95	43.6	48.5	55.4	60.7	65.9
120	47.4	52.3	58.7	64.4	69.3
150	50.3	55.2	62.5	67.7	72.6
185	54.5	59.4	66.6	71.9	76.8
240	60.1	65.3	72.2	77.5	82.0
300	65.7	70.6	78.4	83.3	88.7
400	71.4	76.3	84.5	89.9	–
500	80.9	86.2	92.7	–	–
630	–	–	–	–	–

Three-core armored					
Nominal cross-section [mm²]	3.6 kV	7.2 kV	12 kV	17.5 kV	24 kV
10	28.2	32.7	40.3	–	–
16	30.3	35.2	42.4	48.1	–
25	33.1	38.4	45.6	51.3	58.5
35	35.6	40.5	48.0	53.4	58.3
50	38.7	43.1	51.1	56.5	61.8
70	42.5	47.4	55.3	60.7	65.6
95	46.5	51.4	58.9	64.7	69.5
120	50.3	55.2	63.1	68.4	73.7
150	53.6	58.5	66.0	71.7	76.6
185	57.8	62.7	70.2	75.9	80.8
240	63.4	68.7	76.1	81.5	86.6
300	68.7	74.0	82.4	87.9	92.8
400	75.2	80.1	88.3	93.6	–
500	84.3	89.4	96.4	–	–
630	–	–	–	–	–



9. Technical data

9.1 Weight

Rated voltage [kV]	Unit width [mm]	Unit depth [mm]	
		1550	2000
12	600	400...450 kg	500...550 kg
	750	450...500 kg	570...620 kg
	1000	550...600 kg	700...750 kg

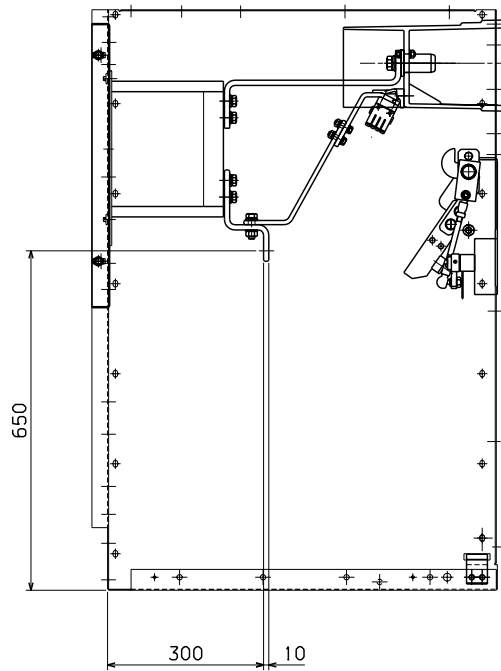
Rated voltage [kV]	Unit width [mm]	Unit depth [mm]	
		1550	2000
17.5	600	400...450 kg	500...550 kg
	750	450...500 kg	570...620 kg
	1000	550...600 kg	700...750 kg

Rated voltage [kV]	Unit width [mm]	Unit depth [mm]	
		1900	2300
24	750	500...550 kg	580...630 kg
	1000	600...650 kg	700...750 kg

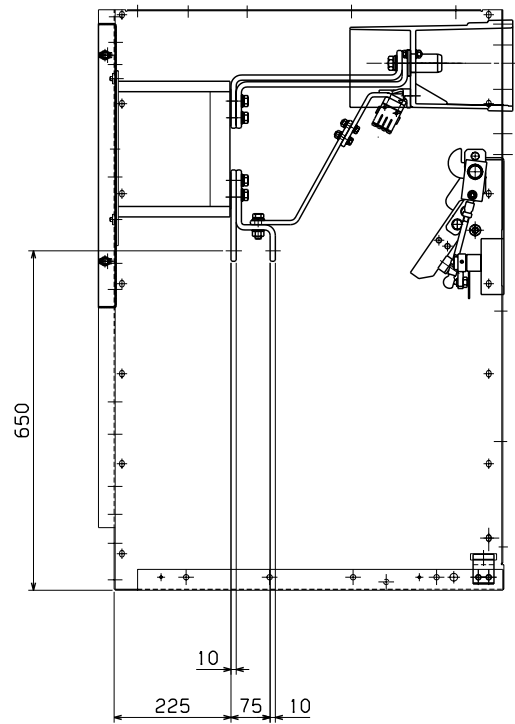
NOTE: The indicated weights do not include the apparatus (circuit-breakers, contactors), transformers and/or measuring sensors and the auxiliary apparatus.

