Medium voltage products

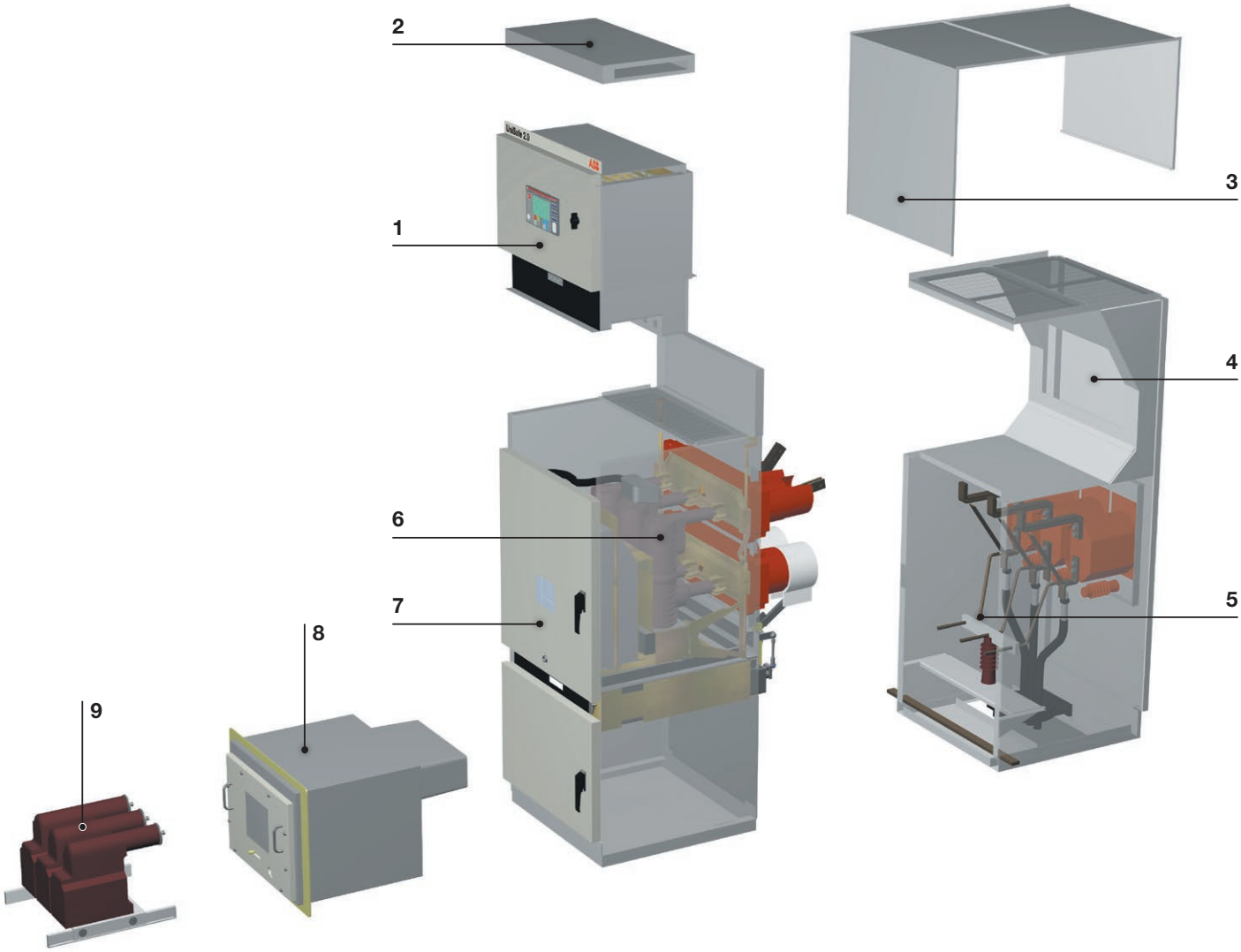
UniSafe 2.0 TCA
Technical Guide

Summary

1. Description

1.1 Compartments

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



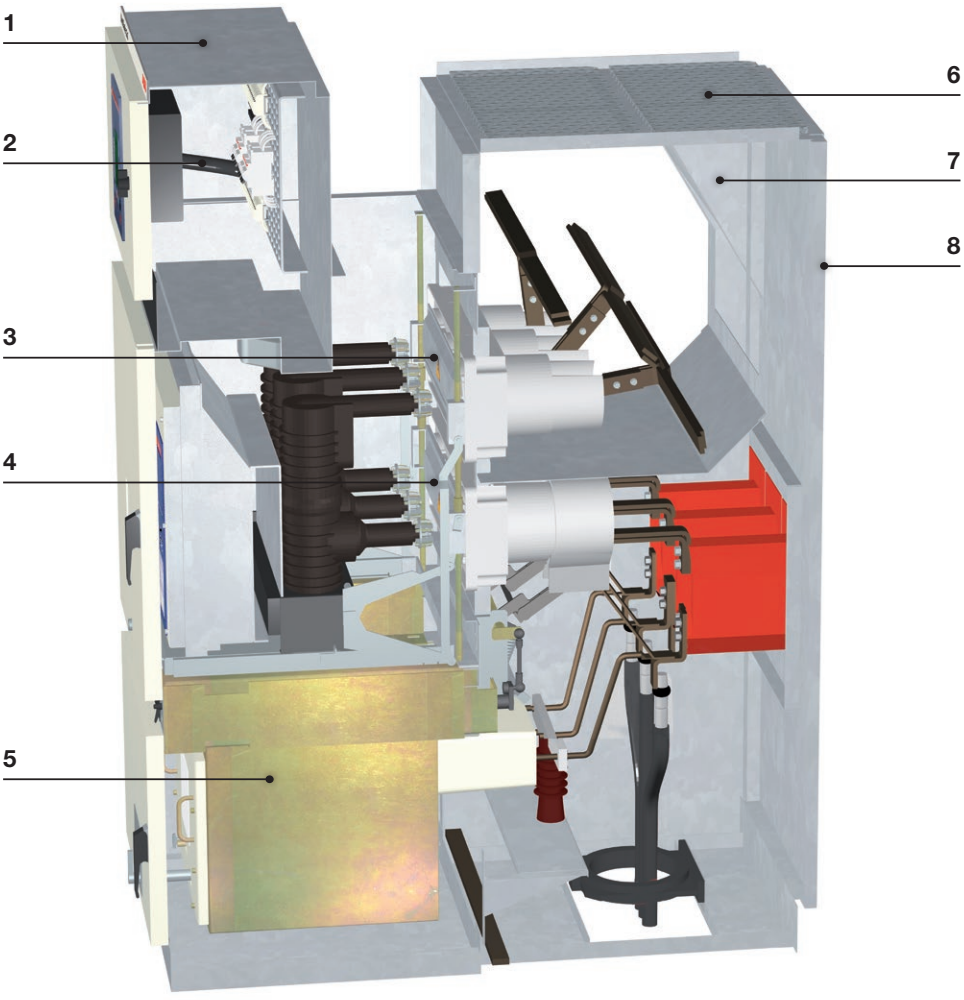
1 Instrument compartment
2 Auxiliary circuit interconnection wiring duct
3 Gas exhaust duct
4 Busbar compartment
5 Feeder compartment
6 Circuit-breaker
7 Circuit-breaker compartment
8 Withdrawable voltage transformers compartment
9 Withdrawable voltage transformers with fuses

1. Description

1.2 Components of the structure

1.2.1 Pre-galvanised 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).

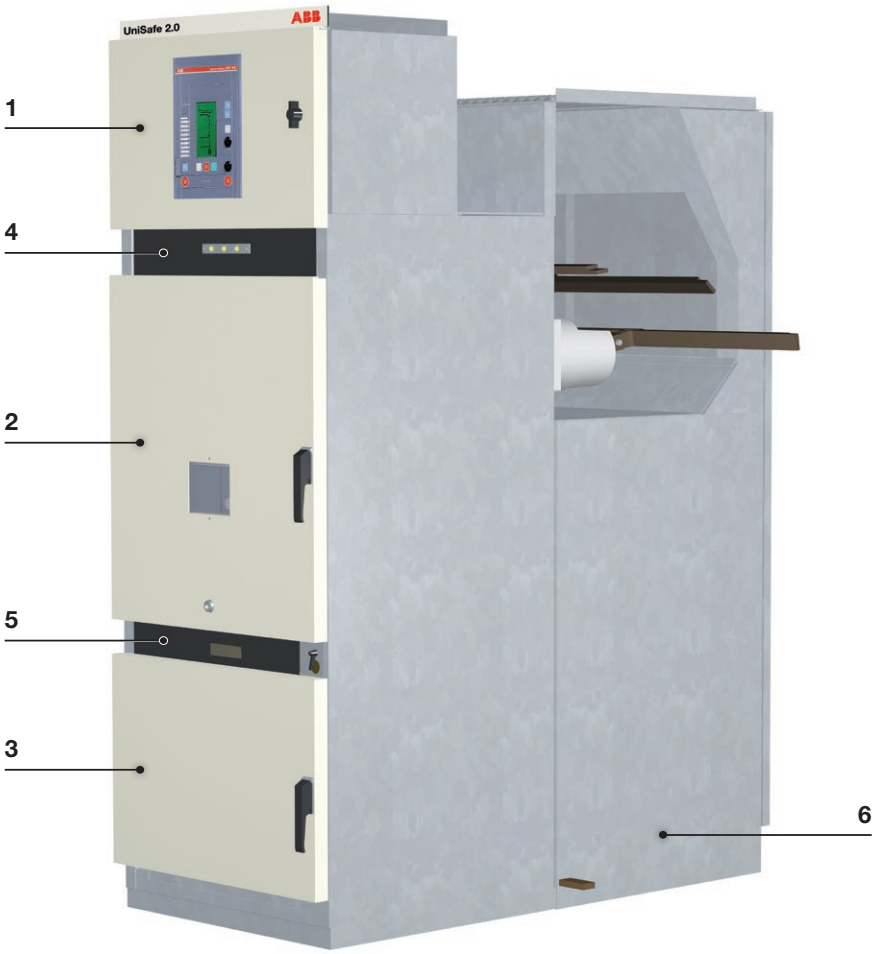


1 Wiring duct
2 Instrument support
3 Top shutter
4 Bottom shutter
5 Compartments (e.g. VT)
6 Gas exhaust flap
7 Segregations
8 Closing panels

1.2.2 Painted sheet-steel

Type:	UNI EN 10130 DC01-B-m
Standard colour:	RAL7035 (doors and end panels)
Standard colour:	RAL7012 (horizontal bands)
Thickness:	3 mm for the doors – 2 mm for the other components
Weight:	52…60 Kg
Use:	auxiliary compartment doors, circuit-breaker and feeder, end panels (also available painted on request).

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 panels	0.8
2000 mm deep end panels	1
24 kV	**Kg**
750 mm wide units	0.4
1000 mm wide units	0.5
1900 mm deep end panels	1
2300 mm deep end panels	1.2



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

1. Description

1.2.3 Copper

Type: UNI EN 5649 Cu ETP[1]

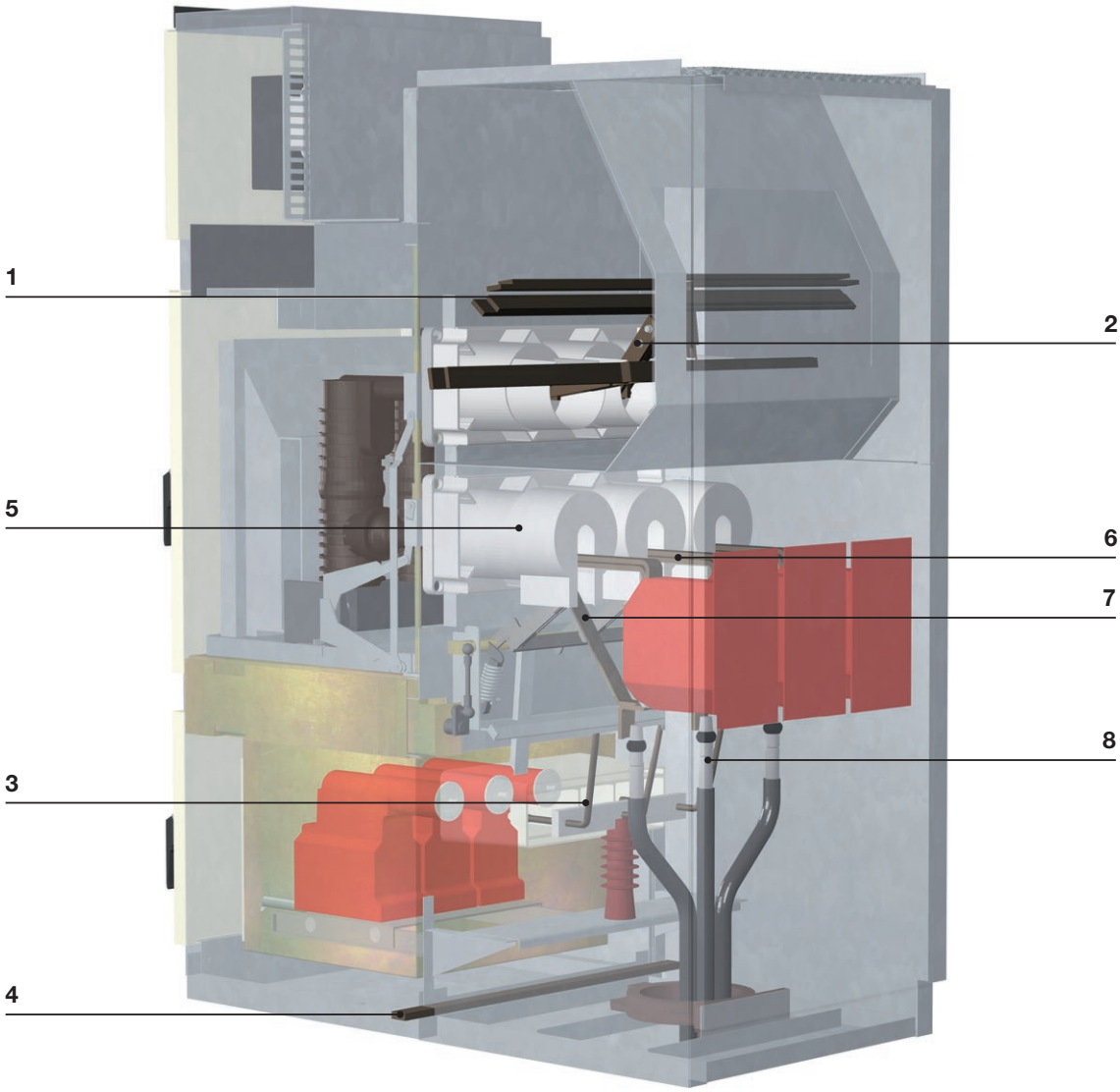
12-17.5 kV				
Rated current (A)	**Cross-section of main busbars (mm)**	**Cross-section of top branches (mm)**	**Cross-section of bottom branches (mm)**	**Cross-section of earthing busbar (mm)**
–	–	–	–	1x40x10
630	–	1x40x10	1x40x10	–
1250	2x40x10	2x40x10	2x40x10	–
1600	3x60x10	3x50x10	3x60x10	–
2000	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.
On request, the main busbar system and the branches can be supplied 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.



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

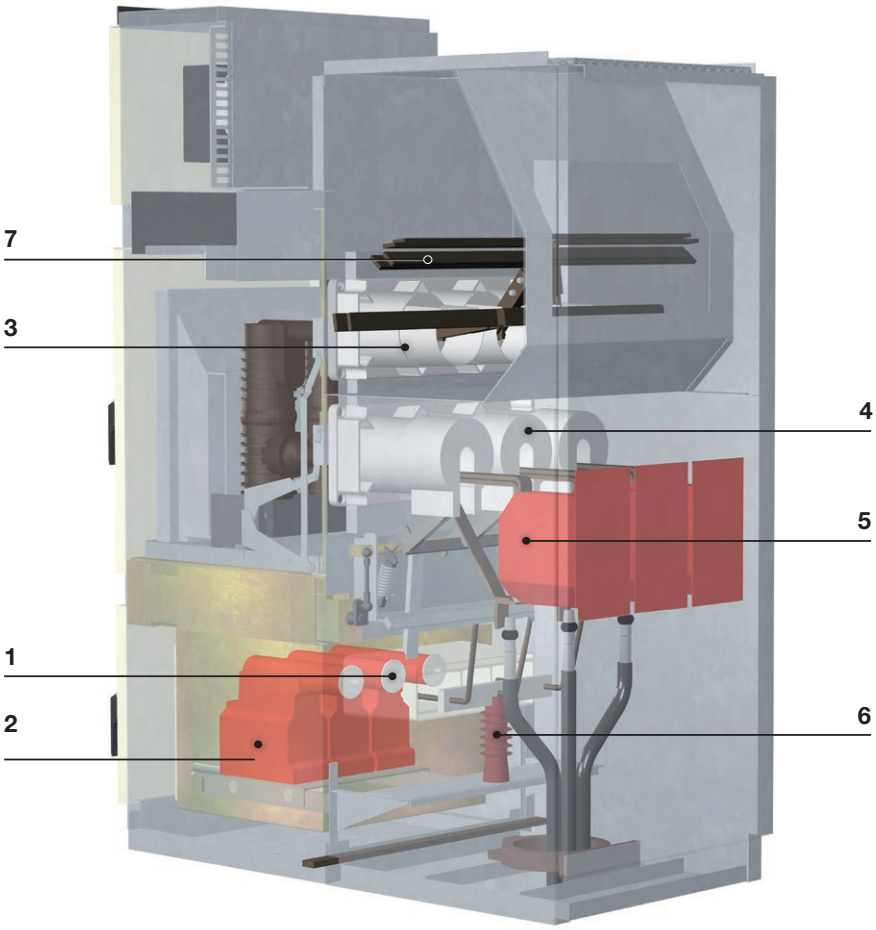
1.2.4 Insulating materials

Type:	Polyester glass
Weight (average):	30…40 Kg
Use:	circuit-breaker compartment and with-drawable VTs compartment monoblocks.

Type:	Epoxy resin
Weight (average):	2 Kg
Use:	insulating covering of busbars and branches (when requested).

Type:	Epoxy resin
Weight:	see chap. 6
Use:	CTs, VTs, sensors, insulators (in variable quantities, see single units - chap. 2 and 3).

Type:	Polycarbonate
Weight:	0.1 Kg
Use:	Inspection window.



1 Withdrawable VTs compartment monoblock
2 VTs
3 Top monoblock
4 Bottom monoblock
5 CTs
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	31.5	31.5
Peak current	kA	80	80	80
Rated short-time withstand current	kA (1s)	50	50	–
Peak current	kA	125	125	–
Internal arc withstand current	kA (1s)	31.5-40	31.5-40	31.5
	kA (0.5s)	50	50	–
Branch connectors rated currents	A	630 1250 1600 2000 2500 3150 3600[2] 4000[2]	630 1250 1600 2000 2500 3150 3600[2] 4000[2]	630 1250 1600 2000 2500[2]
Main busbars rated currents	A	1250 1600 2000 2500 3150 3600[2] 4000[2]	1250 1600 2000 2500 3150 3600[2] 4000[2]	1250 1600 2000 2500[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.

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)	40-50	40-50	–
Making capacity	kAp	80	80	80
		125	125	–

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	1-2-3-4	1-3-4	3-4	3-4	3-4	3-4	3-4	3	3	3
IFM	Incoming feeder with measurement	9	9	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	9	9	9	9	9	9	9
BT	Bus-Tie	9	1-3-4	9	3-4	3-4	3-4	3-4	3	3	3
BTM	Bus-Tie with measurement	9	9	9	3-4-7	3-4-7	3-4-7	3-4-7	3	3	3
IFD	Incoming feeder direct	10	10	10	10	10	10	10	10	10	10
IFDM	Incoming feeder direct with measurement	10	10	10	10	10	10	10	10	10	10

1 Available with Vmax
2 Available with V-Contact
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
10 Available only as a DTO (Design to order)

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	1-3-4	1-3-4	3-4	3-4	3-4	3-4	3-4	3	3	3
IFM	Incoming feeder with measurement	9	9	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	9	9	9	9	9	9	9
BT	Bus-Tie	9	1-3-4	9	3-4	3-4	3-4	3-5	3	3	3
BTM	Bus-Tie with measurement	9	9	9	3-4-7	3-4-7	3-4-7	3-4-7	3	3	3
IFD	Incoming feeder direct	10	10	10	10	10	10	10	10	10	10
IFDM	Incoming feeder direct with measurement	10	10	10	10	10	10	10	10	10	10

1 Available with Vmax
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
10 Available only as a DTO (Design to order)

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
IFD	Incoming feeder direct	8	8	8	8	8
IFDM	Incoming feeder direct with measurement	8	8	8	8	8

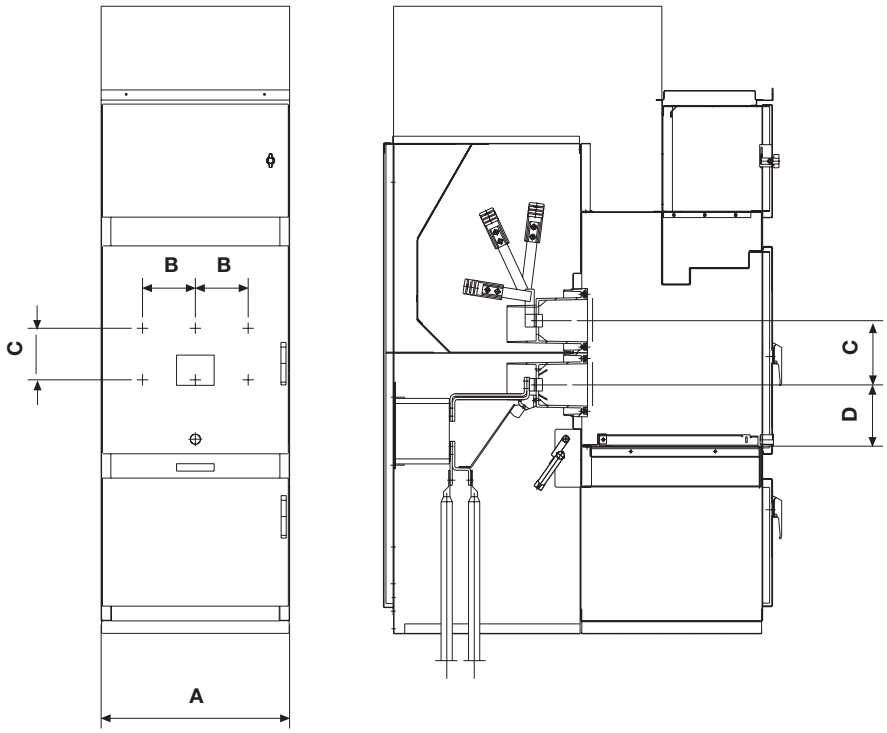
1 Available with HD4 and VD4
2 Available with VM1
3 With Metering truck
4 With VT compartment in the standard solution
5 With VT compartment in deeper solution
6 Available solution
7 Not available solution
8 Available only as a DTO (Design to order)

Busbars applications					
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 available only as a DTO (Design to order)

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 / Vmax 630-1250A / VSC 400A
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 / Vmax 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
1000	275	310	349	VD4 1600-2000-2500A / HD4 1600-200-2500A / VM1 1600-2000-2500A

12-17.5 kV / 40-50 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

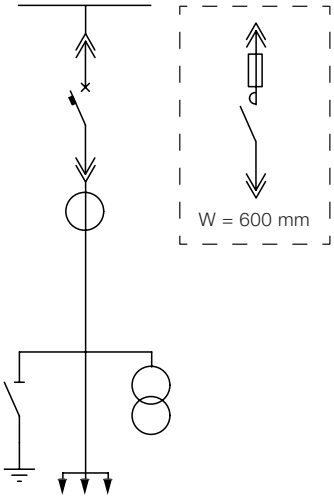
General notes

Each short size current transformer can be replaced by an ABB KEVCD sensor.
The earthing switch is not a compulsory switchboard accessory.