9.2 Cable connections

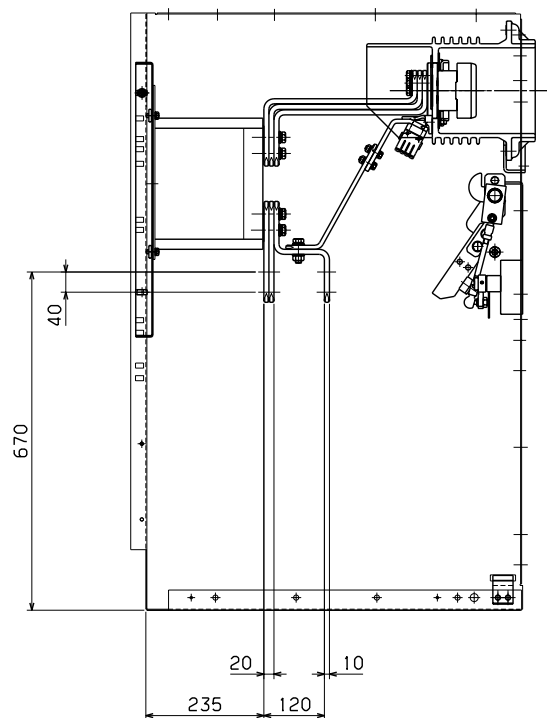
12-17.5 kV / Width 600-750 / 630 A



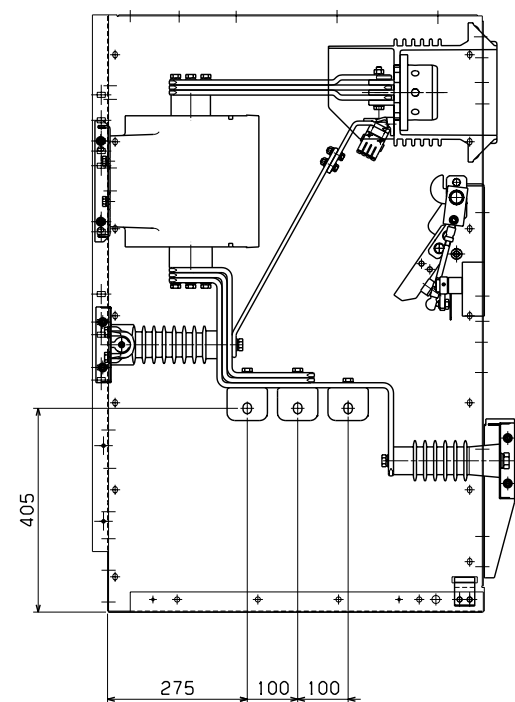
12-17.5 kV / Width 600-750 / 1250 A



12-17.5 kV / Width 750-1000 / 1600-2000-2500 A

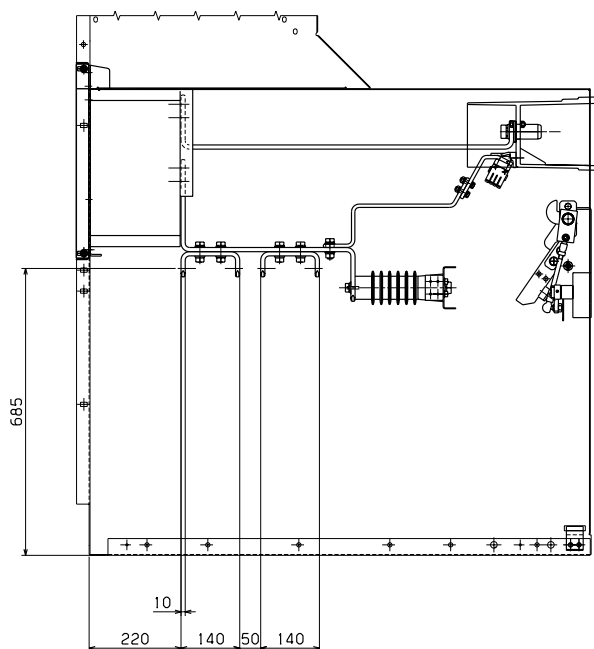


12-17.5 kV / Width 1000 / 3150-3600-4000 A

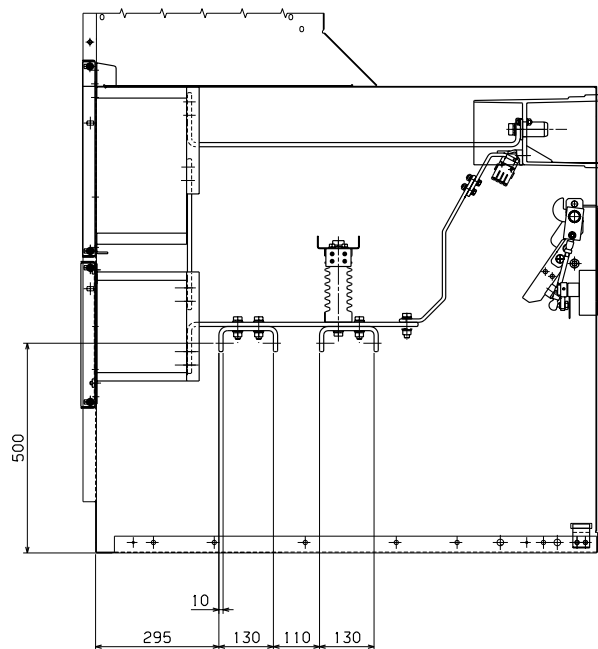


9. Technical data

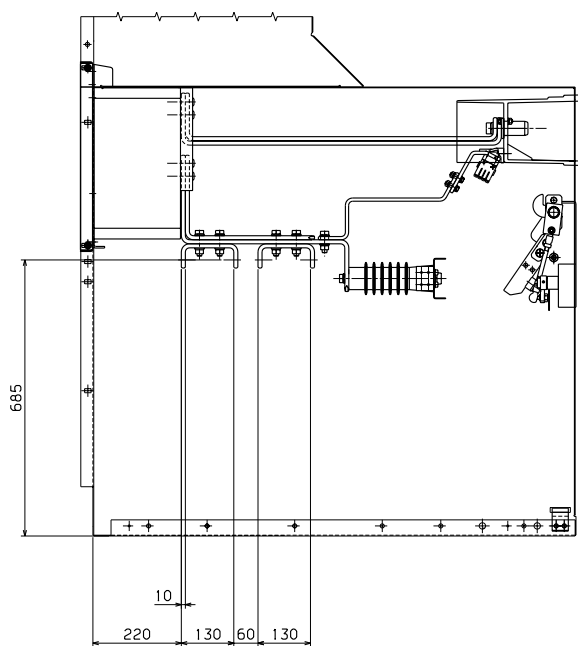
12-17.5 kV / Width 600 deeper / 630 A with 3 CT



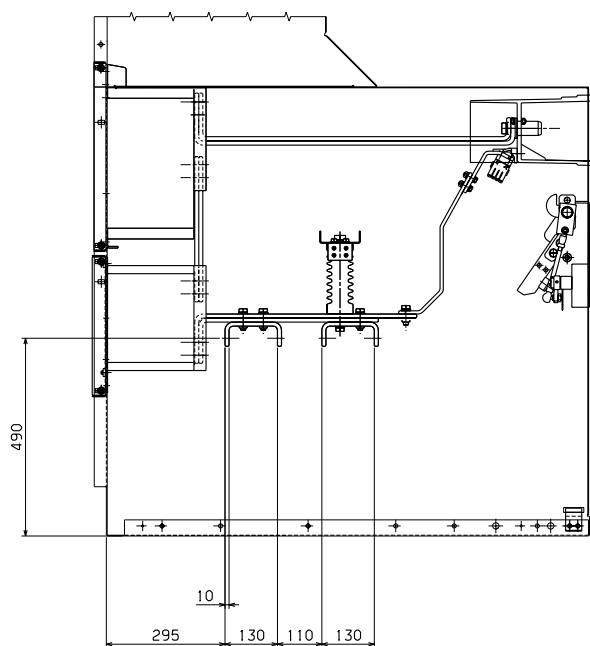
12-17.5 kV / Width 600 deeper / 630 A with 6 CT