2.1 Incoming-outgoing unit (IF)

2.1.1 Bottom cable entry

		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		■ (1)	■ (1)		■	
1250		■ (1)	■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■ (2)		
3600				■ (2)		
4000				■ (2)		
Earthing switch		■	■	■	■	■
Number of cable connections	nr.	2	3	3	2	3
Number of CTs 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 VTs for phase (alternative combinations)						
1 fixed		■	■			
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

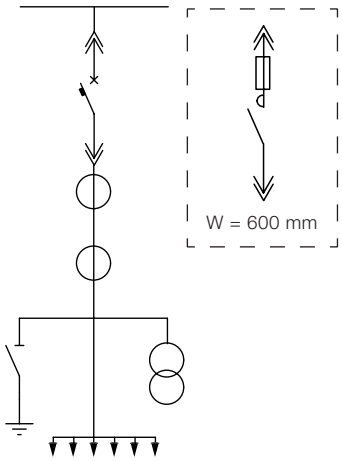


(1) ≤ 31.5 kA version
(2) Current transformers for range from 3150 A to 4000 A (KOKS type)
(3) Only for current range 2500 A

2. Typical conventional units

2.1.2 Bottom cable entry[1]

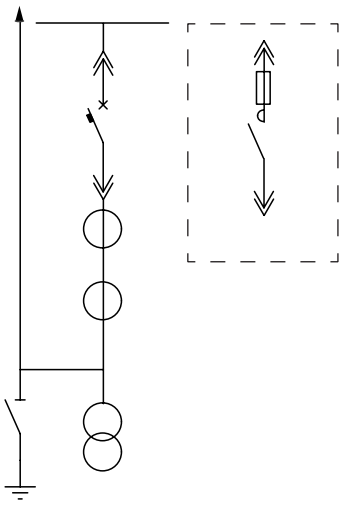
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	2000	2000	2000	2300	2300
Rated current	A					
630		■				
1250		■	■		■	
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch		■	■	■	■	
Number of cable connections	nr.	4	4	4	4	
Number of CTs for phase (alternative combinations)						
1 short size		■	■	■	■	
1 long size		■	■	■	■	
2 short size		■	■	■	■	
1 short and 1 long size		■	■	■	■	
Number of VTs 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]

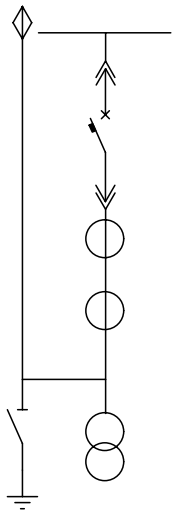
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2700	2700	2700	2850	2850
Height with gas exhaust duct	mm	2700	2700	2700	2850	2850
Depth	mm	2235	2235	2235	2645	2645
Rated current	A					
630						
1250			■		■	
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch			■	■	■	
Number of cable connections	nr.		4	4	4	
Number of CTs for phase (alternative combinations)						
1 short size			■	■	■	
1 long size			■	■	■	
2 short size			■	■	■	
1 short and 1 long size			■	■	■	
Number of VTs 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]



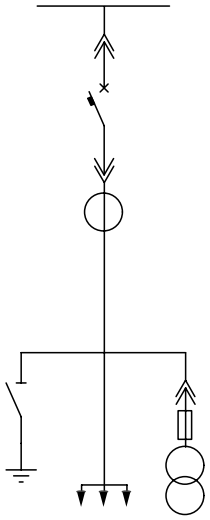
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	1550	2000	2000	2300	2300
Rated current	A					
630						
1250			■			
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch			■	■		
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size			■	■		
1 long size			■	■		
2 short size			■	■		
1 short and 1 long size			■	■		
Number of VTs 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	
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			■ (1)		■	
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■ (2)		
3600				■ (2)		
4000				■ (2)		
Earthing switch			■	■	■	■
Number of cable connections	nr.		3	3	2	3
Number of CTs 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 VTs for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses			■	■	■	■
1 fixed and 1 withdrawable with fuses						

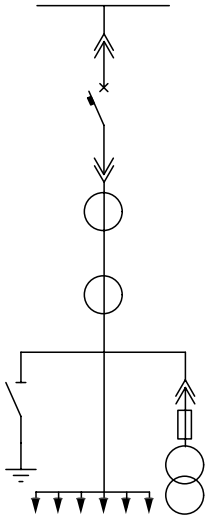


(1) ≤ 31.5 kA version
(2) Current transformers for range from 3150 A to 4000 A (KOKS type)
(3) Only for current range 2500 A

2. Typical conventional units

2.2.2 Bottom cable entry[1] - deeper version

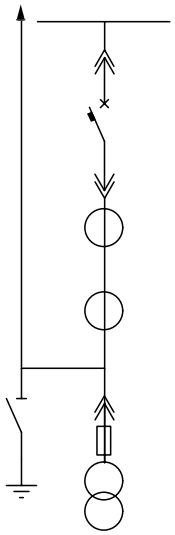
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	1550	2000	2000	2300	2300
Rated current	A					
630						
1250			■		■	
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch			■	■	■	
Number of cable connections	nr.		4	4	4-6	
Number of CTs for phase (alternative combinations)						
1 short size			■	■	■	
1 long size			■	■	■	
2 short size			■	■	■	
1 short and 1 long size			■	■	■	
Number of VTs 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

2.2.3 Top cable entry[1]

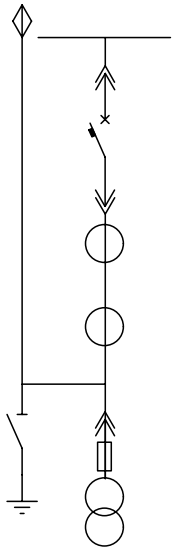
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2700	2700	2700	2850	2850
Height with gas exhaust duct	mm	2700	2700	2700	2850	2850
Depth	mm	2235	2235	2235	2645	2645
Rated current	A					
630						
1250			■		■	
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch			■	■	■	
Number of cable connections	nr.		4	4	4	
Number of CTs for phase (alternative combinations)						
1 short size			■	■	■	
1 long size			■	■	■	
2 short size			■	■	■	
1 short and 1 long size			■	■	■	
Number of VTs 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]



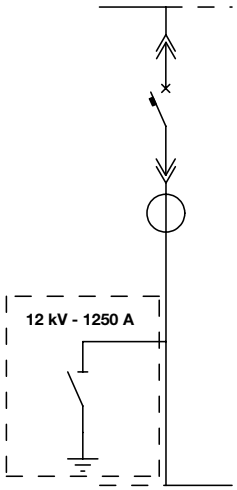
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	1550	2000	2000	2300	2300
Rated current	A					
630						
1250			■			
1600			■			
2000			■			
2500				■		
3150						
3600						
4000						
Earthing switch			■	■		
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size			■	■		
1 long size			■	■		
2 short size			■	■		
1 short and 1 long size			■	■		
Number of VTs 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	
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		■ (1)				
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■ (2)		
3600				■ (2)		
4000				■ (2)		
Earthing switch		■ (4)	■ (4)			
Number of cable connections	nr.					
Number of CTs 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 VTs for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

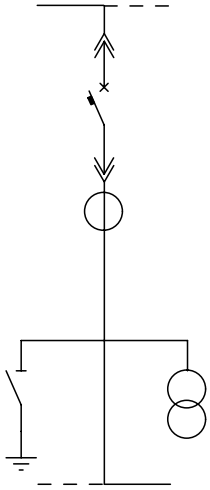


(1) ≤ 31.5 kA version
(2) Current transformers for range from 3150 A to 4000 A (KOKS type)
(3) Only for current range 2500 A
(4) Only for 12 kV and 1250 A

2. Typical conventional units

2.3.2 Deeper version[1]

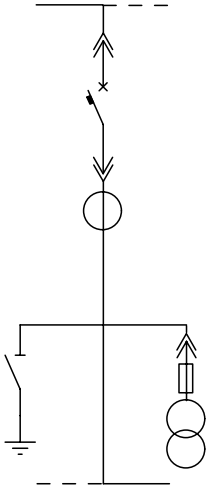
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	2000	2000	2000	2300	2300
Rated current	A					
630						
1250		■	■		■	
1600			■			■
2000			■			■
2500				■		■
3150						
3600						
4000						
Earthing switch		■	■	■	■	
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size		■	■	■	■	■
1 long size		■	■	■	■	■
2 short size						
1 short and 1 long size						
Number of VTs 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 Bus tie with measurement (BTM)[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	2000	2000	2000	2300	2300
Rated current	A					
630						
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150						
3600						
4000						
Earthing switch			■	■	■	
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size			■	■	■	■
1 long size			■	■	■	■
2 short size						
1 short and 1 long size						
Number of VTs for phase (alternative combinations)						
1 fixed						
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses			■	■	■	■
1 fixed and 1 withdrawable with fuses						



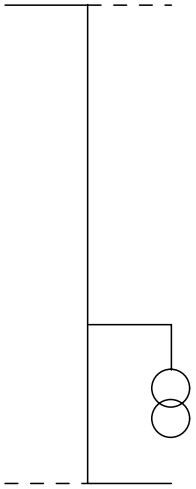
[1] ≤ 31.5 kA version

2. Typical conventional units

2.5 Bus riser (BR)

2.5.1 Conventional

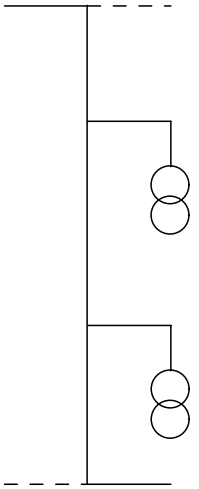
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	1550	1550	1550	1900	1900
Rated current	A					
630						
1250		■ (1) (2)	■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■		
3600				■		
4000				■		
Earthing switch						
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size						
1 long size						
2 short size						
1 short and 1 long size						
Number of VTs 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) Only 12 kV version

2.5.2 Deeper version[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	2000	2000	2000	2300	2300
Rated current	A					
630						
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150						
3600						
4000						
Earthing switch						
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size						
1 long size						
2 short size						
1 short and 1 long size						
Number of VTs for phase (alternative combinations)						
1 fixed			■	■	■	■
2 fixed			■	■	■	■
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

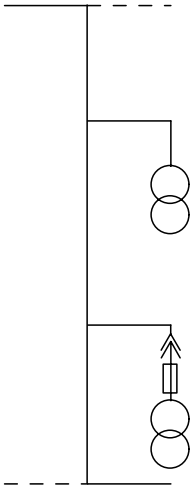


[1] ≤ 31.5 kA version

2. Typical conventional units

2.6 Bus riser with measurement (BRM)[1]

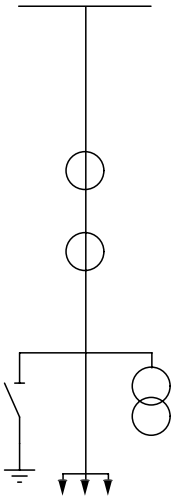
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	2000	2000	2000	2300	2300
Rated current	A					
630						
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150						
3600						
4000						
Earthing switch						
Number of cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size						
1 long size						
2 short size						
1 short and 1 long size						
Number of VTs 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

2.7 Incoming-outgoing unit direct (IFD)[4]

		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		■ [1]	■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■ [2]		
3600				■ [2]		
4000				■ [2]		
Earthing switch		■	■	■	■	■
Number of cable connections	nr.	2	3	3	2	3
Number of CTs for phase (alternative combinations)						
1 short size		■	■	■ [2] [3]	■	■
1 long size		■	■	■ [2] [3]	■	■
2 short size		■	■	■ [2] [3]	■	■
1 short and 1 long size		■	■	■ [2] [3]	■	■
Number of VTs for phase (alternative combinations)						
1 fixed		■	■	■	■	■
2 fixed						
1 fixed with fuses						
1 withdrawable with fuses						
1 fixed and 1 withdrawable with fuses						

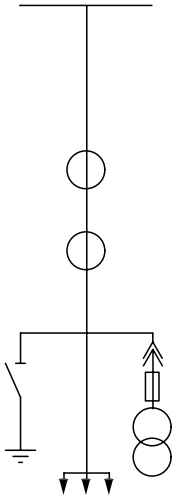


[1] ≤ 31.5 kA version
[2] Current transformers for range from 3150 A to 4000 A (KOKS type)
[3] Only for current range 2500 A
[4] Available only as a DTO (Design to order)

2. Typical conventional units

2.8 Incoming-outgoing unit direct with measurement (IFDM)[4]

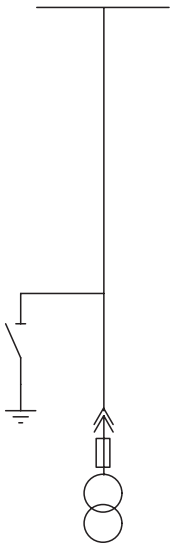
		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Height	mm	2160	2160	2160	2160	2160
Height with gas exhaust duct	mm	2510	2510	2510	2600	2600
Depth	mm	1550	1550	1550	1900	1900
Rated current	A					
630						
1250			■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■ [2]		
3600				■ [2]		
4000				■ [2]		
Earthing switch			■	■	■	■
Number of cable connections	nr.		3	3	2	3
Number of CTs for phase (alternative combinations)						
1 short size			■	■ [2] [3]	■	■
1 long size			■	■ [2] [3]	■	■
2 short size			■	■ [2] [3]	■	■
1 short and 1 long size			■	■ [2] [3]	■	■
Number of VTs 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
[4] Available only as a DTO (Design to order)

2.9 Measurement unit (M)

		12-17.5 kV			24 kV	
Width	mm	600[1]	750[2]	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 cable connections	nr.					
Number of CTs for phase (alternative combinations)						
1 short size						
1 long size						
2 short size						
1 short and 1 long size						
Number of VTs 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] ≥ 40 kA version

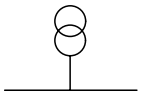
3. Busbar applications

3.1 Current transformers[1]

		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Busbars rated current	A					
1250		●	■ ●	●	●	●
1600		●	■ ●	●	●	●
2000		●	■ ●	●	●	●
2500		●	■ ●	■ ●	●	●
3150						
3600						
4000						

[1] ≤ 31.5 kA version
■ DIN Type
● TTR Type - Available only as DTO (Design to order)

3.2 Voltage transformers[1]



		12-17.5 kV			24 kV	
Width	mm	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[2]

		12-17.5 kV			24 kV	
Width	mm	600	750	1000	750	1000
Busbars rated current	A					
1250		■	■		■	
1600			■			■
2000			■			■
2500				■		■
3150				■		
3600				■		
4000				■		

[2] Available only as a DTO (Design to order)

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 60044-1
Voltage transformers	IEC 60044-2
Current sensors	IEC 60044-8 (CDV)
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 1,000 m above sea level. For higher altitude applications, please contact your ABB sales representative.
- Presence of normal, non-corrosive and uncontaminated atmosphere.

4. General characteristics

4.3 Level of insulation

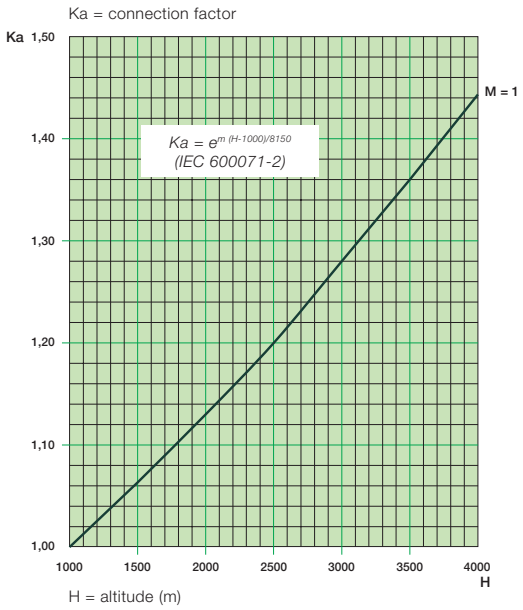
4.3.1 Reference Standards

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)	
	Across the isolating distance	Common value	Across the isolating distance	Common value
3.6	12	10	46	40
7.2	23	20	70	60
12	32	28	85	75
17.5	45	38	110	95
24	60	50	145	125

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/m^3).
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 below shows the correction factors according to the altitude.



Voltage test at industrial frequency (installation altitude) ≥ Test voltage at industrial frequency (according to IEC 62271-1) x Ka

Impulse withstand voltage (installation altitude) ≥ Impulse withstand voltage (according to IEC 62271-1) x Ka

4.3.3 Example of calculation

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 metres
Correction factor (Ka)	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

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

4.4 Degrees of protection

4.4.1 Reference Standards

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 are usually supplied with the following standard degrees of protection:

– External housing IP4X
– Inside the compartments IP2X

On request, the external housing can be supplied with other degrees of protection (IP43 maximum).

4. General characteristics

4.5 Internal arc withstanding

4.5.1 Reference Standards

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.
The criteria apply to the external switchgear housing.

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 2,8 metres with standard duct and 3,5 metres with standard duct with top chimneys and the degree of protection obtainable is up to IP43.
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).
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 gasexhausting zone and protect the gas exhaust channel extremity in order to avoid entry of water, dust, small animals and any foreign bodies.

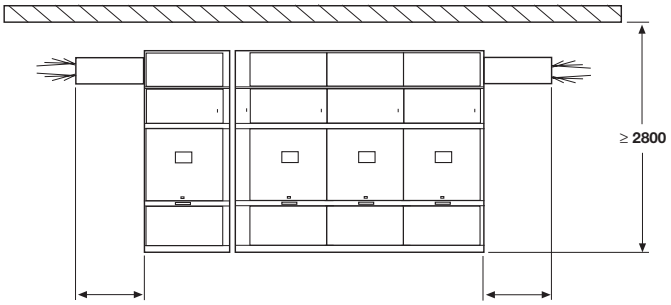
If the extremities of the gas duct are directed towards areas of the installation building that are accessible to personnel and/or dedicated to installation of other equipment, machines and plants, these extremities must be extended in order to permit the exhaust of the hot gases in zones that are not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

The extensions must be realised 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.

4.5.5 Standard duct arrangement

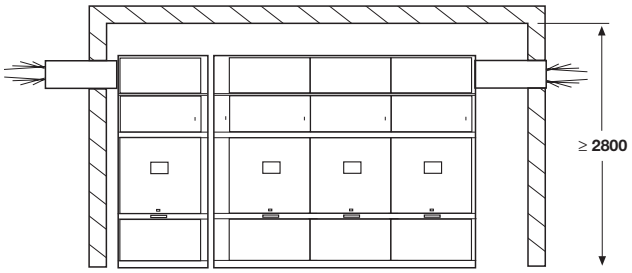
Evacuation from the room of the exhausted gas produced by the internal arc fault must normally be carried out. The following solutions can be used when it is possible to exhaust the gases outside the switchgear room:

Standard duct

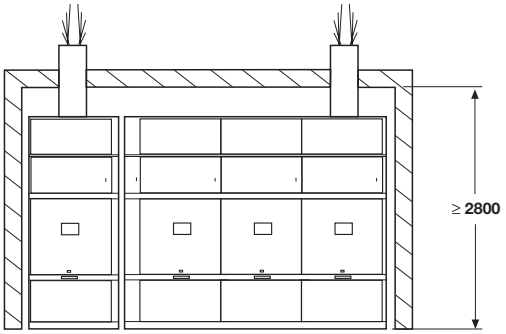


The following drawings illustrate some construction examples for exhaust gas evacuation from the room:

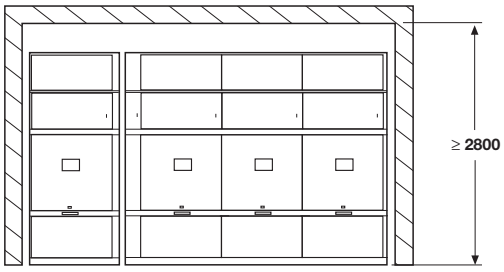
Example 1

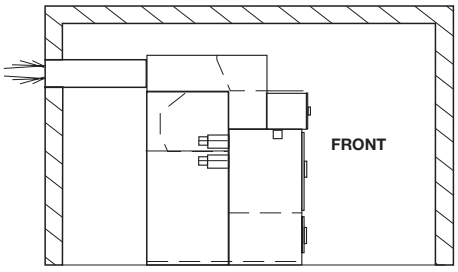


Example 2



Example 3



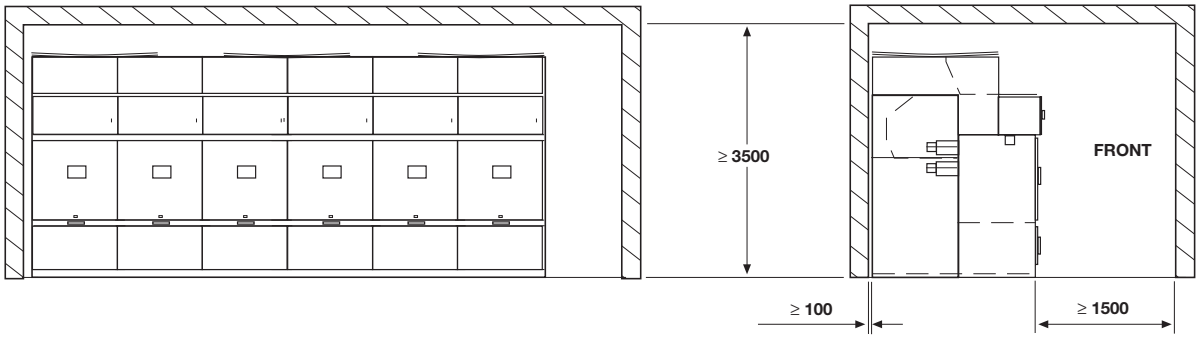


4. General characteristics

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:



Internal Arc Classified: general considerations

UniSafe 2.0 is a metal enclosed internal arc proof switchgear. It has been type tested according to IEC62271-200 Standard, Annex A fulfilling criteria 1 to 5.

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.

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.