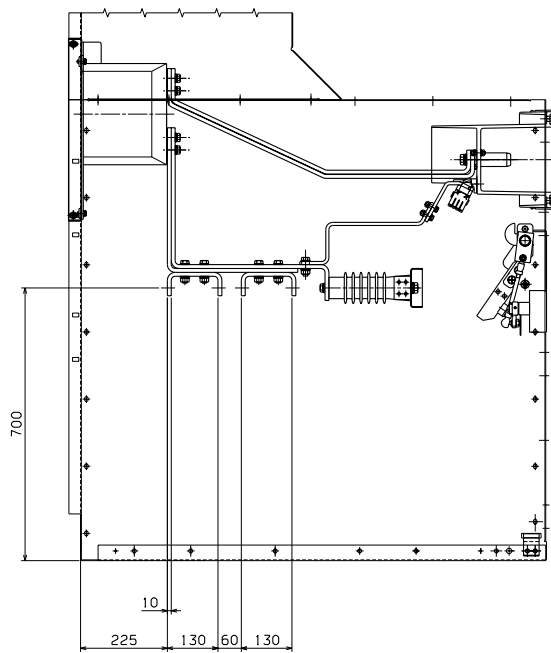
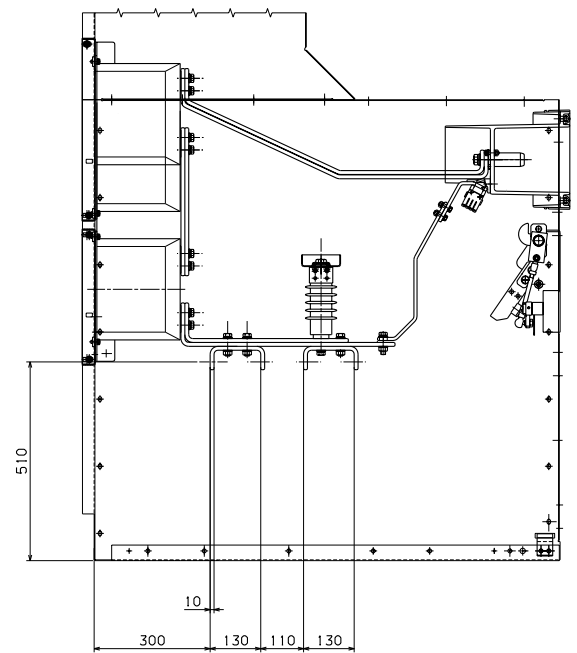
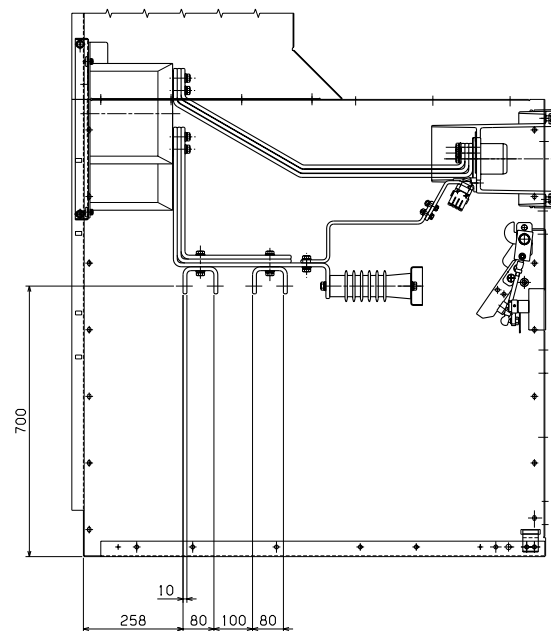
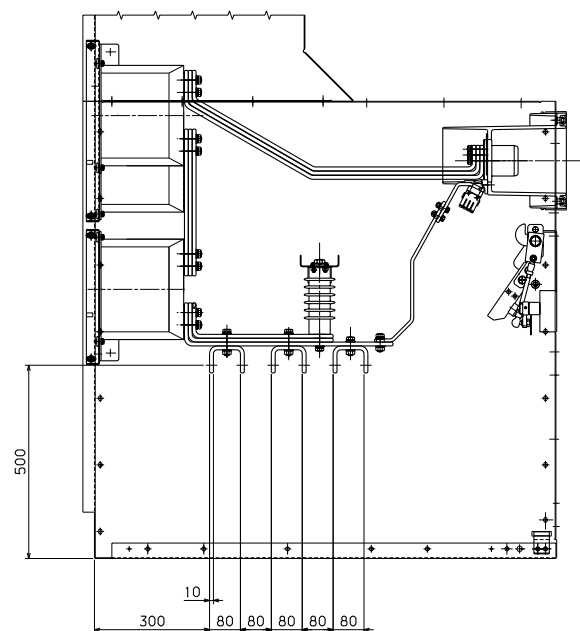