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

5. Apparatus

5.1 HD4 withdrawable circuit-breakers for PowerCube units type PB

5.1.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of HD4 circuit-breakers (A - 40 °C)						Circuit-breaker		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 **17.5**	16 25 31.5	16 25 31.5	630 630 630						HD4/W 12.06.16 p150 HD4/W 12.06.25 p150 HD4/W 12.06.32 p150	HD4/W 17.06.16 p150 HD4/W 17.06.25 p150 HD4/W 17.06.32 p150	**PB 1/M**
	16 25 31.5	16 25 31.5	1250 1250 1250						HD4/W 12.12.16 p150 HD4/W 12.12.25 p150 HD4/W 12.12.32 p150	HD4/W 17.12.16 p150 HD4/W 17.12.25 p150 HD4/W 17.12.32 p150	
	16 25 31.5	16 25 31.5		630 630 630					HD4/W 12.06.16 p210 HD4/W 12.06.25 p210 HD4/W 12.06.32 p210	HD4/W 17.06.16 p210 HD4/W 17.06.25 p210 HD4/W 17.06.32 p210	**PB 2/M**
	16 25 31.5 40 50	16 25 31.5 40 50		1250 1250 1250 1250 1250					HD4/W 12.12.16 p210 HD4/W 12.12.25 p210 HD4/W 12.12.32 p210 HD4/W 12.12.40 p210 HD4/W 12.12.50 p210	HD4/W 17.12.16 p210 HD4/W 17.12.25 p210 HD4/W 17.12.32 p210 HD4/W 17.12.40 p210 HD4/W 17.12.50 p210	
	40 50	40 50			1250 1250				– –	– –	
	16 25 31.5 40 50	16 25 31.5 40 50			1600 1600 1600 1600 1600				HD4/W 12.16.16 p210 HD4/W 12.16.25 p210 HD4/W 12.16.32 p210 HD4/P 12.16.40 p210 HD4/P 12.16.50 p210	HD4/W 17.16.16 p210 HD4/W 17.16.25 p210 HD4/W 17.16.32 p210 HD4/P 17.16.40 p210 HD4/P 17.16.50 p210	
	16 25 31.5 40 50	16 25 31.5 40 50			2000 2000 2000 2000 2000				HD4/W 12.20.16 p210 HD4/W 12.20.25 p210 HD4/W 12.20.32 p210 HD4/P 12.20.40 p210 HD4/P 12.20.50 p210	HD4/W 17.20.16 p210 HD4/W 17.20.25 p210 HD4/W 17.20.32 p210 HD4/P 17.20.40 p210 HD4/P 17.20.50 p210	
	25 31.5 40 50	25 31.5 40 50				2500 2500 2500 2500			HD4/P 12.25.25 p275 HD4/P 12.25.32 p275 HD4/P 12.25.40 p275 HD4/P 12.25.50 p275	HD4/P 17.25.25 p275 HD4/P 17.25.32 p275 HD4/P 17.25.40 p275 HD4/P 17.25.50 p275	**PB 3/M**
	31.5 40 50	31.5 40 50				3150 3150 3150			HD4/W 12.32.32 p275 HD4/W 12.32.40 p275 HD4/W 12.32.50 p275	HD4/W 17.32.32 p275 HD4/W 17.32.40 p275 HD4/W 17.32.50 p275	
	31.5 40 50	31.5 40 50				3600(1) 3600(1) 3600(1)			HD4/W 12.32.32 p275 HD4/W 12.32.40 p275 HD4/W 12.32.50 p275	HD4/W 17.32.32 p275 HD4/W 17.32.40 p275 HD4/W 17.32.50 p275	
	31.5 40 50	31.5 40 50				4000(1) 4000(1) 4000(1)			HD4/W 12.32.32 p275 HD4/W 12.32.40 p275 HD4/W 12.32.50 p275	HD4/W 17.32.32 p275 HD4/W 17.32.40 p275 HD4/W 17.32.50 p275	
24	16 20 25	16 20 25					630 630 630		HD4/W 24.06.16 p210 HD4/W 24.06.20 p210 HD4/W 24.06.25 p210	– – –	**PB 4/M**
	16 20 25 31,5	16 20 25 31,5					1250 1250 1250 1250		HD4/W 24.12.16 p210 HD4/W 24.12.20 p210 HD4/W 24.12.25 p210 HD4/P 24.12.32 p210	– – – –	
	16 20 25 31.5	16 20 25 31.5						1600 1600 1600 1600	HD4/P 24.16.16 p275 HD4/P 24.16.20 p275 HD4/P 24.16.25 p275 HD4/P 24.16.32 p275	– – – –	**PB 5/M**
	16 20 25 31.5	16 20 25 31.5						2000 2000 2000 2000	HD4/P 24.20.16 p275 HD4/P 24.20.20 p275 HD4/P 24.20.25 p275 HD4/P 24.20.32 p275	– – – –	
	16 20 25 31.5	16 20 25 31.5						2500(2) 2500(2) 2500(2) 2500(2)	HD4/P 24.25.16 p275 HD4/P 24.25.20 p275 HD4/P 24.25.25 p275 HD4/P 24.25.32 p275	– – – –	

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) 3600 A with fan pre-installed in the PB3 modules. A further fan must be installed in the rear of the switchgear for 4000 A versions (at the customr's charge).
(2) 2500 A with fan pre-installed in the PB5 modules.

5. Apparatus

5.2 VD4 withdrawable circuit-breakers for PowerCube units type PB(*)

5.2.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of VD4 circuit-breakers (A - 40 °C)						Circuit-breaker		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 17.5	16 20 25 31.5	16 20 25 31.5	630 630 630 630						VD4/P 12.06.16 p150 VD4/P 12.06.20 p150 VD4/P 12.06.25 p150 VD4/P 12.06.32 p150	VD4/P 17.06.16 p150 VD4/P 17.06.20 p150 VD4/P 17.06.25 p150 VD4/P 17.06.32 p150	PB 1/M
	16 20 25 31.5	16 20 25 31.5	1250 1250 1250 1250						VD4/P 12.12.16 p150 VD4/P 12.12.20 p150 VD4/P 12.12.25 p150 VD4/P 12.12.32 p150	VD4/P 17.12.16 p150 VD4/P 17.12.20 p150 VD4/P 17.12.25 p150 VD4/P 17.12.32 p150	
	16 20 25 31.5	16 20 25 31.5		630 630 630 630					VD4/W 12.06.16 p210 VD4/W 12.06.20 p210 VD4/W 12.06.25 p210 VD4/W 12.06.32 p210	VD4/W 17.06.16 p210 VD4/W 17.06.20 p210 VD4/W 17.06.25 p210 VD4/W 17.06.32 p210	PB 2/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		1250 1250 1250 1250 1250 1250					VD4/W 12.12.16 p210 VD4/W 12.12.20 p210 VD4/W 12.12.25 p210 VD4/W 12.12.32 p210 VD4/W 12.12.40 p210 –	VD4/W 17.12.16 p210 VD4/W 17.12.20 p210 VD4/W 17.12.25 p210 VD4/W 17.12.32 p210 VD4/W 17.12.40 p210 –	
	40 50	40 50			1250 1250				VD4/P 12.12.40 p210 VD4/P 12.12.50 p210	VD4/P 17.12.40 p210 VD4/P 17.12.50 p210	
	20 25 31.5 40 50	20 25 31.5 40 50			1600 1600 1600 1600 1600				VD4/P 12.16.20 p210 VD4/P 12.16.25 p210 VD4/P 12.16.32 p210 VD4/P 12.16.40 p210 VD4/P 12.16.50 p210	VD4/P 17.16.20 p210 VD4/P 17.16.25 p210 VD4/P 17.16.32 p210 VD4/P 17.16.40 p210 VD4/P 17.16.50 p210	
	20 25 31.5 40 50	20 25 31.5 40 50			2000 2000 2000 2000 2000				VD4/P 12.20.20 p210 VD4/P 12.20.25 p210 VD4/P 12.20.32 p210 VD4/P 12.20.40 p210 VD4/P 12.20.50 p210	VD4/P 17.20.20 p210 VD4/P 17.20.25 p210 VD4/P 17.20.32 p210 VD4/P 17.20.40 p210 VD4/P 17.20.50 p210	
	20 25 31.5 40 50	20 25 31.5 40 50				2500 2500 2500 2500 2500			VD4/P 12.25.20 p275 VD4/P 12.25.25 p275 VD4/P 12.25.32 p275 VD4/P 12.25.40 p275 VD4/P 12.25.50 p275	VD4/P 17.25.20 p275 VD4/P 17.25.25 p275 VD4/P 17.25.32 p275 VD4/P 17.25.40 p275 VD4/P 17.25.50 p275	PB 3/M
	31.5 40 50	31.5 40 50				3150 3150 3150			VD4/W 12.32.32 p275 VD4/W 12.32.40 p275 VD4/W 12.32.50 p275	VD4/W 17.32.32 p275 VD4/W 17.32.40 p275 VD4/W 17.32.50 p275	
	31.5 40 50	31.5 40 50				3600(1) 3600(1) 3600(1)			VD4/W 12.32.32 p275 VD4/W 12.32.40 p275 VD4/W 12.32.50 p275	VD4/W 17.32.32 p275 VD4/W 17.32.40 p275 VD4/W 17.32.50 p275	
	31.5 40 50	31.5 40 50				4000(1) 4000(1) 4000(1)			VD4/W 12.32.32 p275 VD4/W 12.32.40 p275 VD4/W 12.32.50 p275	VD4/W 17.32.32 p275 VD4/W 17.32.40 p275 VD4/W 17.32.50 p275	
24	16 20 25	16 20 25					630 630 630		VD4/P 24.06.16 p210 VD4/P 24.06.20 p210 VD4/P 24.06.25 p210	– – –	PB 4/M
	16 20 25 31.5	16 20 25 31.5					1250 1250 1250 1250		VD4/P 24.12.16 p210 VD4/P 24.12.20 p210 VD4/P 24.12.25 p210 VD4/P 24.12.32 p210	– – – –	
	16 20 25 31.5	16 20 25 31.5						1600 1600 1600 1600	VD4/P 24.16.16 p275 VD4/P 24.16.20 p275 VD4/P 24.16.25 p275 VD4/P 24.16.32 p275	– – – –	PB 5/M
	16 20 25 31.5	16 20 25 31.5						2000 2000 2000 2000	VD4/P 24.20.16 p275 VD4/P 24.20.20 p275 VD4/P 24.20.25 p275 VD4/P 24.20.32 p275	– – – –	
	16 20 25 31.5	16 20 25 31.5						2500(2) 2500(2) 2500(2) 2500(2)	VD4/P 24.25.16 p275 VD4/P 24.25.20 p275 VD4/P 24.25.25 p275 VD4/P 24.25.32 p275	– – – –	

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(*) PowerCube units are not designed for the “powered trolley” application for VD4 circuit-breakers.
(1) 3600 A with fan pre-installed in the PB3 units. A further fan must be installed in the rear of the switchgear for 4000 A versions (at the customr’s charge).
(2) 2500 A with fan pre-installed in the PB5 units.

5.3 VM1 withdrawable circuit-breakers for PowerCube units type PB

5.3.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of VM1 circuit-breakers (A - 40 °C)						Circuit-breaker		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 17.5	16 20 25 31.5	16 20 25 31.5	630 630 630 630						VM1/P 12.06.16 p150 VM1/P 12.06.20 p150 VM1/P 12.06.25 p150 VM1/P 12.06.32 p150	VM1/P 17.06.16 p150 VM1/P 17.06.20 p150 VM1/P 17.06.25 p150 VM1/P 17.06.32 p150	PB 1/M
	16 20 25 31.5	16 20 25 31.5	1250 1250 1250 1250						VM1/P 12.12.16 p150 VM1/P 12.12.20 p150 VM1/P 12.12.25 p150 VM1/P 12.12.32 p150	VM1/P 17.12.16 p150 VM1/P 17.12.20 p150 VM1/P 17.12.25 p150 VM1/P 17.12.32 p150	
	16 20 25 31.5	16 20 25 31.5		630 630 630 630					VM1/W 12.06.16 p210 VM1/W 12.06.20 p210 VM1/W 12.06.25 p210 VM1/W 12.06.32 p210	VM1/W 17.06.16 p210 VM1/W 17.06.20 p210 VM1/W 17.06.25 p210 VM1/W 17.06.32 p210	PB 2/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		1250 1250 1250 1250 1250 1250					VM1/W 12.12.16 p210 VM1/W 12.12.20 p210 VM1/W 12.12.25 p210 VM1/W 12.12.32 p210 – –	VM1/W 17.12.16 p210 VM1/W 17.12.20 p210 VM1/W 17.12.25 p210 VM1/W 17.12.32 p210 – –	
	40 50	40 50			1250 1250				– –	– –	
	20 25 31.5 40 50	20 25 31.5 40 50			1600 1600 1600 1600 1600				VM1/P 12.16.20 p210 VM1/P 12.16.25 p210 VM1/P 12.16.32 p210 – –	VM1/P 17.16.20 p210 VM1/P 17.16.25 p210 VM1/P 17.16.32 p210 – –	
	20 25 31.5 40 50	20 25 31.5 40 50			2000 2000 2000 2000 2000				VM1/P 12.20.20 p210 VM1/P 12.20.25 p210 VM1/P 12.20.32 p210 – –	VM1/P 17.20.20 p210 VM1/P 17.20.25 p210 VM1/P 17.20.32 p210 – –	
	20 25 31.5 40 50	20 25 31.5 40 50				2500 2500 2500 2500 2500			VM1/P 12.25.20 p275 VM1/P 12.25.25 p275 VM1/P 12.25.32 p275 – –	VM1/P 17.25.20 p275 VM1/P 17.25.25 p275 VM1/P 17.25.32 p275 – –	PB 3/M
	31.5 40 50	31.5 40 50				3150 3150 3150			– – –	– – –	
	31.5 40 50	31.5 40 50				3600(1) 3600(1) 3600(1)			– – –	– – –	
	31.5 40 50	31.5 40 50				4000(1) 4000(1) 4000(1)			– – –	– – –	
24	16 20 25	16 20 25					630 630 630		VM1/P 24.06.16 p210 VM1/P 24.06.20 p210 VM1/P 24.06.25 p210	– – –	PB 4/M
	16 20 25	16 20 25					1250 1250 1250		VM1/P 24.12.16 p210 VM1/P 24.12.20 p210 VM1/P 24.12.25 p210	– – –	
	16 20 25	16 20 25						1600 1600 1600	VM1/P 24.16.16 p275 VM1/P 24.16.20 p275 VM1/P 24.16.25 p275	– – –	PB 5/M
	16 20 25	16 20 25						2000 2000 2000	VM1/P 24.20.16 p275 VM1/P 24.20.20 p275 VM1/P 24.20.25 p275	– – –	
	16 20 25	16 20 25						2500(2) 2500(2) 2500(2)	VM1/P 24.25.16 p275(3) VM1/P 24.25.20 p275(3) VM1/P 24.25.25 p275(3)	– – –	

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) 3600 A with fan pre-installed in the PB3 modules. A further fan must be installed in the rear of the switchgear for 4000 A versions (at the customr's charge).
(2) 2500 A with fan pre-installed in the PB5 modules.
(3) Ask ABB whether available.

5. Apparatus

5.4 Vmax withdrawable circuit-breakers for PowerCube units type PB

5.4.1 Identification table and weights

kV	Isc (kA) 3s	Icw (kA)	Rated current of the Vmax circuit-breakers in the PowerCube units (40 °C) [A]						Vmax for 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	Circuit-breaker type	Circuit-breaker type	PowerCube
12 17.5	16	16	630						Vmax/W 12.06.16 p150	Vmax/W 17.06.16 p150(1)	PB1/M
	20	20	630						Vmax/W 12.06.20 p150	Vmax/W 17.06.20 p150(1)	
	25	25	630						Vmax/W 12.06.25 p150	Vmax/W 17.06.25 p150(1)	
	31.5	31.5	630						Vmax/W 12.06.32 p150	Vmax/W 17.06.32 p150(1)	
	16	16	1250						Vmax/W 12.12.16 p150	Vmax/W 17.12.16 p150(1)	
	20	20	1250						Vmax/W 12.12.20 p150	Vmax/W 17.12.20 p150(1)	
	25	25	1250						Vmax/W 12.12.25 p150	Vmax/W 17.12.25 p150(1)	
	31.5	31.5	1250						Vmax/W 12.12.32 p150	Vmax/W 17.12.32 p150(1)	

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) Ask ABB whether available.

5.5 V-Contact VSC withdrawable contactors for PowerCube units type PB

5.5.1 Identification table and weights

kV	Isc (kA)[2]	Icw (kA)	Rated current of V-Contact circuit-breakers (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		
7.2	16	6	400[3]						VSC7/P	PB 1/M
	20	6	400[3]							
	25	6	400[3]							
	31.5	6	400[3]							
12	16	6	400[3]						VSC12/P	
	20	6	400[3]							
	25	6	400[3]							
	31.5	6	400[3]							

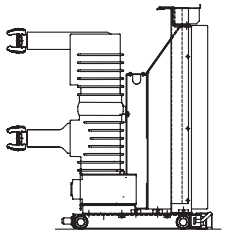
W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) Ask ABB whether available.
(2) Guaranteed, using suitable fuses.
(3) The rated current is liable to be derated depending on the rated current of the fuses.

5. Apparatus

5.6 Isolation trolleys for PowerCube units type PB

5.6.1 Identification table and weights



kV	Isc (kA)	Icw (kA)	Rated current of the isolation trolleys (A - 40 °C)						Isolation trolley	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 17.5	16 20 25 31.5	16 20 25 31.5	...1250						S-HD4/W 17.12.32 p150	PB 1/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					S-HD4/W 17.12.32 p210 S-HD4/W 17.12.50 p210	PB 2/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				S-HD4/W 17.20.32 p210 S-HD4/P 17.20.50 p210	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...2500			S-HD4/P 17.25.50 p275	PB 3/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...3150			S-HD4/P 17.32.50 p275	
	31.5 40 50	31.5 40 50				...3600(1) ...3600(1)			S-HD4/P 17.32.50 p275	
	31.5 40 50	31.5 40 50				...4000(1) ...4000(1)			S-HD4/P 17.32.50 p275	
24	16 20 25	16 20 25					...1250		S-HD4/W 24.12.25 p210	PB 4/M
	16 20 25	16 20 25						...2000	S-HD4/P 24.20.25 p275	PB 5/M
	16 20 25	16 20 25						...2500(2)	S-HD4/P 24.25.25 p275	

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

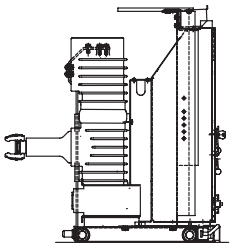
(1) 3600 A with fan pre-installed in the PB3 modules. A further fan must be installed in the rear of the switchgear for 4000 A versions (at the customr's charge).

(2) 2500 A with fan pre-installed in the PB5 modules.

5.7 Earthing trolleys with making capacity for PowerCube units type PB

5.7.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of the earthing trolleys (A - 40 °C)						Earthing trolley[1]	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 17.5	16 20 25 31.5	16 20 25 31.5	...1250						EM-U/W 17.12.32 p150 EM-L/W 17.12.32 p150	PB 1/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					EM-L/W 17.12.32 p210 EM-U/W 17.12.32 p210	PB 2/M
									EM-L/W 17.12.50 p210[2] EM-U/W 17.12.50 p210[2]	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				EM-L/W 17.20.32 p210 EM-U/W 17.20.32 p210	
									EM-L/P 17.20.50 p210 EM-U/P 17.20.50 p210	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...2500			EM-L/P 17.25.50 p275 EM-U/P 17.25.50 p275	PB 3/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...3150			EM-L/P 17.32.50 p275 EM-U/P 17.32.50 p275	
24	16 20 25	16 20 25					...1250		EM-L/W 24.12.25 p210 EM-U/W 24.12.25 p210	PB 4/M
	16 20 25	16 20 25						...2000	EM-L/P 24.20.25 p275 EM-U/P 24.20.25 p275	PB 5/M
	16 20 25	16 20 25						...2500[2]	EM-L/P 24.25.25 p275 EM-U/P 24.25.25 p275	



W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

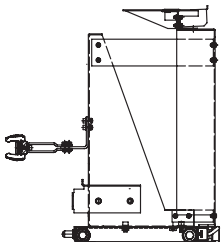
(1) EM-L... = Earthing trolley with making capacity and lower insulating bushings (for earthing the cables).
EM-U... = Earthing trolley with making capacity and upper insulating bushings (for earthing the busbar system).
(2) Ask ABB.

5. Apparatus

5.8 Earthing trolleys without making capacity for PowerCube units type PB

5.8.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of the earthing trolleys (A - 40 °C)						Earthing trolley[1]	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 17.5	16 20 25 31.5	16 20 25 31.5	...1250						E-U/W 17.12.32 p150 E-L/W 17.12.32 p150	PB 1/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					E-L/W 17.12.32 p210 E-U/W 17.12.32 p210	PB 2/M
									E-L/W 17.12.50 p210[2] E-U/W 17.12.50 p210[2]	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				E-L/W 17.20.32 p210 E-U/W 17.20.32 p210	
									E-L/P 17.20.50 p210 E-U/P 17.20.50 p210	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...2500			E-L/P 17.25.50 p275 E-U/P 17.25.50 p275	PB 3/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				...3150			E-L/P 17.32.50 p275 E-U/P 17.32.50 p275	
24	16 20 25	16 20 25					...1250		E-L/W 24.12.25 p210 E-U/W 24.12.25 p210	PB 4/M
	16 20 25	16 20 25						...2000	E-L/P 24.20.25 p275 E-U/P 24.20.25 p275	PB 5/M
	16 20 25	16 20 25						...2500	E-L/P 24.25.25 p275 E-U/P 24.25.25 p275	



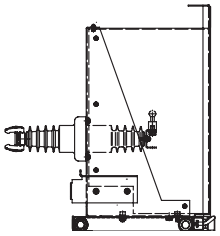
W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) EM-L... = Earthing trolley without making capacity and with lower insulating bushings (for earthing the cables).
EM-U... = Earthing trolley without making capacity and with upper insulating bushings (for earthing the busbar system).
(2) Ask ABB.

5.9 Cable test trolleys for PowerCube units type PB

5.9.1 Identification table and weights

kV	Isc (kA)	Icw (kA)	Rated current of the cable test trolleys (A - 40 °C)						Cable test trolley	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 17.5	16 20 25 31.5	16 20 25 31.5	...1250						T/W 17.12 p150	PB 1/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50		...1250					T/W 17.12 p210	PB 2/M
									T/W 17.12 p210[1]	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50			...2000				T/W 17.20 p210	
									T/P 17.20 p210	
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				2500			T/P 17.32 p275	PB 3/M
	16 20 25 31.5 40 50	16 20 25 31.5 40 50				3150				
24	16 20 25	16 20 25					...1250		T/W 24.12 p210	PB 4/M
	16 20 25	16 20 25						...2000	T/W 24.20 p275	PB 5/M
	16 20 25	16 20 25						...2500[1]	T/P 24.25 p275	



W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) Ask ABB.

5. Apparatus

5.10 Trucks for measuring TV type TJP X.3

5.10.1 Identification table and weights

kV	Isc/Icw	Dimensions	Truck type	PowerCube
12 17.5	16 20 25 31.5	W=600mm P=150mm h=405mm	PTT1/W	PB1/TM
12 17.5	40 50	W=750mm P=210mm h=590mm	PTT2/W	PB2/TM
24	16 20 25 31.5	W=600mm P=210mm h=635mm	PTT4/W	PB4/TM

5.11 PowerCube Units type PB without apparatus

5.11.1 Identification table and weights

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	1250	31.5	31.5
	750	2000	31.5	31.5
	750	2000	40-50	40-50
	1000	4000	31.5	31.5
	1000	4000	40-50	40-50
24	750	1250	31.5	31.5
	1000	2500	31.5	31.5

[1] On earthing switch, if requested.
[2] The TV cubicle cannot be supplied for any of the PB/RE units or for the PB1/RM unit. Construction is at the customer's charge.

5.12 V-Contact type vacuum contactors

5.12.1 Identification table and weights

kV	Isc (kA)[2]	Icw (kA)	Rated current of V-Contact circuit-breakers (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		
7.2	16	6	400[3]						VSC7/P	PB 1/M
	20	6	400[3]							
	25	6	400[3]							
	31.5	6	400[3]							
12	16	6	400[3]						VSC12/P	
	20	6	400[3]							
	25	6	400[3]							
	31.5	6	400[3]							

W = Width of PowerCube Units type PB.
P = Horizontal center distance between the circuit-breaker poles.
U/L = Distance between the upper and lower terminal.
H = Distance between the lower terminal and earth.
Ø = Diameter of the contacts in the insulator block of PowerCube Units type PB.

(1) Ask ABB whether available.
(2) Guaranteed, using suitable fuses.
(3) The rated current is liable to be derated depending on the rated current of the fuses.

5.13 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	230	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

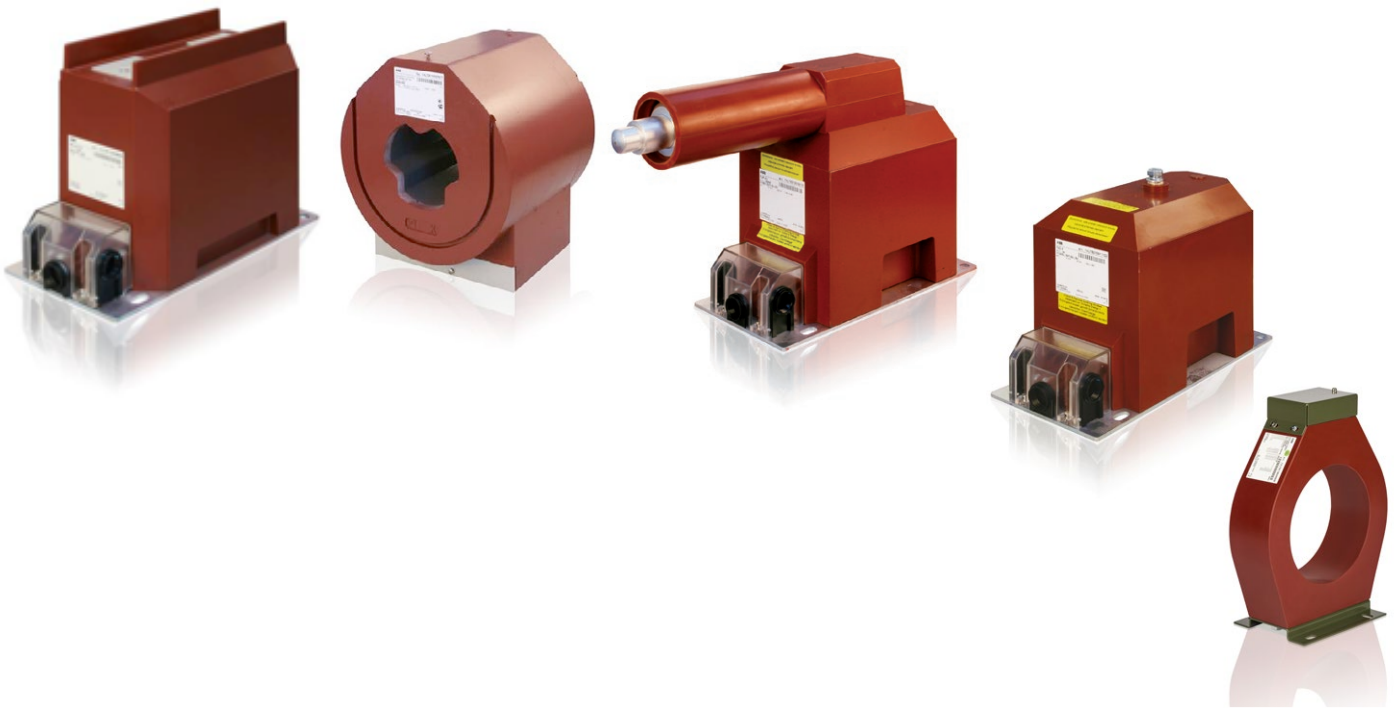
ABB offer wide range of conventional Instrument transformers (ITs) as well as Electronic Instrument transformers, also known as Sensors. The portfolio of instrument transformers includes various types of products for medium voltage system and covers whole range of switchgear applications and many others applications. ITs are designed also in accordance to DIN standard thus fits into ABB portfolio as well as to OEM switchgear manufacturers. Our long experience gathered from our own development, production and testing of instrument transformers give us the possibility to offer the customer a broad range of products that comply fully with the various customer requirements.

The basic role of IT's 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/√3-120/√3, 100/3-120/3 and 100-120 volts. The 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 ITs are used – metering and protection control.

Our whole portfolio meets global and local requirements, such as certification, which allows worldwide usage. ABB ITs 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 ITs is 75 K instead of 50 K which could be with other IT manufacturer.

It's recommend to use original ABB ITs not only for type testing, but also for all regular projects. Replacement of ABB ITs to other brand may result to 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 cover main ABB switchgear applications and brings new possibilities in a system solutions.



6.1 Accuracy classes

Accuracy class is a designation assigned to a transformer ratio error and phase displacement error, which remain within specified limits under prescribed conditions of use and according to 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

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

FS (Security factor) is a CT parameter for metering purposes and 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.
Ex.: FS5 at 5 times rated current the CT may be saturated at least 10%.

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	–

We can also produce CTs with other accuracy classes, for example PX, TPS, TPX, TPY and TPZ.
ALF (Accuracy limit factor) is a parameter of CT for protection purposes and is defined as the ratio of accuracy limit current for which the error is guaranteed (less than 5 or 10% depends whether 5P or 10P) to the rated primary current.
Ex.: 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 voltage (% of rated)	Phase displacement [minutes] At voltage (% of rated)
	100	100
0.2	0.2	10
0.5	0.5	20
1	1.0	40
3	3.0	–

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 VTs are designed with standard over voltage factor 1.9xUn/8h.

Protection classes according to IEC 61869-3		
Accuracy class	Ratio error [%] At voltage (% of rated)	Phase displacement [minutes] At voltage (% of rated)
	100	100
3P	3.0	120
6P	6.0	240

6. Measuring instruments

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 transformer

Ribs on the top of the transformer for longer creepage distance and increasing a performance are necessary for UniSafe 2.0 switchgears

Silver coated primary terminals help set higher range for temperature rise tests

The wide range of supported standards, including IEC 61869, allows a big number of modifications on the individual request of each customer

The reconnection at the secondary terminals allow huge variability

Transparent and sealable secondary terminal helps get required IP coverage

The highest surface quality is guaranteed thanks to casting into the epoxy resin, with more than 60 years of experience gathered at this field combined with the APG (air pressure gelation) casting

Ambient temperature from -25 °C to 60 °C

Wide range of designs thanks to different primary current, dimensions and quantity of cores

Capacitive voltage divider, which represents the best option for a voltage indication. No post insulator with indication system is needed

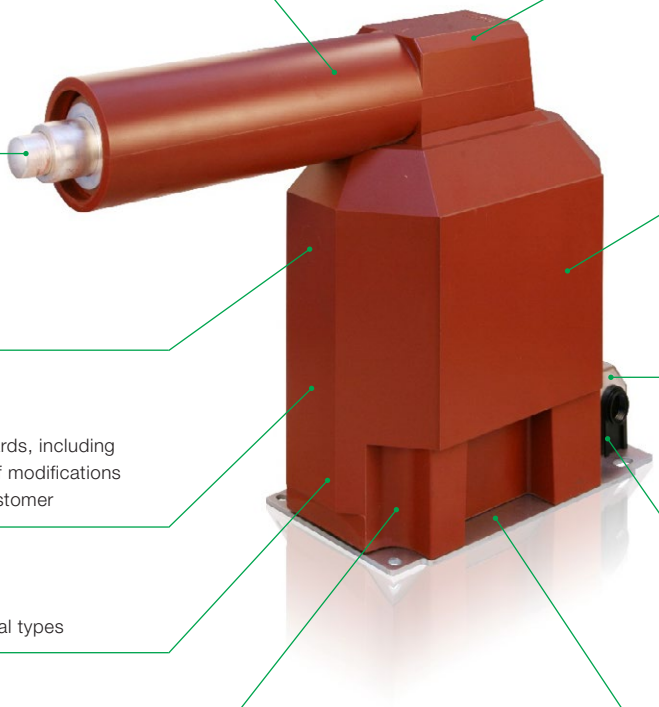
Screw for terminal earthing is directly connected with a base plate, which guarantees fast and easy installation

Voltage transformers

Designs suitable for VT trucks. Fuse can be oriented in a direction of the secondary terminal or opposite. More variations of fuses is available in range 1 – 6.3 A (some with indication)

VTs available with or without fuse

Primary contacts can be equipped with different connectors (cable – primary screw, busbar – spring thumb)



The highest surface quality is guaranteed thanks to casting into the epoxy resin, with more than 60 years of experience gathered at this field combined with the APG (air pressure gelation) casting

Over voltage factor 1.9xUn/8h as a standard for a single pole voltage transformers

The reconnection at the secondary terminals allow huge variability

The wide range of supported standards, including IEC 61869, allows a huge number of modifications on the individual request of each customer

Transparent and sealable secondary terminal helps get required IP coverage

For high burdens are available special types

Ambient temperature from -25 °C up to 60 °C

Screw for terminal earthing is directly connected with a base plate, which guarantees fast and easy installation

6. Measuring instruments

6.3 ABB Current transformers' (CTs) portfolio

ABB offer 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 6.5). 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 CTs portfolio, for more information contact us or visit our webpages. All our CTs are type tested according to IEC 61869.

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 characteristic

- For measuring and protection with up to 5 cores (depending on parameters and configuration)
- Secondary reconnectable
- Capacitive divider build in TPU transformers help 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 the third (TPU 6X.13 or 6X.23)

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

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 characteristic

- 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

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

6. Measuring instruments

Selection table

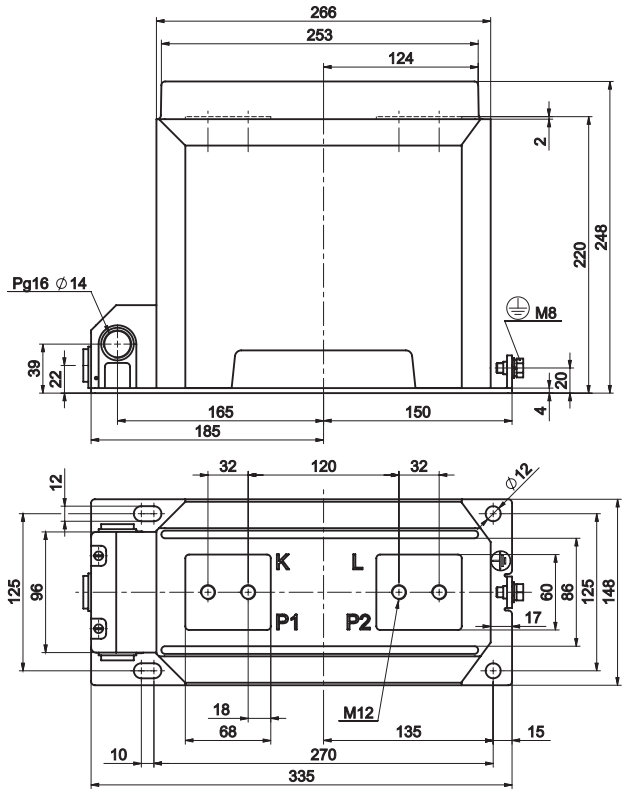
12-17.5 kV (TPU 4X.XX = 12 kV, TPU 5X.XX = 17.5 kV)				
Type of Transformer (see drawings)	In [A]	Switchboard [mm]		
		600	750	1000
Short types				
TPU 40.13, TPU 43.13, TPU 50.13, TPU 53.13	≤1250	■	■	
TPU 40.53, TPU 43.53, TPU 50.53, TPU 53.53	≤1250	■	■	
TPU 40.33, TPU 43.33, TPU 50.33, TPU 53.33	≤1250		■	
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			■

6.3.1 Dimensional drawings of the Current transformers

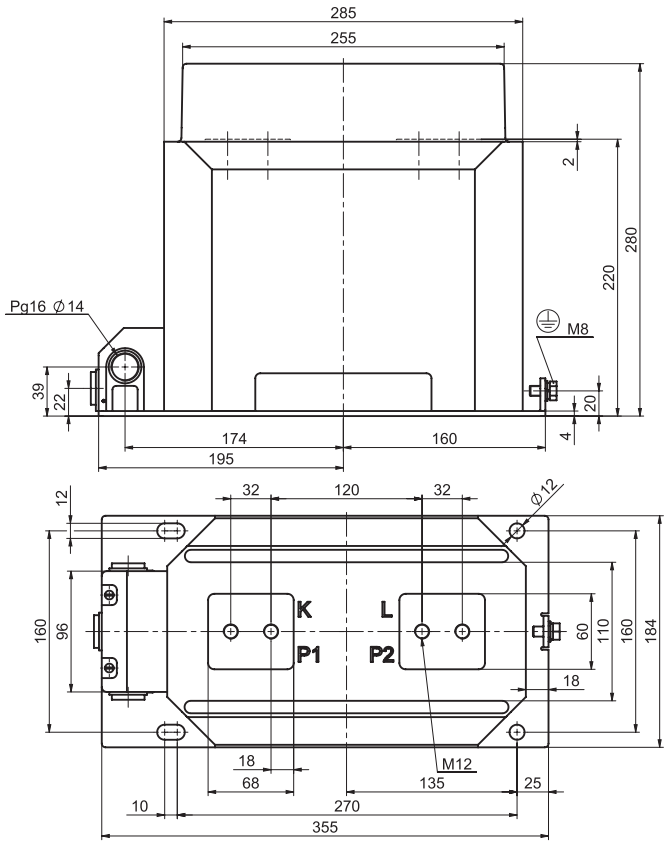
12-17.5 kV Short types

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

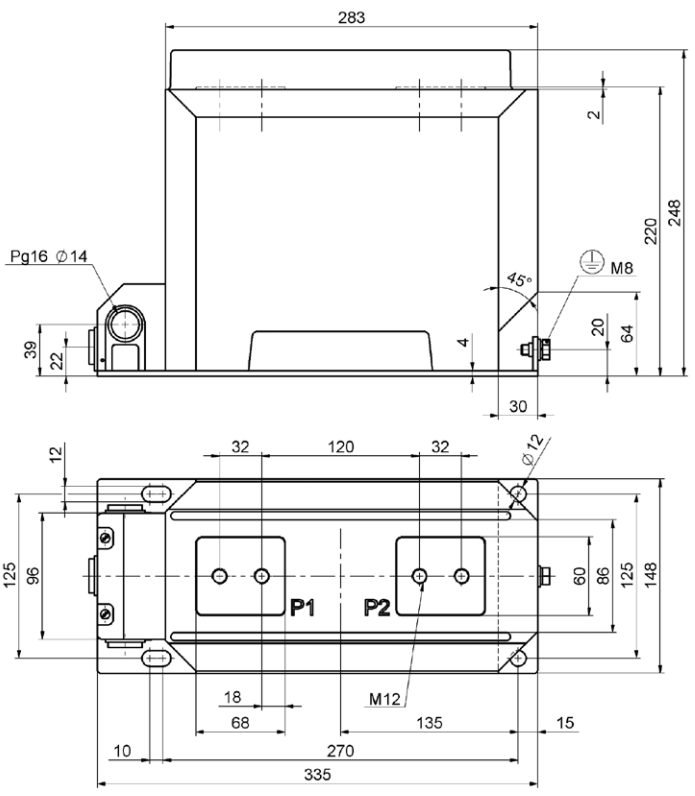
TPU 40.33, TPU 43.33, TPU 50.33, TPU 53.33
Weight: 31-39 kg
Creepage distance: 215 mm



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

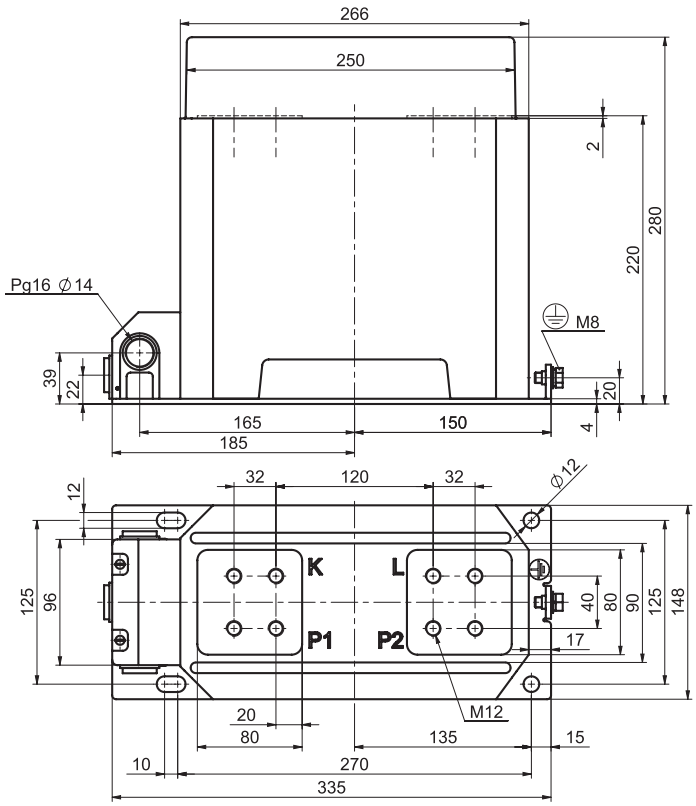
6. Measuring instruments

TPU 40.53, TPU 43.53, TPU 50.53, TPU 53.53
Weight: 28 kg
Creepage distance: 214 mm



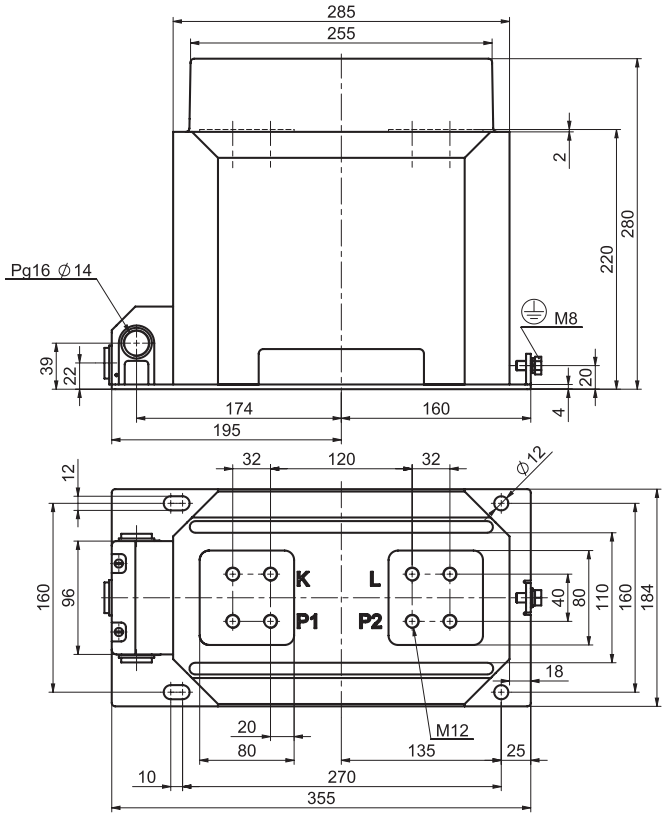
Drawing number	Polarity
1VL4600921R0101	P1 to secondary terminal
1VL4600921R0102	P2 to secondary terminal

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	
44614260	1VL4600500P0101	P1 to secondary terminal
44614270	1VL4600500P0102	P2 to secondary terminal

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

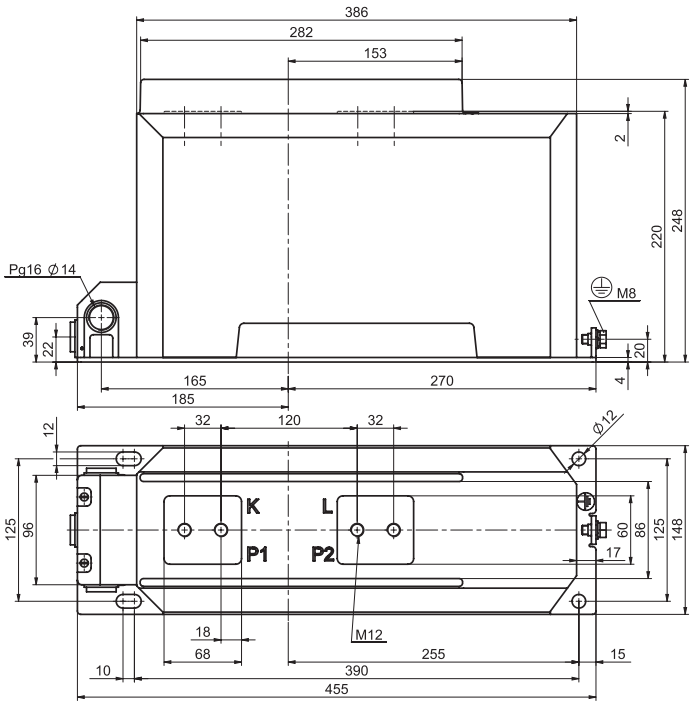


Drawing number		Polarity
TPU 4	TPU 5	
44614340	44614810	P1 to secondary terminal
44614350	44614820	P2 to secondary terminal

6. Measuring instruments

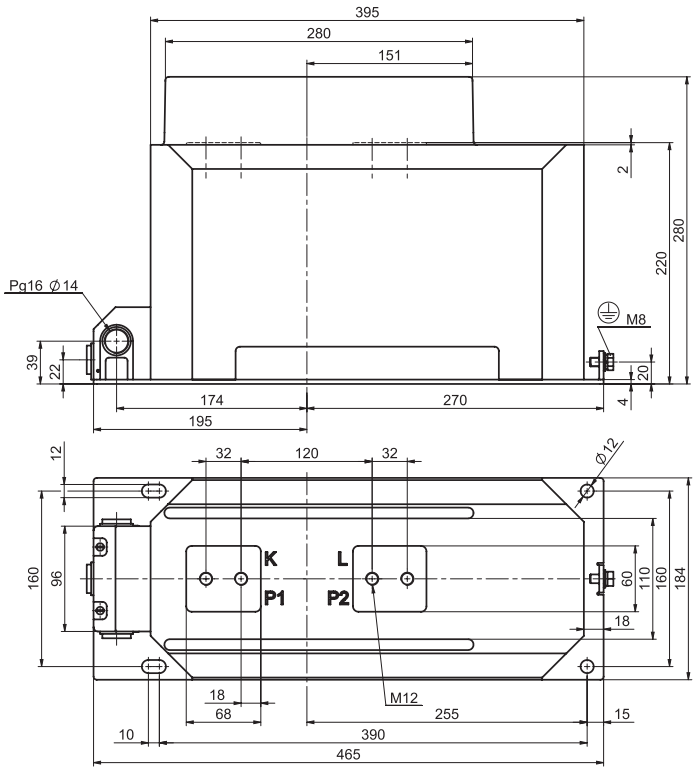
12-17.5 kV Long types

TPU 40.23, TPU 43.23, TPU 50.23, TPU 53.23
Weight: 29-37 kg
Creepage distance: 214 mm