12-17.5 kV / Width 600 deeper / 1250 A with 3 CT



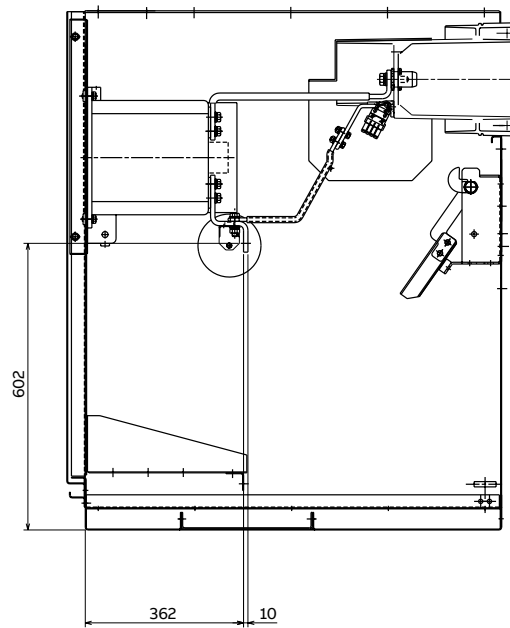
12-17.5 kV / Width 600 deeper / 1250 A with 6 CT



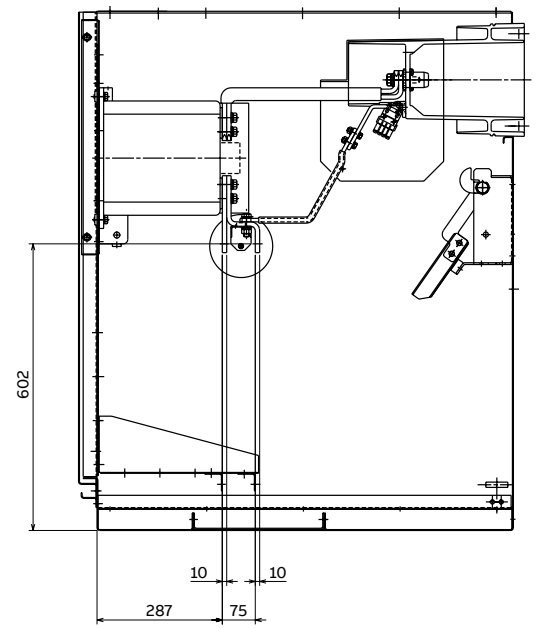
12-17.5 kV / Width 750 deeper / 1250 A with 3 CT**12-17.5 kV / Width 750 deeper / 1250 A with 6 CT****12-17.5 kV / Width 750-1000 deeper /
1600-2000-2500 A with 3 CT****12-17.5 kV / Width 750-1000 deeper /
1600-2000-2500 A with 6 CT**