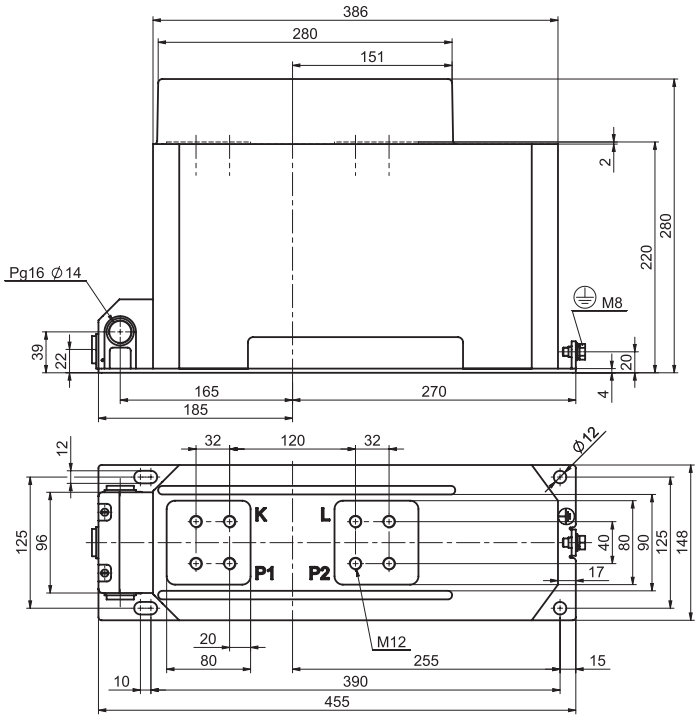
Drawing number		Polarity
TPU 4	TPU 5	
44614120	44614670	P1 to secondary terminal
44614130	44614680	P2 to secondary terminal

TPU 40.43, TPU 43.43, TPU 50.43, TPU 53.43
Weight: 45-55 kg
Creepage distance: 215 mm



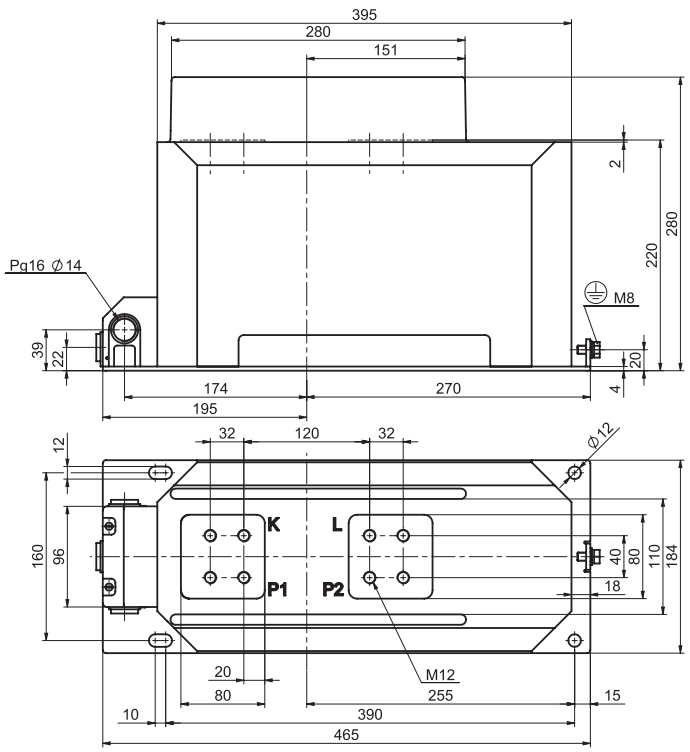
Drawing number		Polarity
TPU 4	TPU 5	
44614220	44614770	P1 to secondary terminal
44614230	44614780	P2 to secondary terminal

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

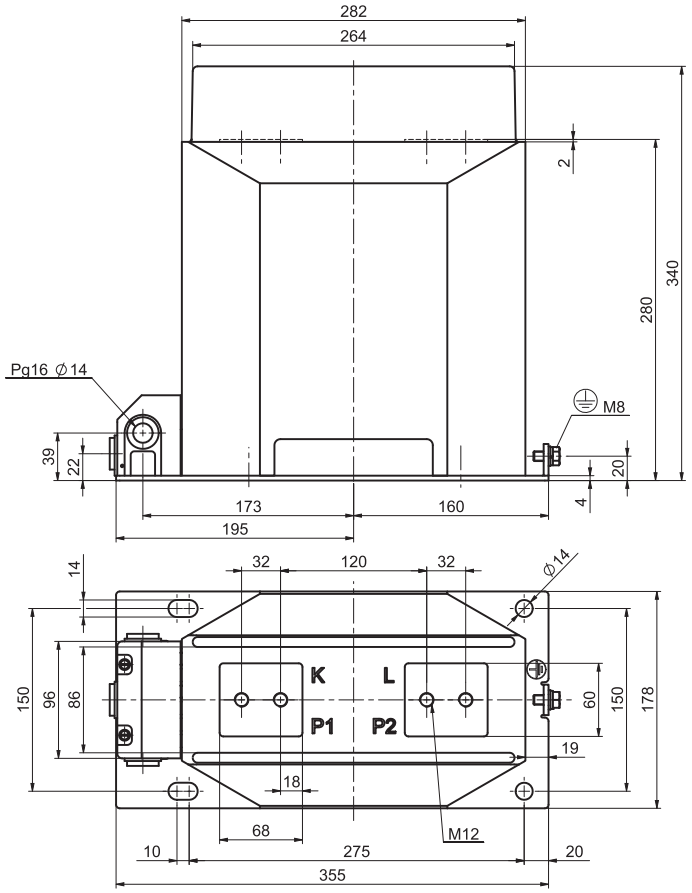


Drawing number		Polarity
TPU 4	TPU 5	
44614380	44614850	P1 to secondary terminal
44614390	44614860	P2 to secondary terminal

6. Measuring instruments

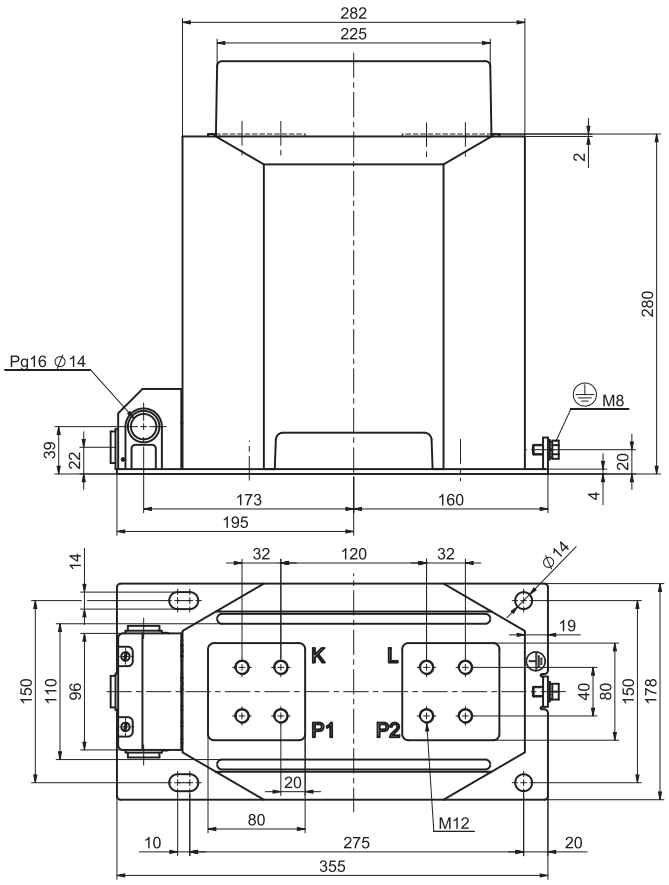
24 kV Short types

TPU 60.13, TPU 63.13
Weight: 31-35 kg
Creepage distance: 280 mm



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

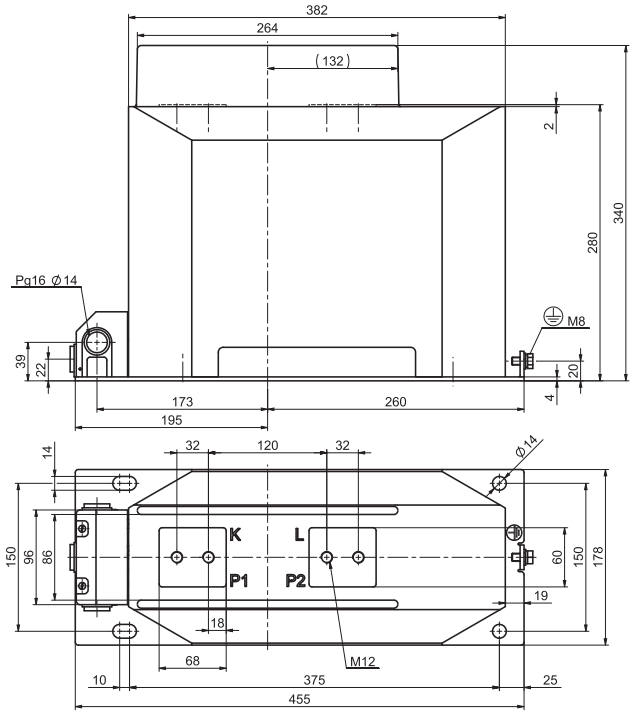
TPU 64.13, TPU 65.13, TPU 66.13
Weight: 36-41 kg
Creepage distance: 270 mm



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

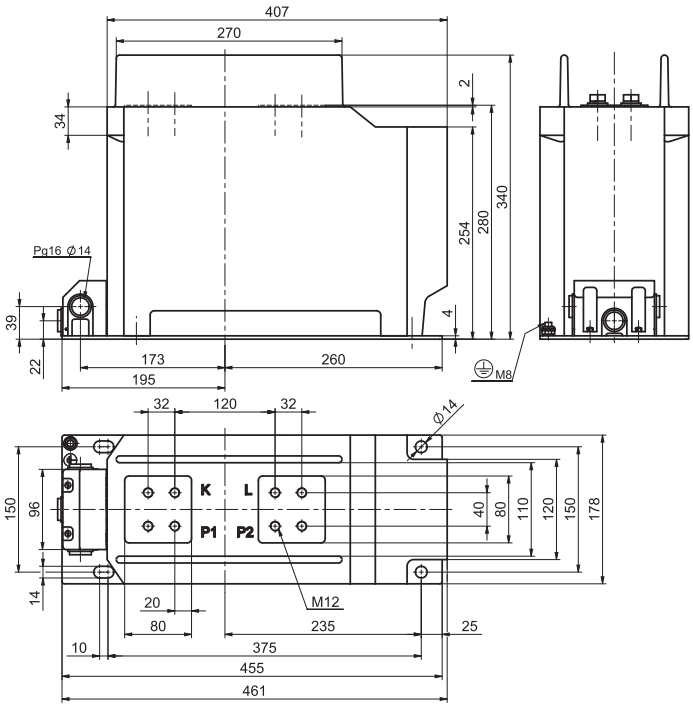
24 kV Long types

TPU 60.23, TPU 63.23
Weight: 43-49 kg
Creepage distance: 280 mm



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

TPU 64.23, TPU 65.23, TPU 66.23
Weight: 50-57 kg
Creepage distance: 272 mm

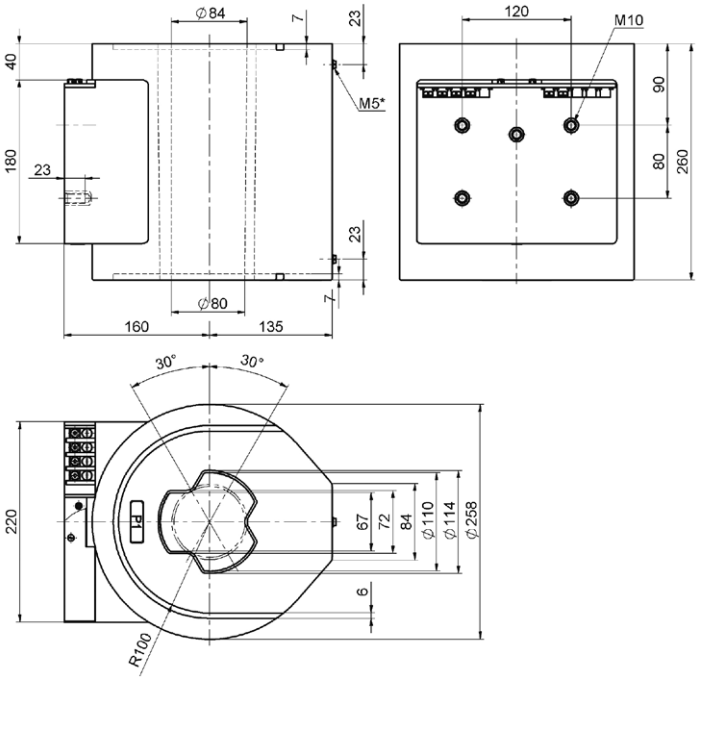


Drawing number	Polarity
44615220	P1 to secondary terminal
44615230	P2 to secondary terminal

6. Measuring instruments

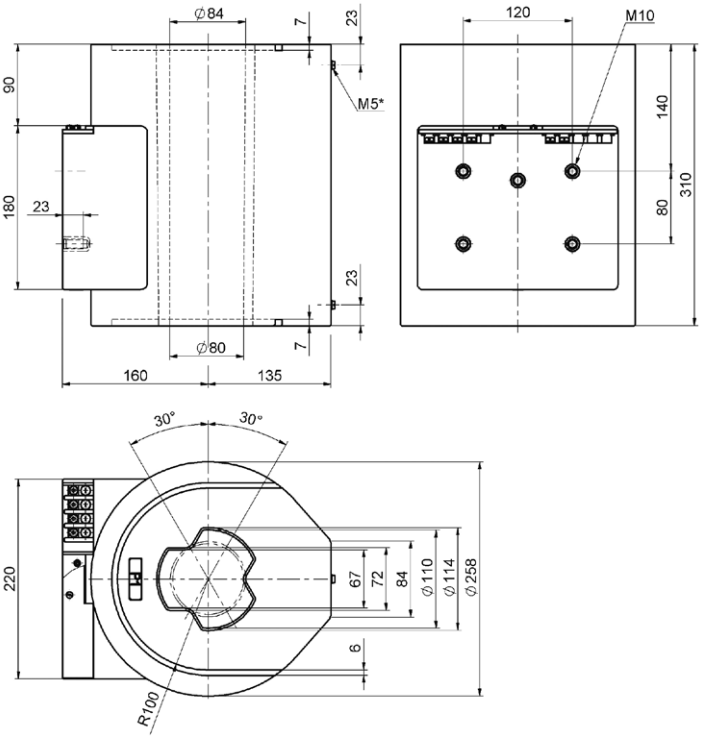
12-17.5 kV Bus types

KOKS 12A31, KOKS 17.5A31
Weight: 35 kg



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

KOKS 12A41, KOKS 17.5A41
Weight: 42 kg



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

TTR

The TTR transformers with bar primary conductor can be used as a bushing. TTR are cast in epoxy resin and are suitable as bushing between two air insulating switchgear compartments or different switchboards. The TTR transformers are various sizes depending on the combination of parameters (primary current, accuracy classes, burdens, overcurrent factor, etc.). TTR are designed with either 1 or 2 secondary windings.
The transformer can be mounted in any position and it is fixed by using four screws.
Bar primary type CTs (TTR) are not for standard UniSafe 2.0 switchgears projects, but could be used for customized UniSafe 2.0 panels, so called design to order projects.

TTR 4

Ratings

- Highest voltage for equipment: 3.6 kV – 12 kV
- Primary current: 100 - 2500 A
- Rated short-time thermal current: up to 40 kA/3 s and 50 kA/1 s

TTR 6

Ratings

- Highest voltage for equipment: 24 kV
- Primary current: 100 - 2500 A
- Rated short-time thermal current: up to 40 kA/3 s and 50 kA/1 s

TTR XX.11

Voltage	Current	.	Dimension	Ribs
4…up to 12 kV	1…up to 600 A [1]		1…model series	1…bar type
6…up to 24 kV	2…up to 600 A [2]			
	3…up to 1250 A			
	4…up to 1500 A			
	5…up to 2000 A			
	6…up to 2500 A			

[1] Smaller param.
[2] Higher param.

TTR current transformers are for Design to order projects only.

6. Measuring instruments

6.4 ABB Voltage transformers' (VTs) 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 VTs are type tested according to IEC 61869. For protection of single pole VTs (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 1.9xUn/8h. TJC and TJCH is suitable for the Switchgear portfolio, OEM partners and many others. The TJCH types are suitable for bigger burdens.

Main characteristic

- 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 / √3 kV
- Secondary voltage: 100 / √3 – 120 / √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.

For TJC dimensional drawings see chapter 6.4.1 Dimensional drawings of Voltage transformers

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 characteristic

- 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 / √3 kV
- Secondary voltage: 100 / √3 – 120 / √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, 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 picture at the top of this page).

TJP selection table

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

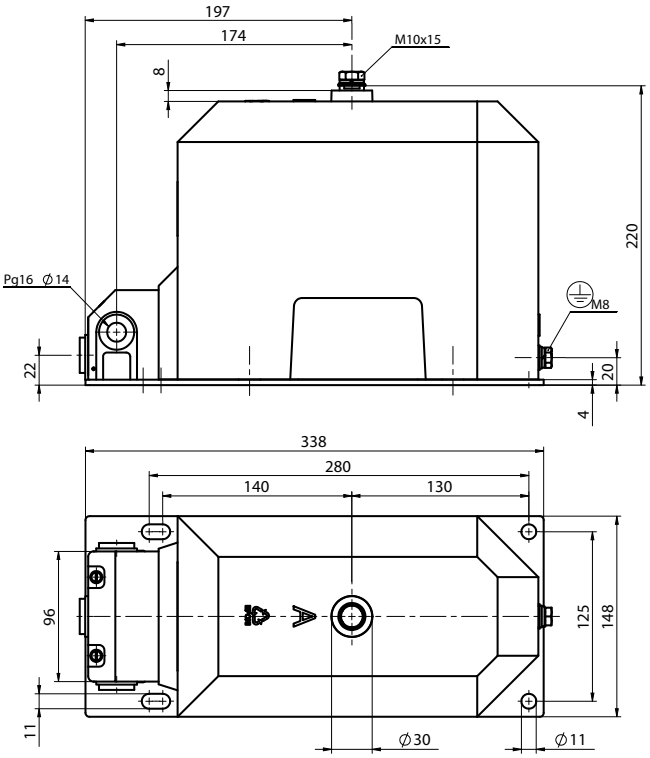
[3] Fuse holder direction of TJP 4.0-F and TJP 5.0-F types used in UniSafe 2.0 must be in opposite direction of secondary terminals.

For TJP dimensional drawings see chapter 6.4.1 Dimensional drawings of Voltage transformers

6. Measuring instruments

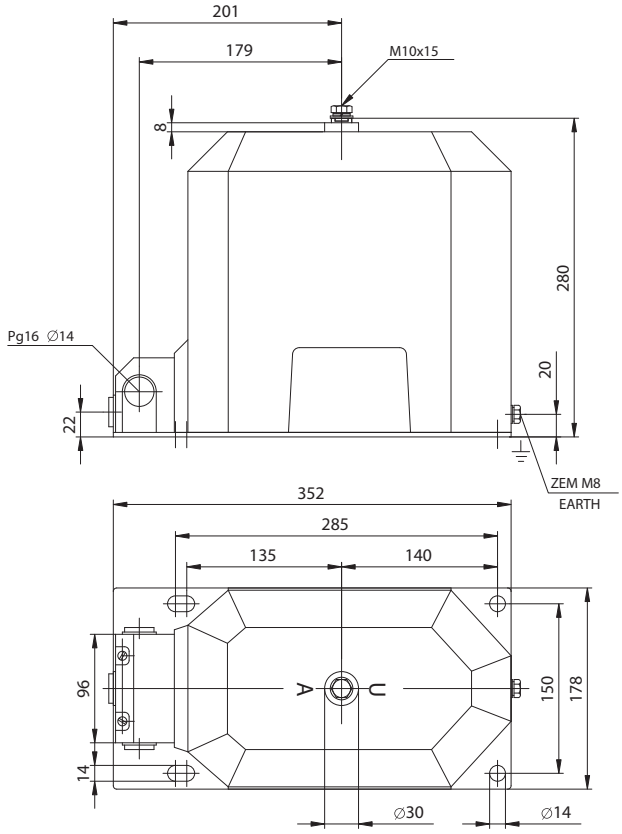
6.4.1 Dimensional drawings of the Voltage transformers

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

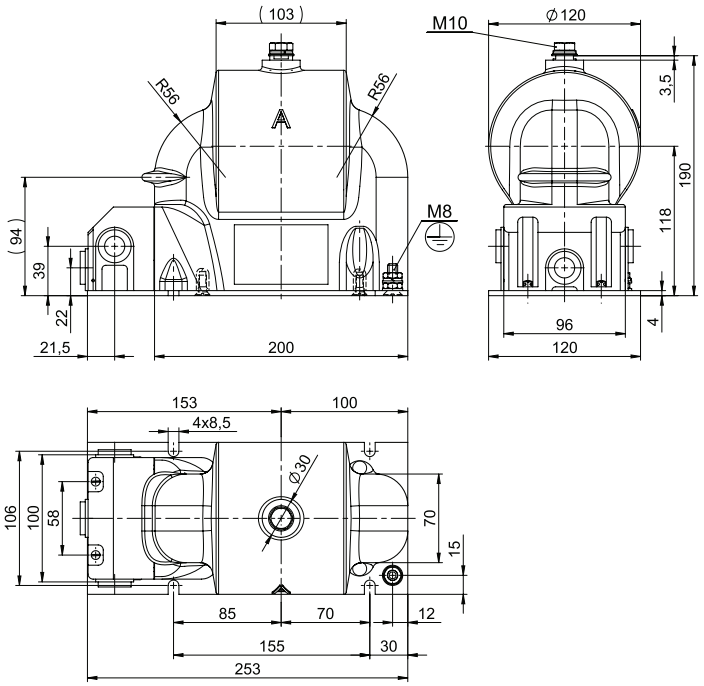


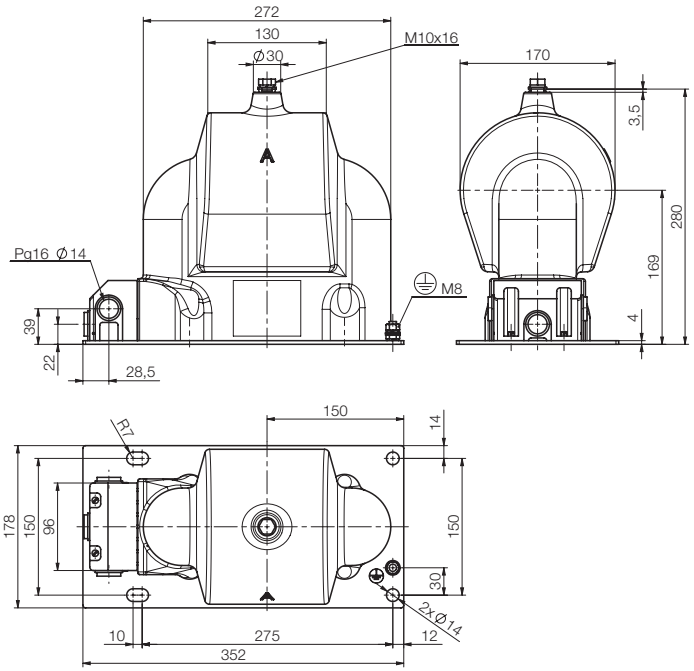
Drawing number
44203580

TJE 3, TJE 4
Weight: 10 kg
Creepage distance: 245 mm

(TJE 3.1, TJE 4.1)
Weight: 11.5 kg
Creepage distance: 245 mm

TJCL 6
Weight: 24 kg
Creepage distance: 335 mm



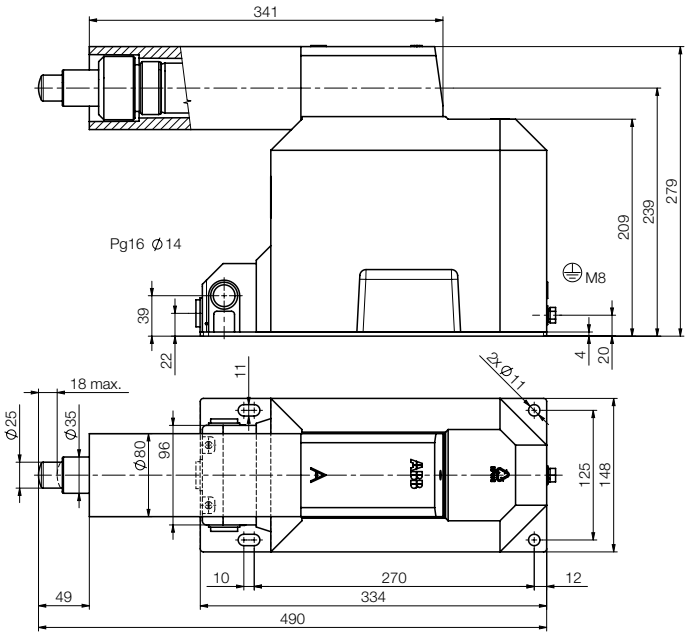


Drawing number	
TJE 3, TJE 4	TJE 3.1, TJE 4.1
1VL4200252R0101	1VL4200271R0101

Drawing number
1VL4200291R0101

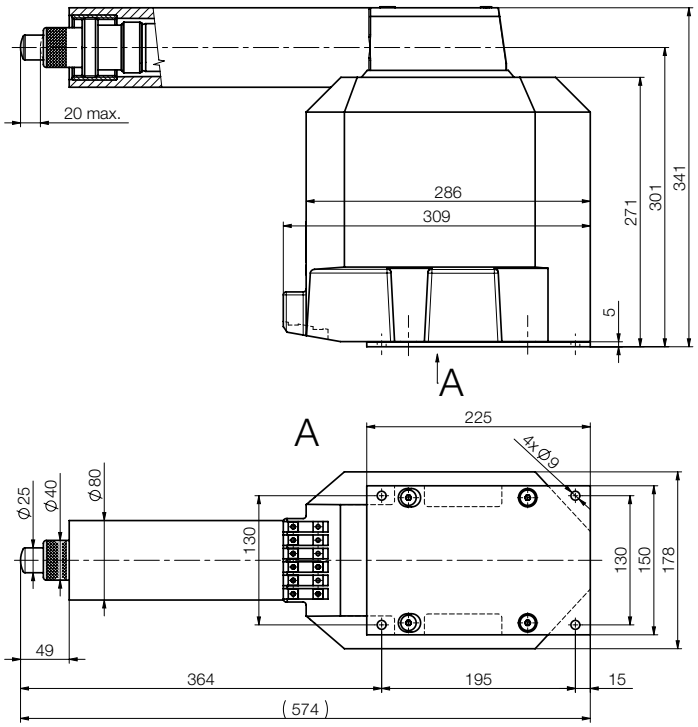
6. Measuring instruments

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



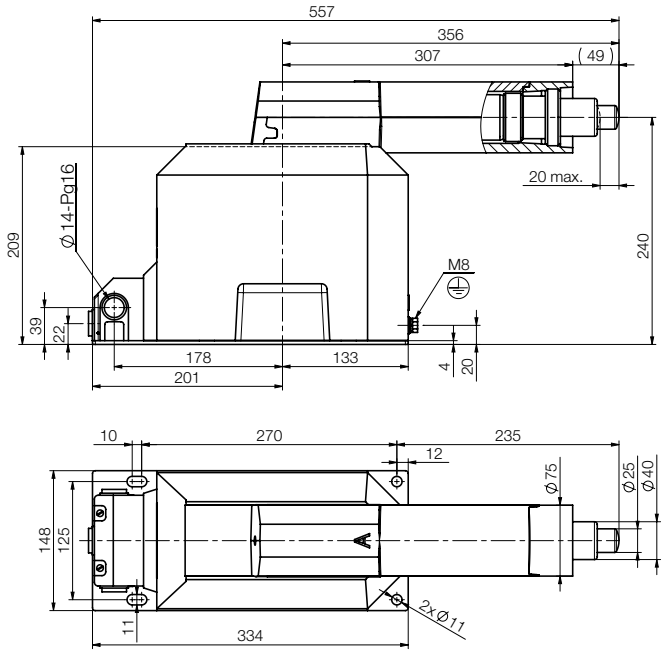
Drawing number
1VL4200314R0101

TJP 6.3
Weight: 42 kg
Creepage distance: 547 mm



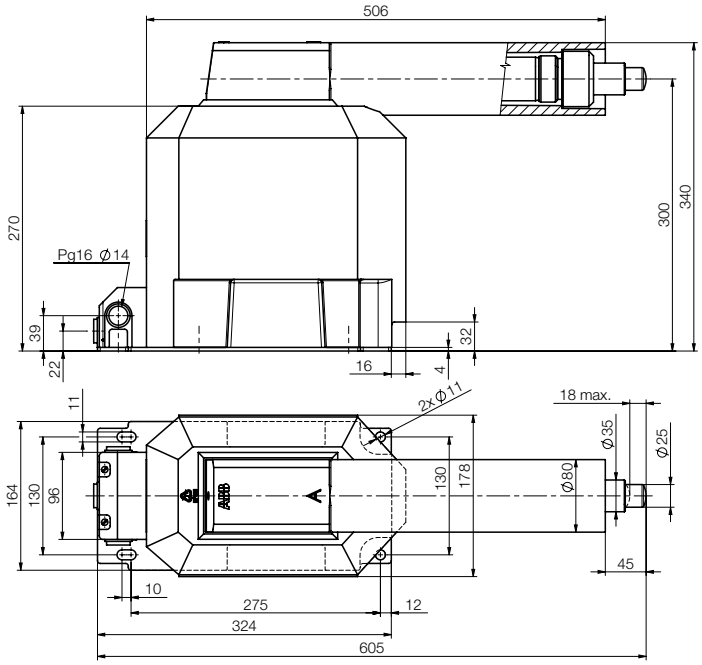
Drawing number
1VL4200315R0101

TJP 4.0-F, TJP 5.0F
Weight: 24 kg
Creepage distance: 403 mm



Drawing number
1VL4200300R0101

TJP 6.0
Weight: 42 kg
Creepage distance: 548 mm



Drawing number
44204070

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 offer 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.

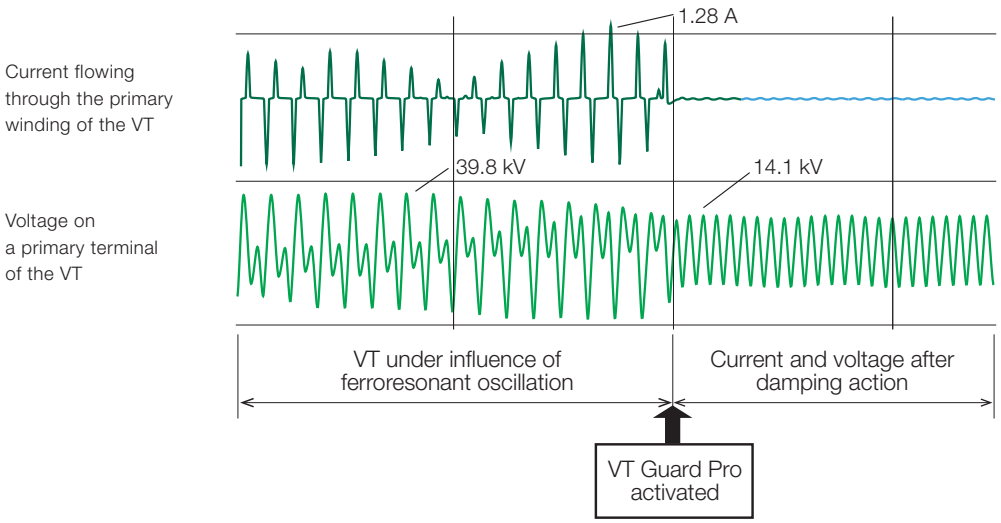
Main characteristic

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

KOLA characteristics

- Available 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. KOKM 06 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 (multiple cables).

Characteristics

- Diameters: 150x500 mm to 450x650 mm allows 6 dimension designs
- Up to 4 secondary terminals

Ratings

- 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

For RCCTs dimensional drawings see chapter 6.6.1 Dimensional drawings of RCCTs

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

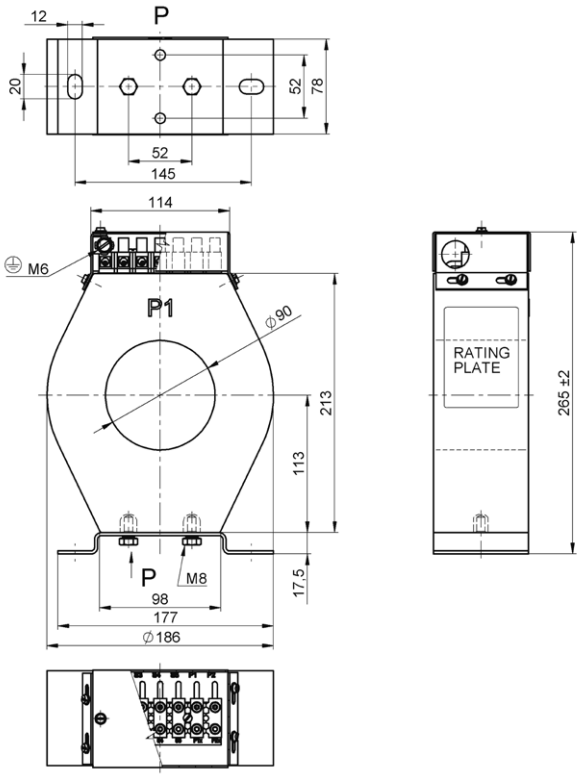
- Highest voltage for equipment: 1.2 kV
- Primary current: up to 10000 A
- Rated short-time thermal current: up to 100 kA/1 s

The individual types

Outer diameter [mm]		Hole diameter [mm]																Drawing	Casting height [mm]	Total height [mm]	Hole center height [mm]
		A	B	D	E	F	G	H	K	N	R	S	U	W	X	Y	Z				
		33	42	60	70	85	90	100	120	155	180	200	250	350	400	450	500				
C	148	60	60	60	60	60												KOKM 1_C_	183	249	112
		160	160	160	160	160															
F	186	60	60	60	60	60	60	60	← Range of transformer width									KOKM 1_F_	213	279	131
		160	160	160	160	160	160	160	↓												
H	200	80	80	80	80	80	80	80	80									KOKM 1_H_	235	301	138
		180	180	180	180	180	180	180	180												
J	235	80	80	80	80	80	80	80	80									KOKM 1_J_	265	331	158
		300	300	300	300	300	300	300	300												
K	250	80	80	80	80	80	80	80	80	80								KOKM 1_K_	275	341	158
		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_	297	363	158
		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_	297	363	158
		240	240	240	240	240	240	240	240	240	240	240									
P	340		80	80	80	80	80	80	80	80	80	80	80					KOKM 1_P_	379	445	204
			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	513	225
						200	200	200	200	200	200	200	200	200							
W	590						80	80	80	80	80	80	80	80	80	80	80	KOKM 1_W_	605	653	300
							200	200	200	200	200	200	200	200	200	200	200				

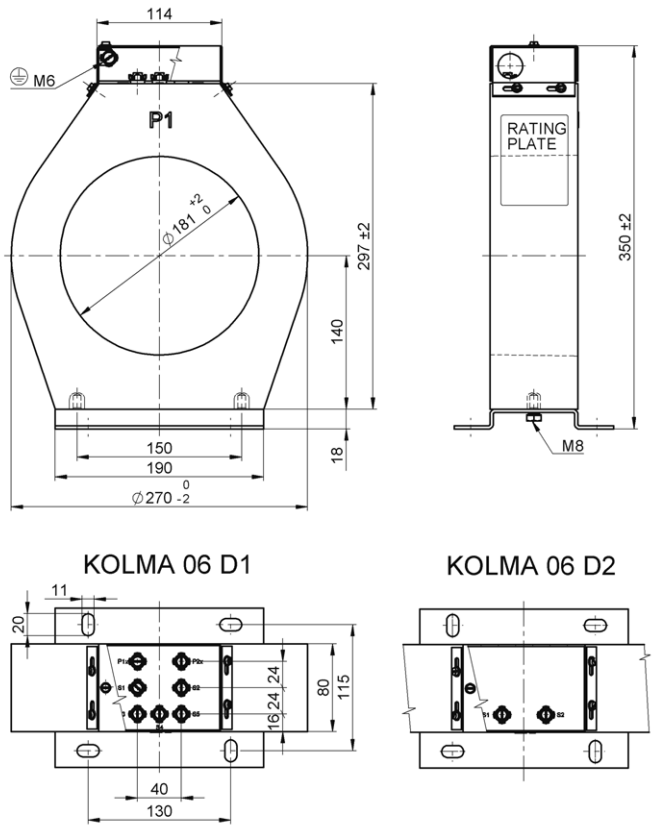
6.6.1 Dimensional drawings of the RCCTs transformers

KOLMA 06 A1
Weight: app. 7.5 kg



Drawing number
1VL4900386R0101

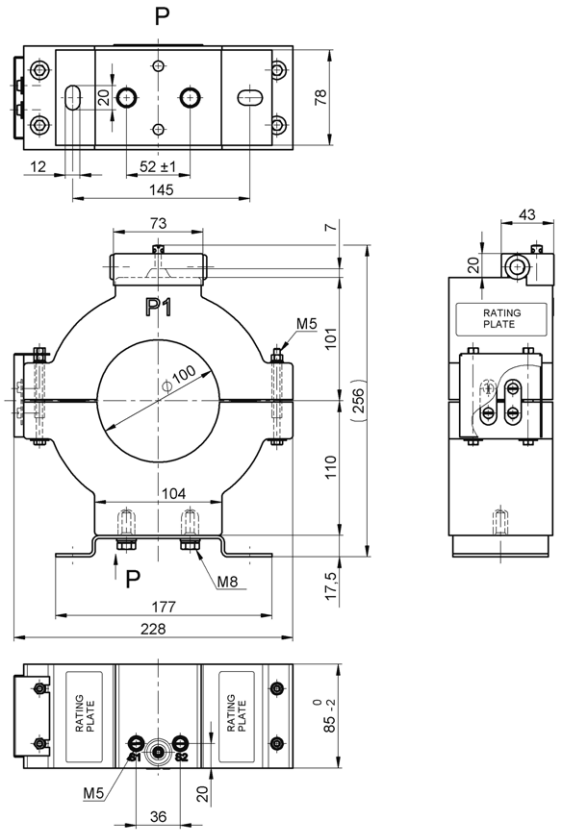
KOLMA 06 D1, D2
Weight: app. 13 kg



Drawing number	
KOLMA 06 D1	KOLMA 06 D2
1VL4600888R0101	1VL4600888R0102

6. Measuring instruments

KOLA 06 B2
Weight: app. 8 kg



Drawing number
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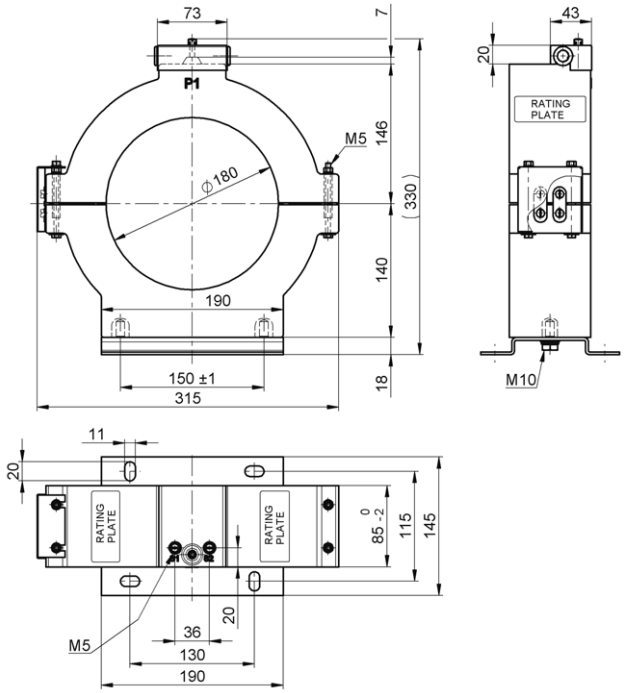
KOLA 06 D2
Weight: app. 12.5 kg



Drawing number
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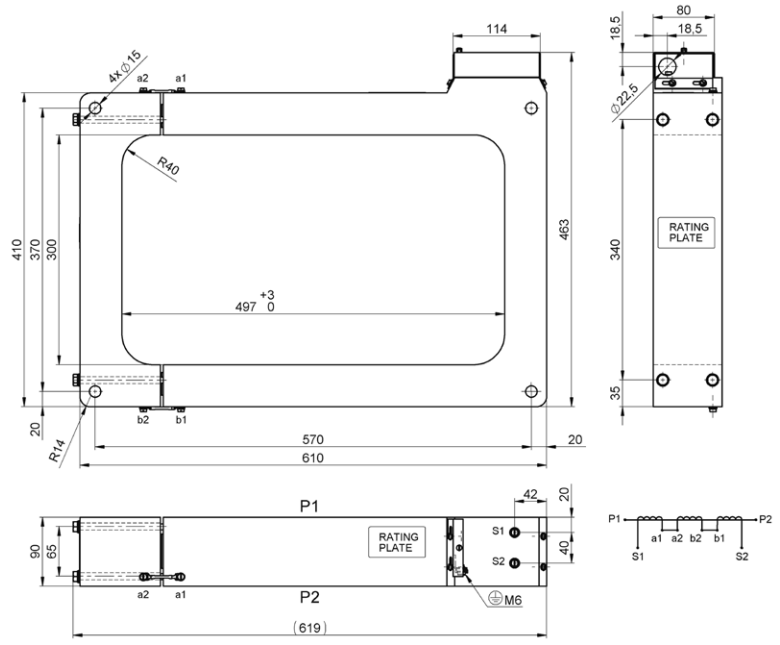
KOLA 06 J2
Weight: app. 32 kg



Drawing number
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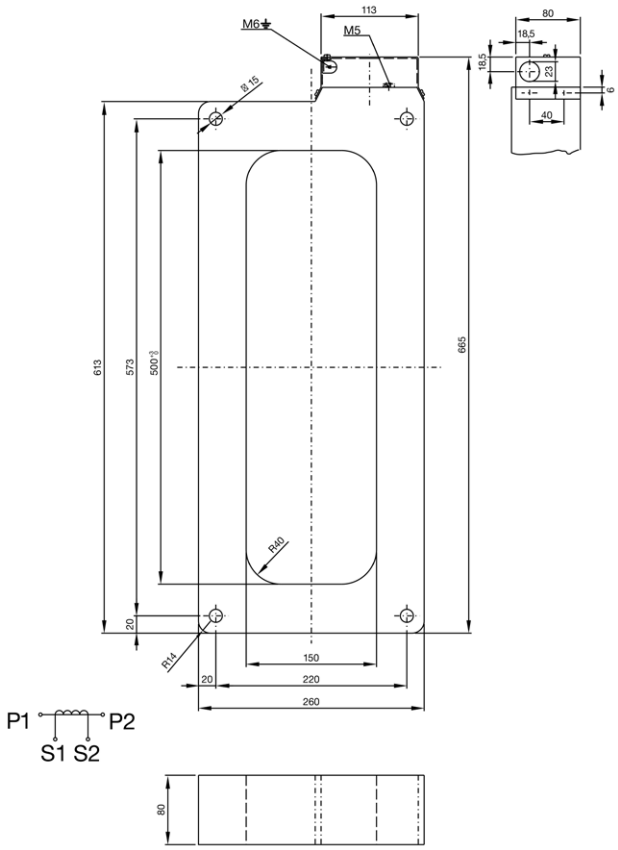
KOKM 06 J21
Weight: 20 kg



Drawing number
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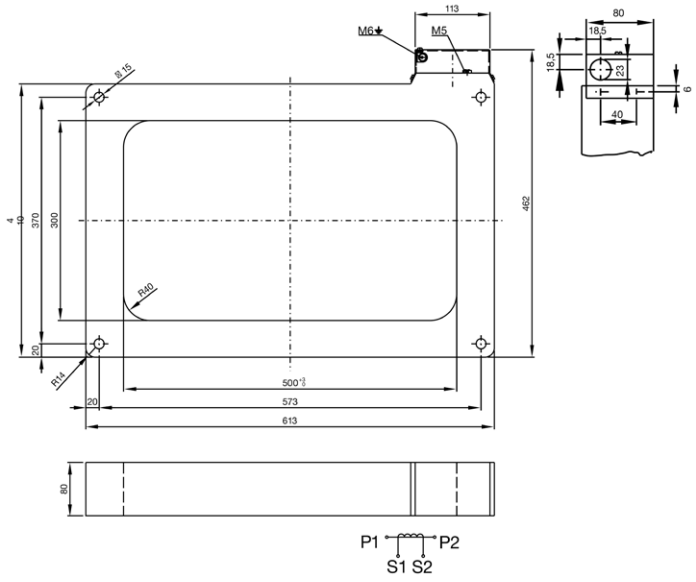
6. Measuring instruments

KOKM 06 J2
Weight: 25 kg



Drawing number
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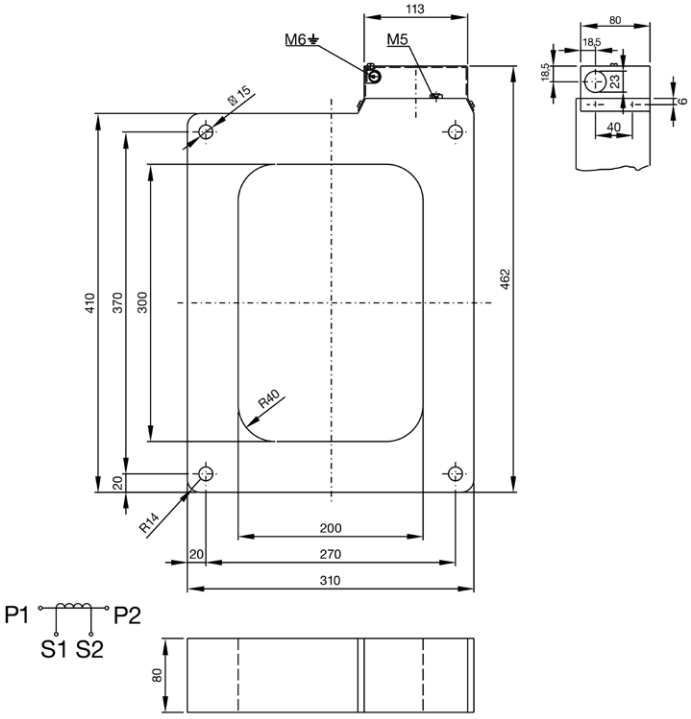
KOKM 06 J22
Weight: 19 kg