9. Technical data

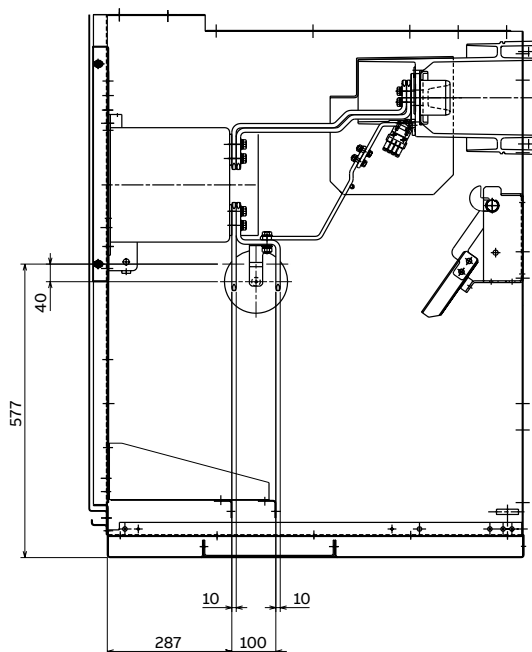
24 kV / Width 750 / 630 A



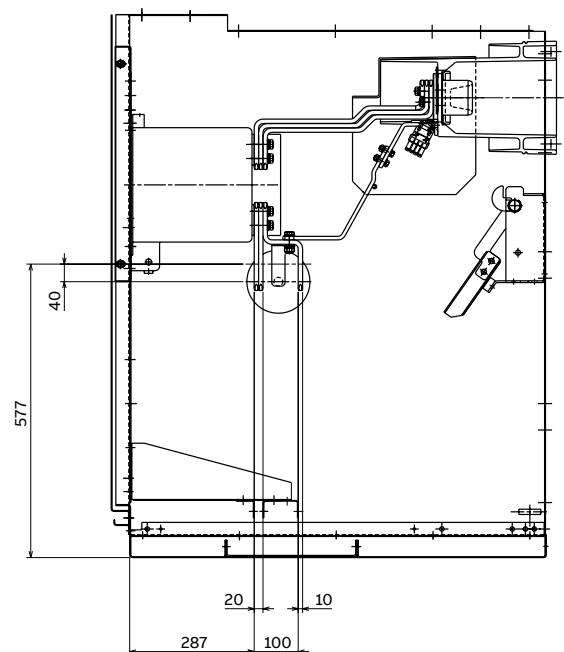
24 kV / Width 750 / 1250 A



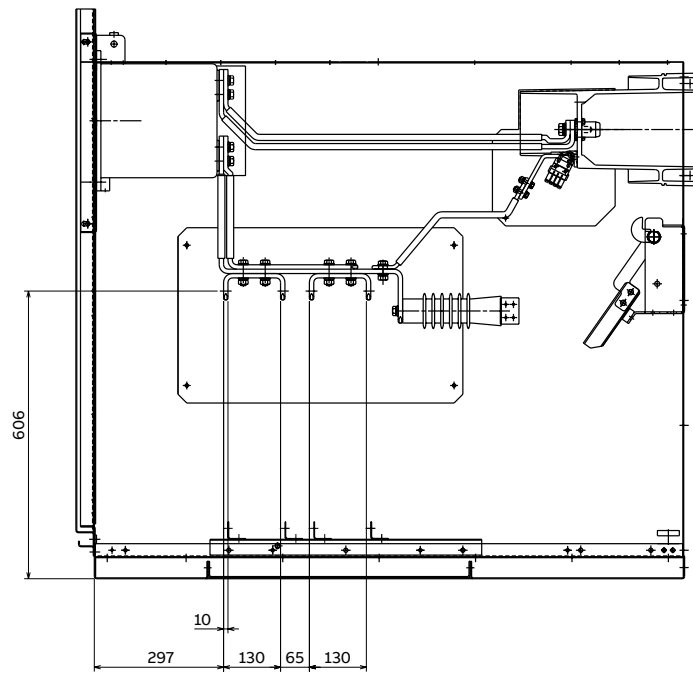
24 kV / Width 1000 / 1600 A



24 kV / Width 1000 / 2000-2500 A