Drawing number
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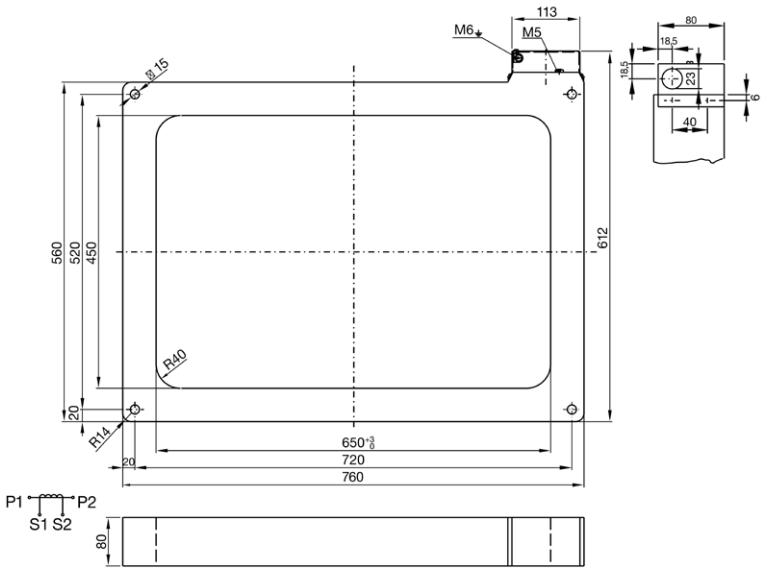
KOKM 06 J29
Weight: 39 kg



Drawing number
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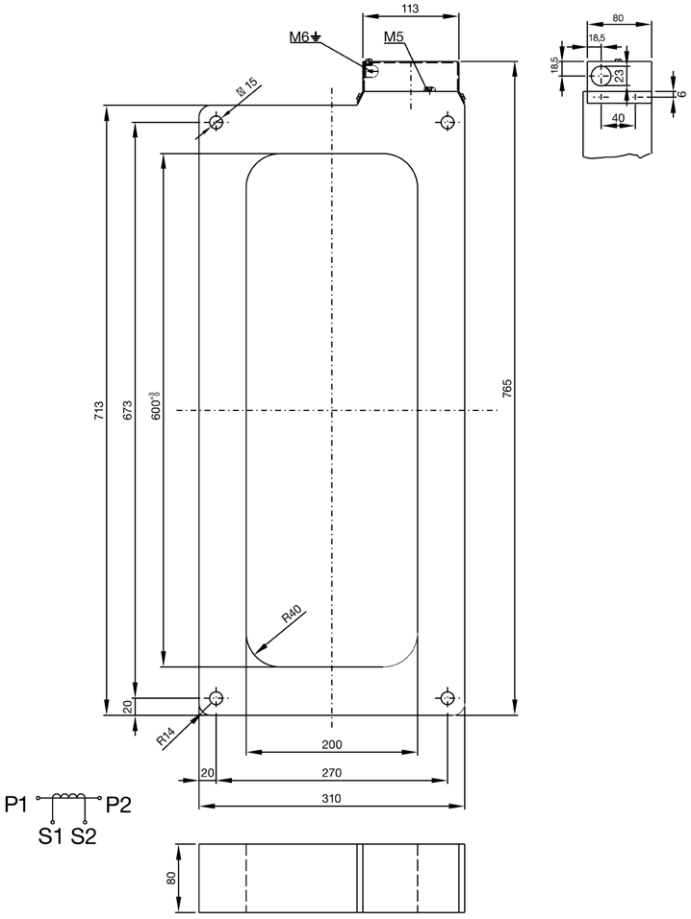
6. Measuring instruments

KOKM 06 J23
Weight: 28 kg



Drawing number
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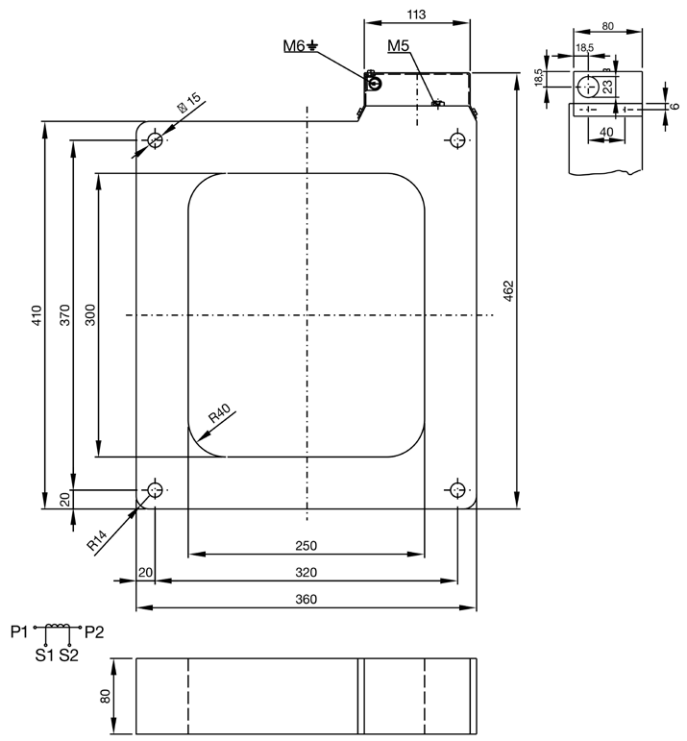
KOKM 06 J24
Weight: 22 kg



Drawing number
1VL4900440R0101

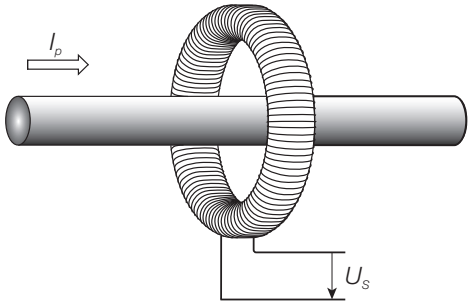
6.7 ABB Sensors portfolio

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

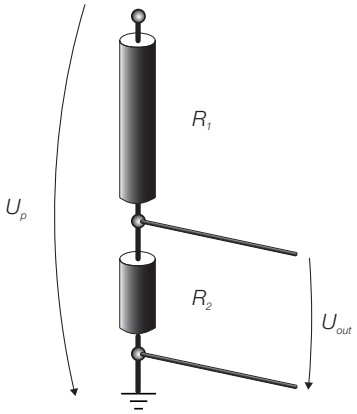
Current measurement is based on the Rogowski coil principle. A Rogowski coil is a toroidal coil, without an iron core, placed around the primary conductor in the same way as the secondary winding in a current transformer. However, the output signal from a Rogowski coil is not a current, but a voltage 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 and REF 620 (from left to right).

6. Measuring instruments

6.7.1 Advantages of ABB sensors

Primary terminals with the same quality level and ribs as for traditional current transformers. Design of KEVCD transformer is done the way to be able to replace conventional inductive CT inside the switchgear.

Silver coated primary terminals help set higher range for temperature rise tests.

Very fast design process, thanks to standardized products.

Wide range of parameters cover one design. It allows really quick delivery time.

Sensor accuracy classes are verified including secondary cable. Cables are integral part of sensors and are delivered together.

Flexibility towards varying load flows through the switchgear. Possibility to connect different equipment /load and upgrade of switchgear parameters without additional costs thanks to wide range of sensors parameters covered by one design.

The highest surface quality is guaranteed thanks to casting into the epoxy resin, with more than 60 years of experience gathered at this field combined with the APG (air pressure gelation) casting.

Due to the absence of a ferromagnetic core the sensor has a linear response over a very wide primary current range, far exceeding the typical CT range.

KEVCD could have combination of current and voltage sensor at one body (AE and BE type), which can easily replace inductive current and voltage transformers. It helps to significantly reduce energy consumption during life time and decrease the weight of instruments by 57 kg per phase.

Cables are connected directly to the IED, and subsequently neither burden calculation nor secondary wiring is needed.

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 characteristic

- 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 / √3, 15/ √3, 22/ √3
- Cable lengths: 5, 6.5, 7.5 m
- Current accuracy class: 0.5/5P630
- Voltage accuracy class: 0.5/3P

6.3.7 Types and weights

Type	Sensors	Voltage [kV]	Current [A]
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.

For KEVCD dimensional drawings see chapter 6.7.2 Dimensional drawings of Sensors

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 characteristic
- 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

For KECA dimensional drawings see chapter 6.7.2 Dimensional drawings of Sensors

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, its connected directly to the IED and subsequently neither burden calculation nor secondary wiring is needed.

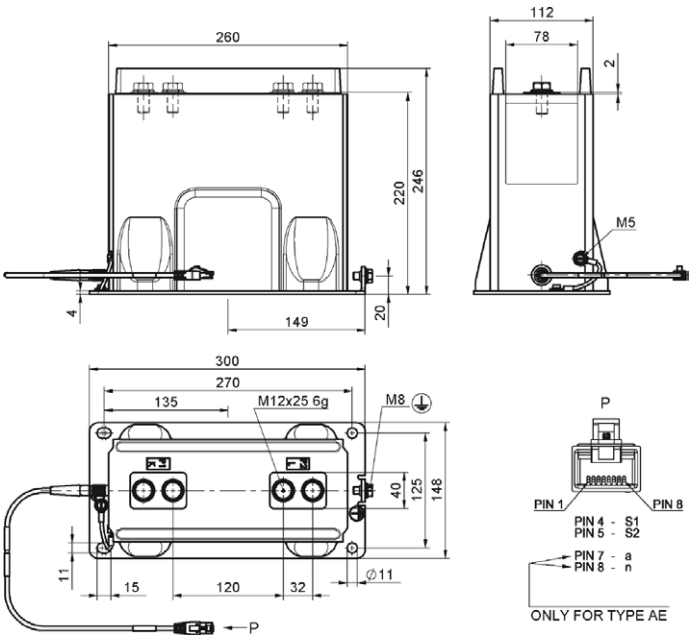
KEVCD 24 connected to REF615

KECA 250 B1 connected to REF601

6. Measuring instruments

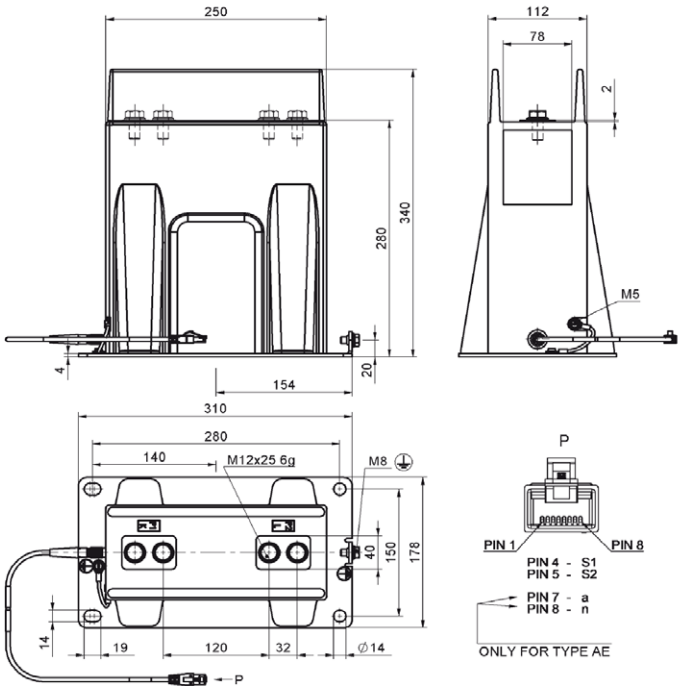
6.7.2 Dimensional drawings of Sensors

KEVCD A 12, 17.5 kV
Weight: 12.5 kg



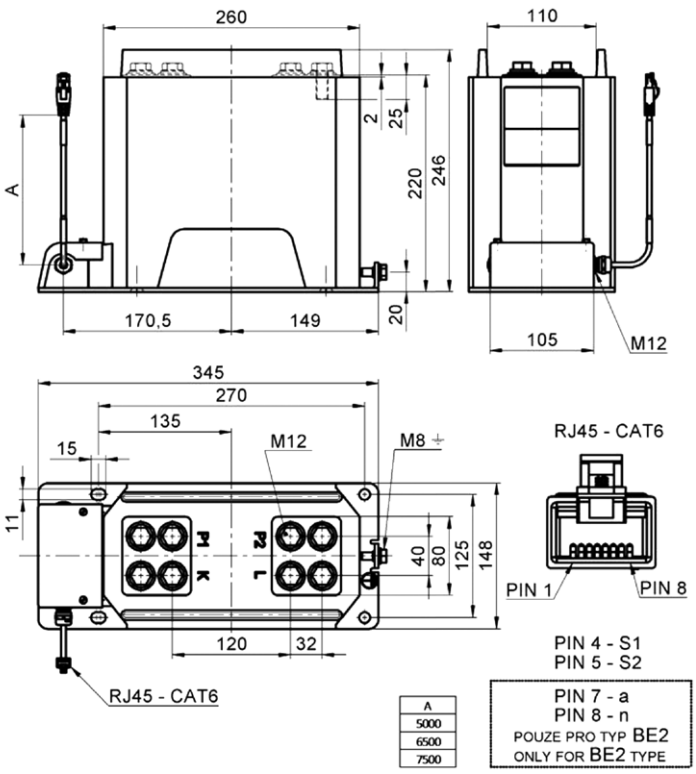
Type		Description
KEVCD 12 AE 3	KEVCD 17.5 AE 3	Current/Voltage sensor
KEVCD 12 AG 3	KEVCD 17.5 AG 3	Current sensor

KEVCD A 24 kV
Weight: 15.6 kg



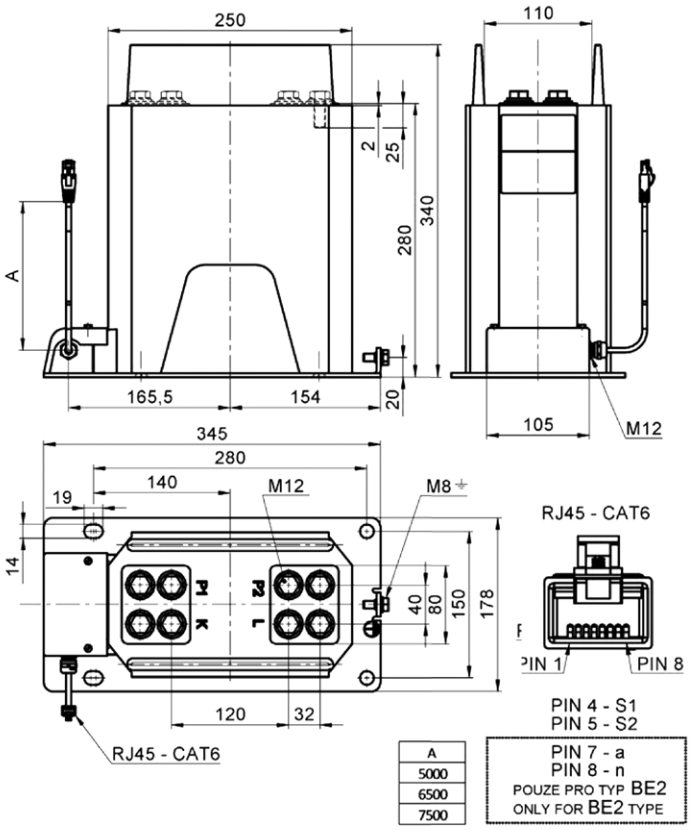
Type	Description
KEVCD 24 AE 3	Current/Voltage sensor
KEVCD 24 AG 3	Current sensor

KEVCD B 12, 17.5 kV
Weight: 20 kg



Type	
KEVCD 12 BE 2	KEVCD 17.5 BE 2
KEVCD 12 BG 2	KEVCD 17.5 BG 2

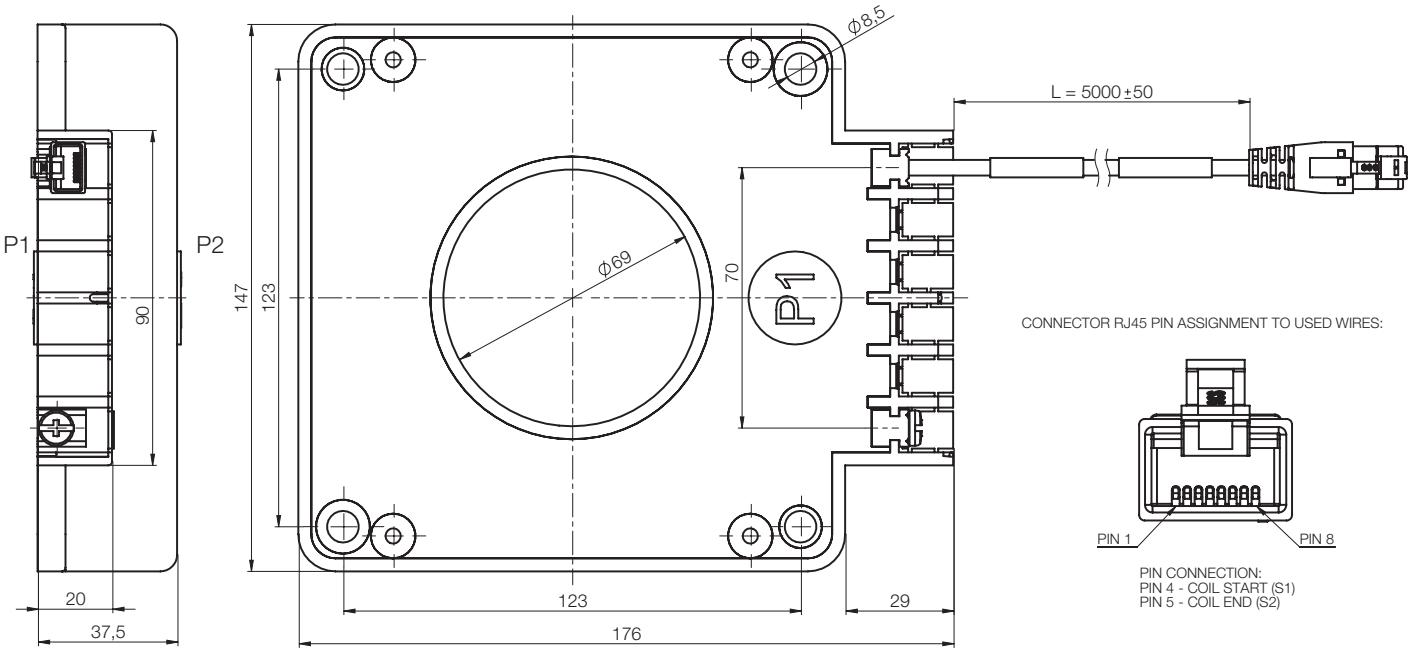
KEVCD B 24 kV
Weight: 24 kg

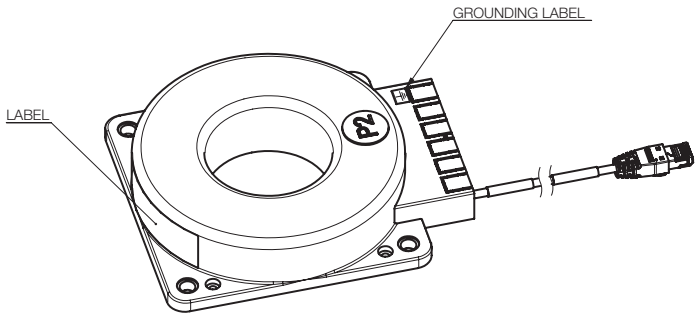


Type
KEVCD 24 BE 2
KEVCD 24 BG 2

6. Measuring instruments

KECA 250 B1
Weight: 1 kg





7. Relays

7.1 ABB's 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.

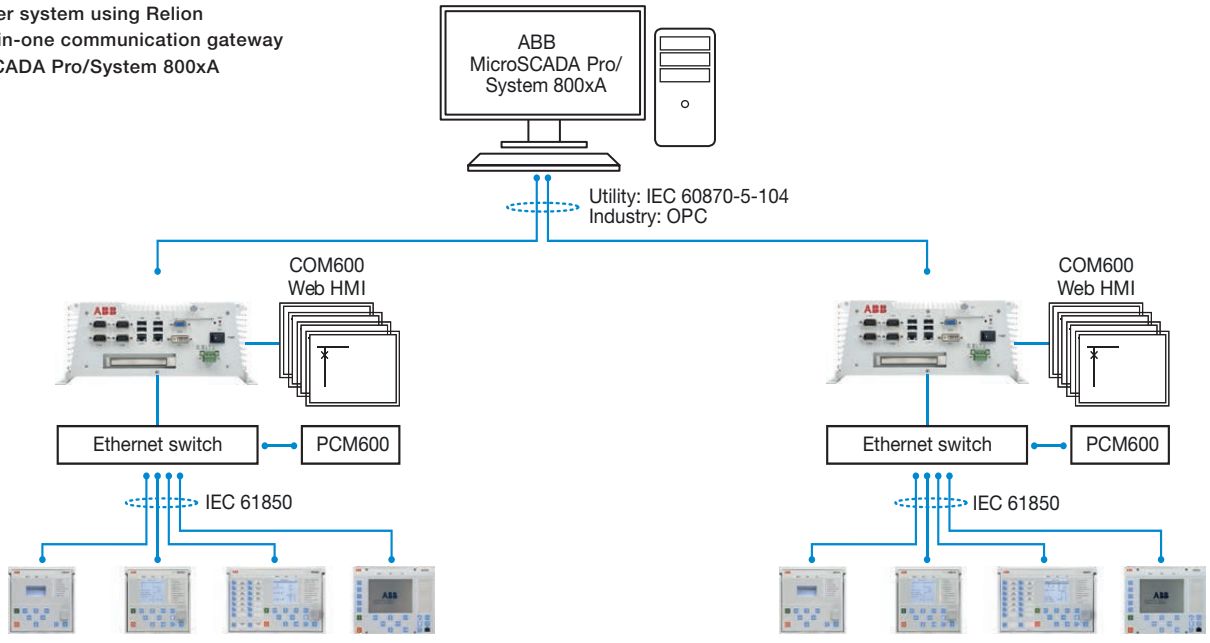
Protection relays are activated when something abnormal has happened in the power system; they do not prevent network faults from arising. Selecting the right protection functions and methods improves the performance and the reliability of the protection system, thus minimizing the effects of network 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 as small a part of the network as possible, and to allow the faulted part of the network 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. Relays

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

7.3 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 component 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 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 in 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 sevice 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 as to allow the faulty line to disconnect.

7. Relays

TVOC

This system consists of an electronic monitoring device housed in the low voltage cubicle, to which optic sensors are connected. These latter are distributed amongst the power cubicles and are connected to the device by means of optic fibers.
The device causes the circuit-breakers to open when a preset level of light is exceeded.
Current transformers can also be connected to the monitoring device to prevent the system from being tripped by occasional light created by external factors (a camera flash, reflected external light, etc.).
The protection module only transmits the opening command to the circuit-breaker if it receives the light signal and that of short-circuit current at the same time.
The total release time is 62 ms (2 ms TVOC + 60 ms the circuit-breaker).