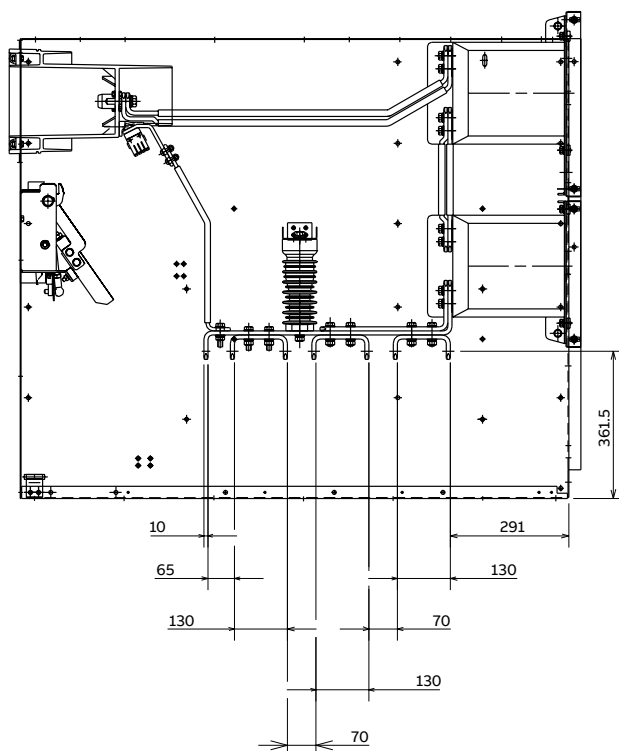


24 kV / Width 750 deeper / 1250 A with 3 CT

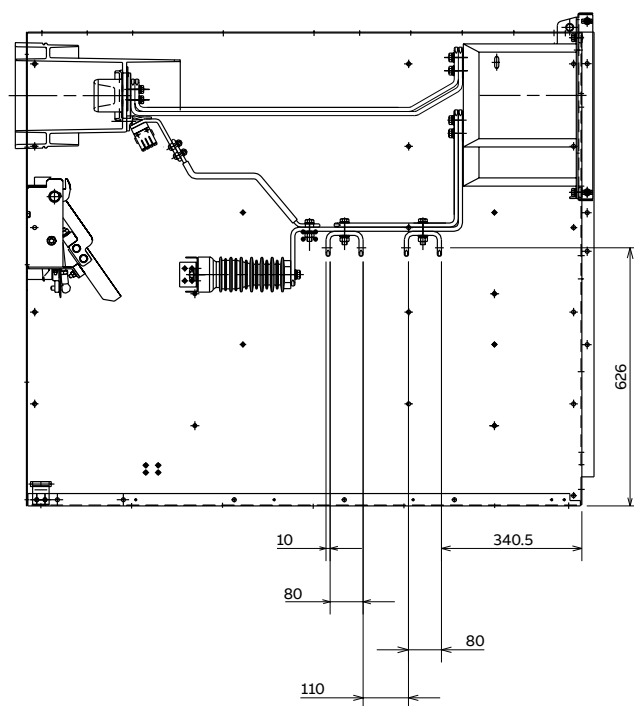


9. Technical data

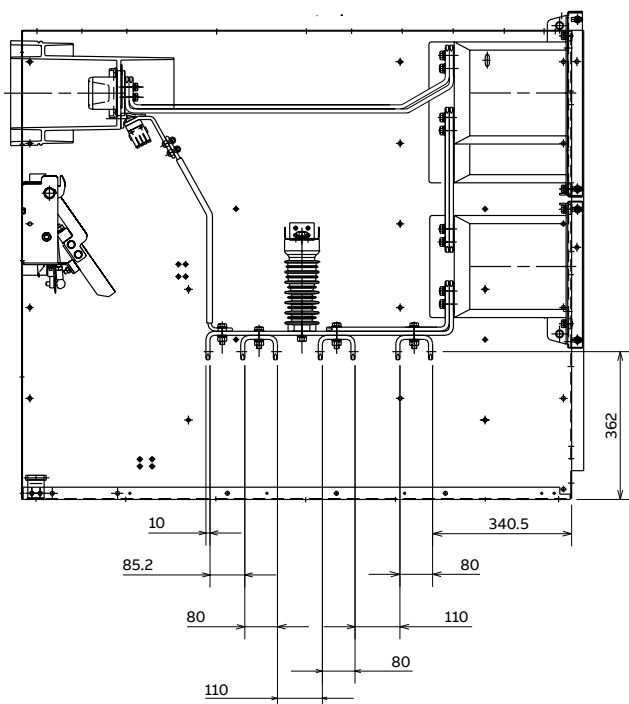
24 kV / Width 750 deeper / 1250 A with 6 CT



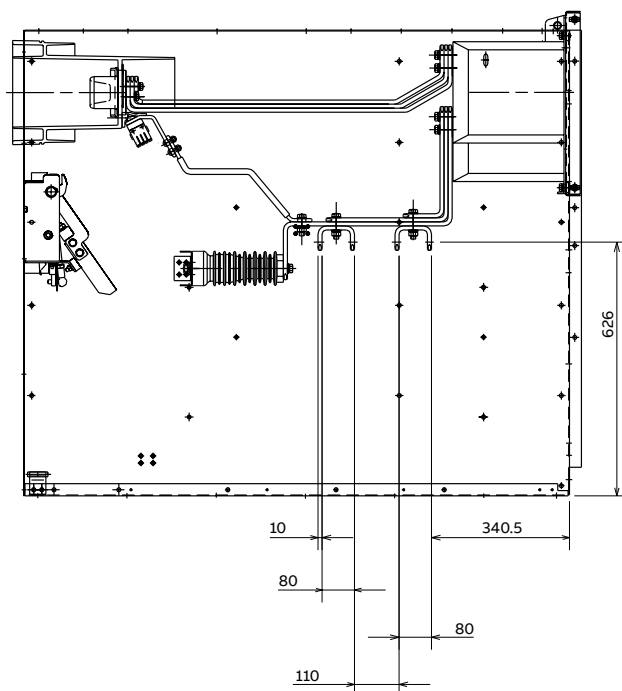
24 kV / Width 1000 deeper / 1600 A with 3 CT



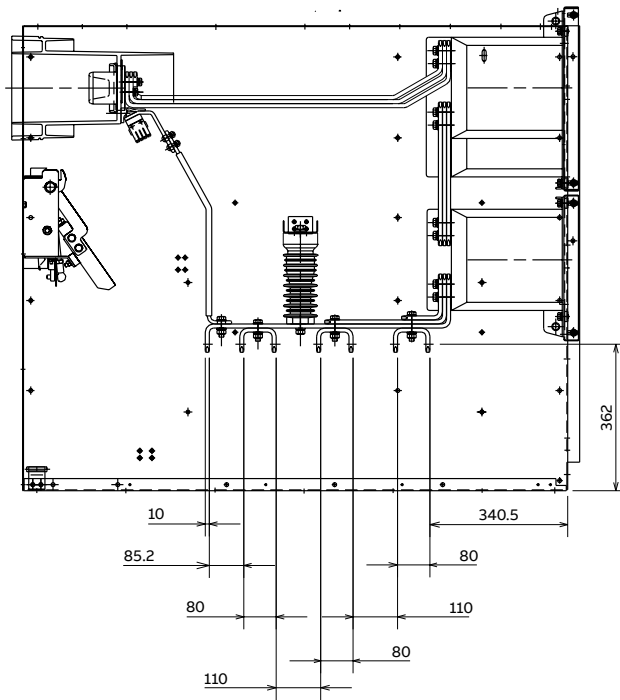
24 kV / Width 1000 deeper / 1600 A with 6 CT



24 kV / Width 1000 deeper / 2000-2500 A with 3 CT



24 kV / Width 1000 deeper / 2000 - 2500 A with 6 CT



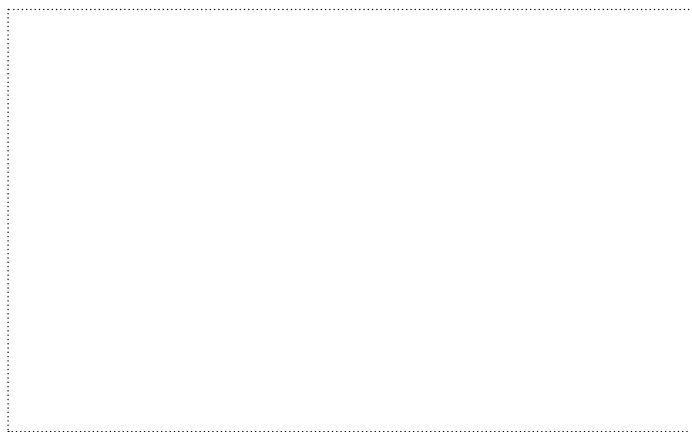




Notes

A large grid of dots for taking notes, consisting of 20 rows and 30 columns of small, evenly spaced dots.

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