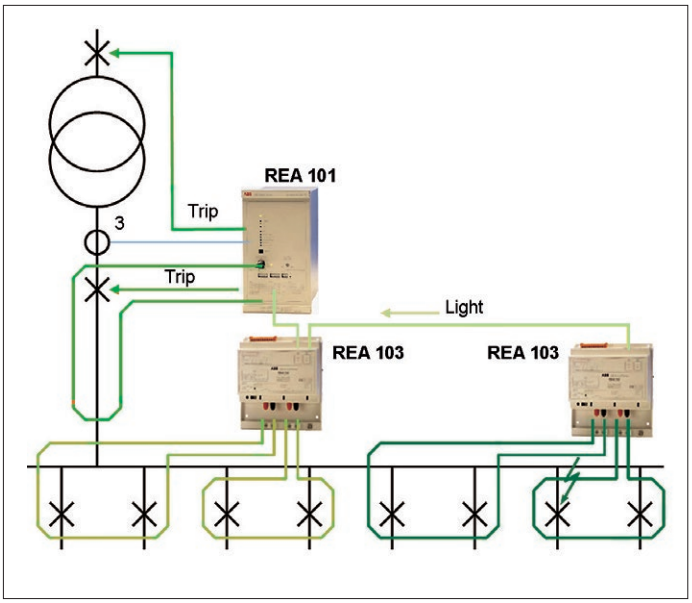
REA

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).

Electric arc protection with IED

On request, the IED (Intelligent Electronic Devices) REF615, RET615, REM615 and REF610 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 total release time is 72 ms (12 ms IED + 60 ms the circuit-breaker).

Typical configuration with REA 101 and subunit 103



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

TVOC electric arc protection unit

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 IEDs 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 IEDs 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 IEDs are characterized by their functional scalability and withdrawable-unit design.

Auxiliary power supply voltage:

Hight: 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

7.4 Substation automation

ABB's protection and control relays are an integral part of substation automation systems. The substation automation system, together with the protection relays, lay the foundation for all the higher-level remote functions, such as advanced power system management and the monitoring of the condition of the equipment, when it is in service. Substation-level systems are easy to use and to adapt to customer-specific requirements.

Increased competition is driving many power providers to focus on system productivity, with the aim to reduce costs and increase customer satisfaction. To reach this goal, an upgrade of an aging infrastructure is usually involved. Updating to substation automation offers the opportunity to reduce operational and maintenance costs, increase plant productivity with the help of enhanced schemes, as well as condition monitoring for the apparatus (e.g., circuit breakers, power transformers).

Product offering

The COM600 series offers versatile substation management units. These units are deployed together with protection and control relays and other communication devices to realize smart substation and grid automation solutions in utility and industrial distribution networks. The COM600 series units perform the combined role of a user interface, a communication gateway and an automation platform in a single physical unit.
The COM600 series accomodates web technology-based functionality, which provides access to substation devices and processes via a web browser-based human machine interface (HMI). All standard substation monitoring and control aspects can be handled using the web-HMI.
The COM600 series integrates substation devices, like protection and control relays, substation controllers and meters, based on the IEC 61850 communication standard, as well as most other commonly used communication standards and legacy protocols. Seamless connectivity can be established with gateway functionality between the substation devices and external higher-level systems such as the Network Control Center (NCC) or a process such as the Distributed Control System (DCS) using IEC 60870-5, DNP3, Modbus or OPC-based protocols.

The COM600 series hardware platform is based on ruggedized mechanics with no moving parts subject to wear and tear. The compact and robust design is well adapted to harsh environments.
The COM600 series comprises of two products:
– COM600S for Substation Automation (for IEC and ANSI markets)
– COM600F for Feeder Automation (for ANSI markets only).

The COM600S has the capability to function as a combined substation HMI, gateway and process controller in a small to medium-sized substation automation installation. Its HMI feature enables substation monitoring and operations.
It integrates various units to provide access to real-time data. It also records process data in its historian to enable access to past data. Its logic processor enables implementation of substation-level automation tasks. The gateway functionality provides a provision to communicate data from protection and control relays in the substation and COM600S itself to higher-level systems and vice versa.

For more information, please refer to the following documentation:
– COM600S Substation Management Unit Product Guide Substation Management Unit COM600S.

Substation Management Unit COM600S

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.
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

Remote I/O unit RIO600

7. Relays

7.6 Selection table

The Relion Interactive Selection Guide (ISG), which covers the entire Relion family, is available online. Go to: http://abb.relionisg.com

In the table:
X = function supported
O = function available as option

	605	605	605	605	610	610	610	611	611	611	611
	REF601	REJ601	REJ603	REM601	REF610	REM610	REU610	REB611 IEC	REF611 IEC	REM611 IEC	REU611 IEC
Standard											
ANSI	X	X		X	X	X	X				
IEC	X	X	X	X	X	X	X	X	X	X	X
Application											
Arc fault protection application											
Busbar application								X			
Back-up application	X	X			X			O	X		
Capacitor bank application											
Feeder application	X	X	X		X		X		X		X
Generator											
Motor application				X		X		O		X	
Power management/load-shedding application											
Transformer application								O			
Functionality											
Autorecloser	X	X		X	X				X		
Circuit breaker controlability	X			X				X	X	X	X
Condition monitoring	X			X				X	X	X	
Current-based protection	X	X	X	X	X	X		X	X	X	
Distance protection											
Fault locator											
Generator differential protection								X			
LCD display with Single Line Diagram (SLD)											
Line differential protection (with in-zone transformer support)											
Load-shedding											
Motor differential protection								X			
On load tap changer control											
Power quality											
Self-powered protection relay			X								
Synchro-check											
Transformer differential protection								X			
Voltage based protection							X				X
Withdrawable release mechanism					X	X	X	X	X	X	X
Hardware											
Analog inputs (CTs/VTs)	4/0	4/0	4/0	4/0	4/0	4/0	0/4	4/0	4/1	4/0	0/5
Analog inputs (sensor channels/CTs)	3/1	3/1	–	3/1	–	–	–	–	–	–	–
Binary inputs/outputs	4/6	4/6	0/2	4/6	5/8	5/8	5/8	4/6	10/9	4/6	4/6
RTD/mA inputs	–	–	–	–	–	–	–	–	–	–	–
mA outputs	–	–	–	–	–	–	–	–	–	–	–
Communication protocols											
DNP 3.0					X		X				
IEC 60870-5-103	X	X		X	X	X	X				
IEC 61850								X	X	X	X
Modbus	X	X		X	X	X	X	X	X	X	X
Profibus								X	X	X	X
Communication media											
Ethernet (RJ45)								X	X	X	X
Ethernet (LC)								X	X	X	X
Ethernet redundant solutions (HSR/PRP/RSTP)								X	X	X	X
Serial (RS 232/485, ST conn.)	X	X		X	X	X	X	X	X	X	X

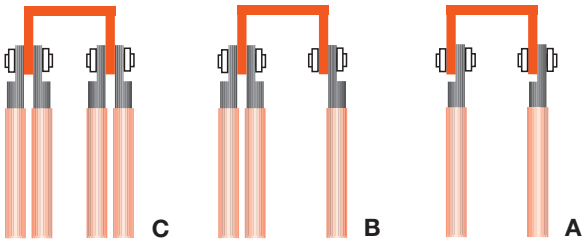
	615	615	615	615	615	615	615	615	615	615	620	620	620	620	620	620	630	630	630	630
	REF615 IEC	RED615 IEC	REM615 IEC	RET615 IEC	REU615 IEC	REV615 IEC	REF 615 ANSI	REF 615R ANSI	REM 615 ANSI	RET 615 ANSI	REF620 IEC	REM620 IEC	RET620 IEC	REF620 ANSI	REM620 ANSI	RET620 ANSI	REF630 IEC	REM630 IEC	RET630 IEC	REG630 IEC
							X	X	X	X				X	X	X				
	X	X	X	X	X	X					X	X	X				X	X	X	X
	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X				
	X						X	X												
						X														
	X	X			X		X	X			X			X			X			
																				X
			X						X			X			X			X		
					X												X			
		X		X	X					X			X			X			X	
	X	X						X			X			X			X			
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
																	X			
	X	X						X									X			
																				X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		X																		
					X			X								X	X			
												X			X			X		X
					X								X						X	
	X	X				X	X	X			X						X			
	X				X		X	X			X	X	X	X			X		X	X
				X						X			X			X			X	X
	X	X	X	X	X	O	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X				
	4/5	4/5	4/5	7/5	4/5	7/5	7/6	4/5	7/4	7/6	4/5	7/5	8/9	7/8	7/4	10/4	4/5	8/4	8/3	8/4
	6/1	6/1	6/1	–	–	–	–	–	–	–	6/1	–	–	–	–	–	–	–	–	–
	18/13	18/13	16/12	14/12	14/12	14/12	18/13	11/7	18/13	14/13	32/18	20/14	16/17	32/18	14/13	16/17	50/45	50/45	50/45	50/45
	2/1	2/1	6/2	6/2	6/2	6/2	–	–	6/2	2/1	6/2	12/4	8/3	–	14/5	2/1	8	8	8	8
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4	4	4	4
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

8. Accessories

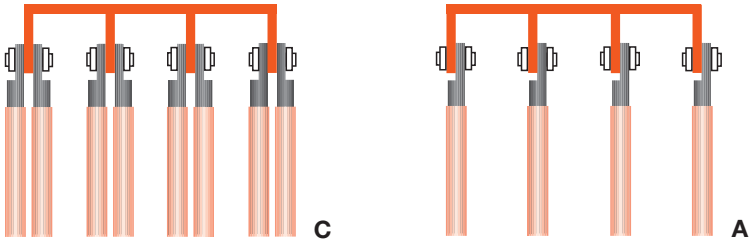
8.1 Cables

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

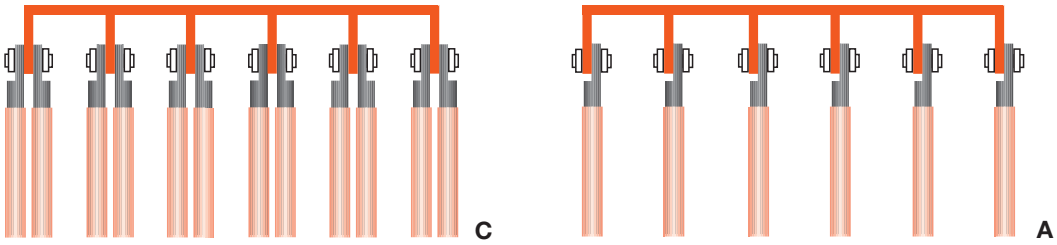
Unit with 2 cable connections per phase



Unit with 4 cable connections per phase



Unit with 6 cable connections per phase



(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.

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	–	–	–	–	–

C B A

9. 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

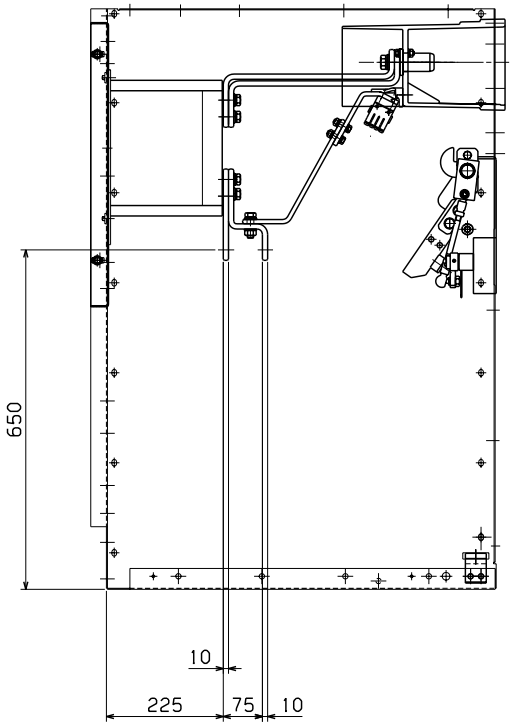
Rated voltage [kV]	Unit width [mm]	Unit depth [mm]	
		1550	2000
17.5	600	400…450 kg	500…550 kg
	750	450…500 kg	570…620 kg
	1000	550…600 kg	700…750 kg

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

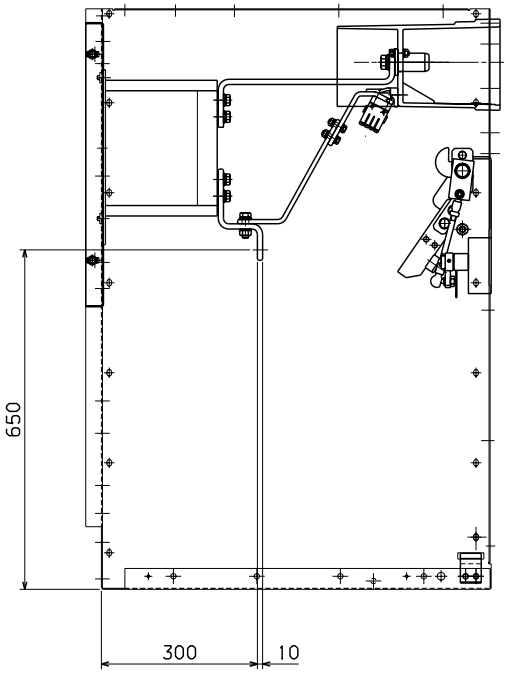
N.B. The indicated weights do not include the apparatus (circuit-breakers, contactors, switch disconnectors), transformers and/or measuring sensors and the auxiliary apparatus.

9.2 Cable connections

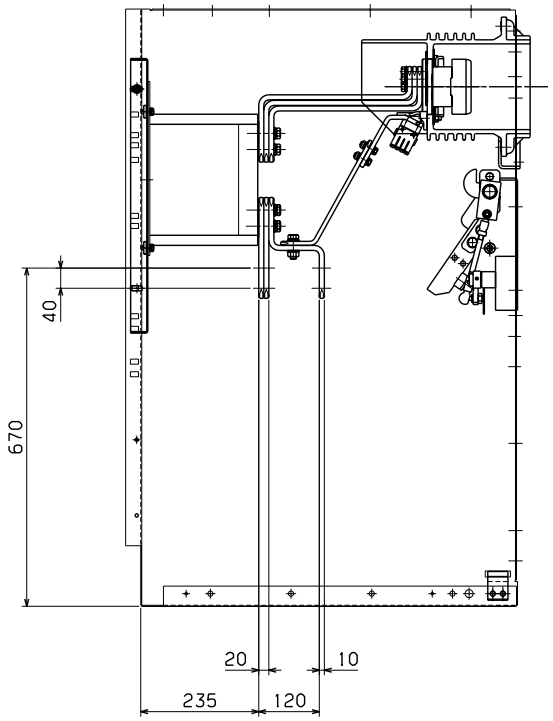
12-17.5 kV / Width 600-750 /1250 A



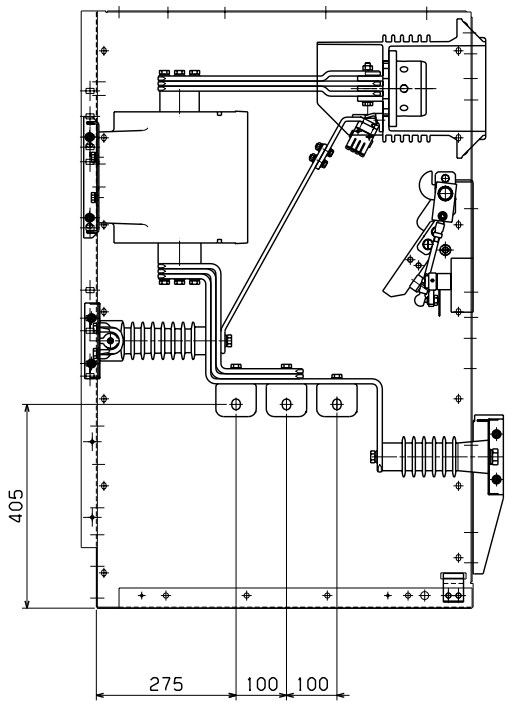
12-17.5 kV / Width 600-750 / 630 A



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

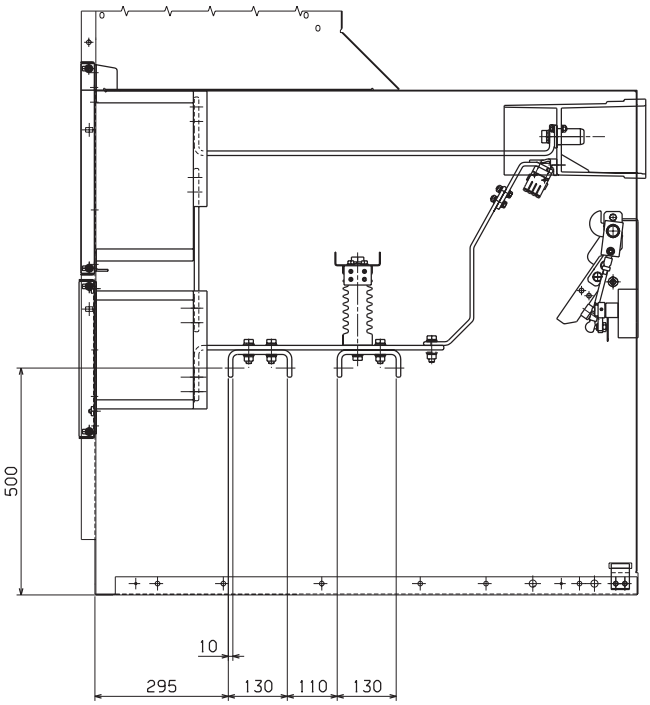


12-17.5 kV / Width 1000 / 3150-3600-4000 A

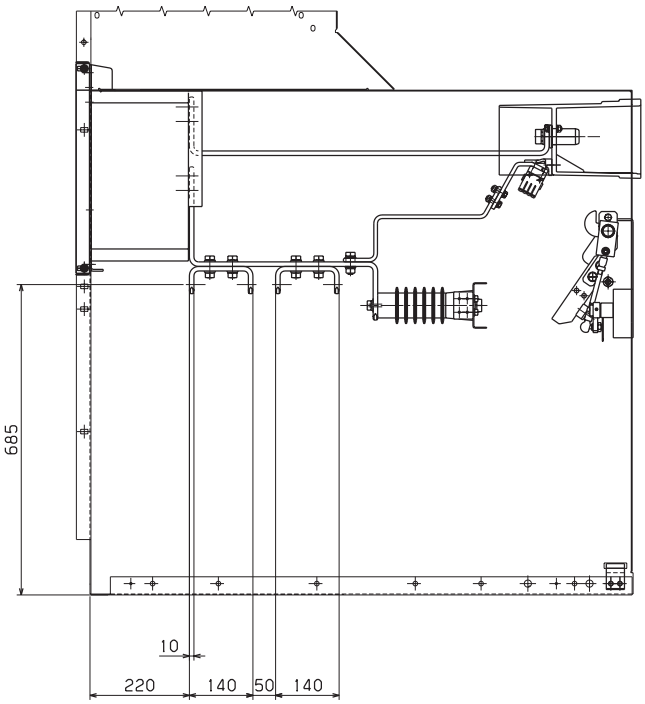


9. Data

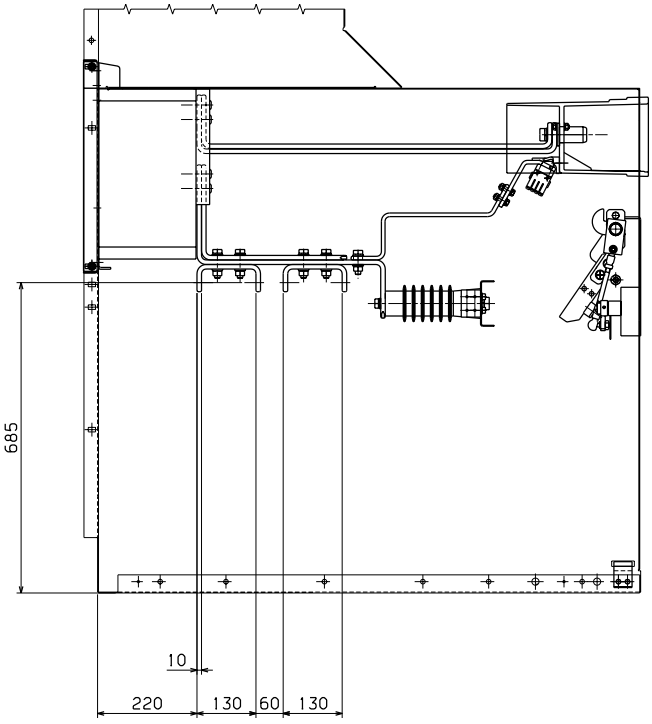
12-17.5 kV / Width 600 deeper / 630 A with 6CTs



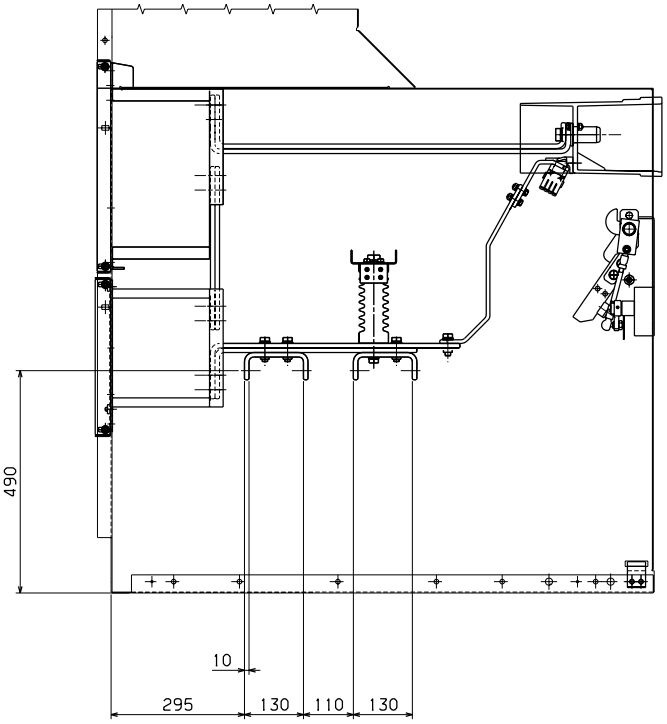
12-17.5 kV / Width 600 deeper / 630 A with 3CTs



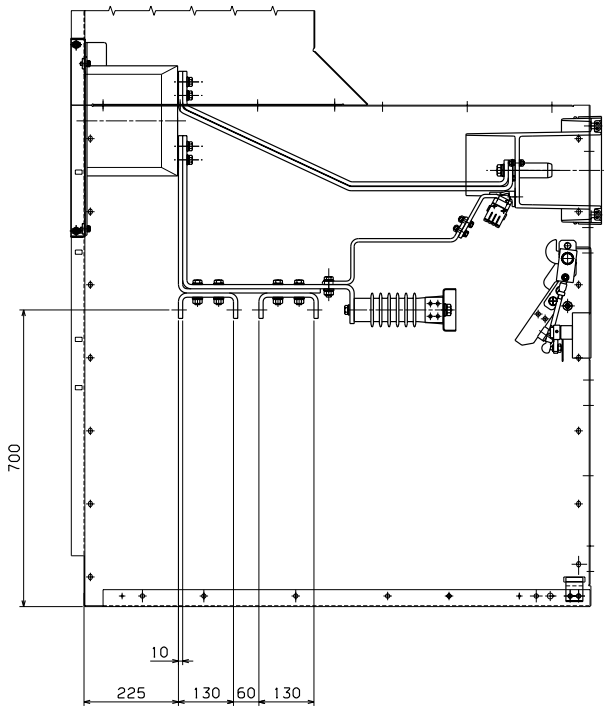
12-17.5 kV / Width 600 deeper / 1250 A with 3CTs



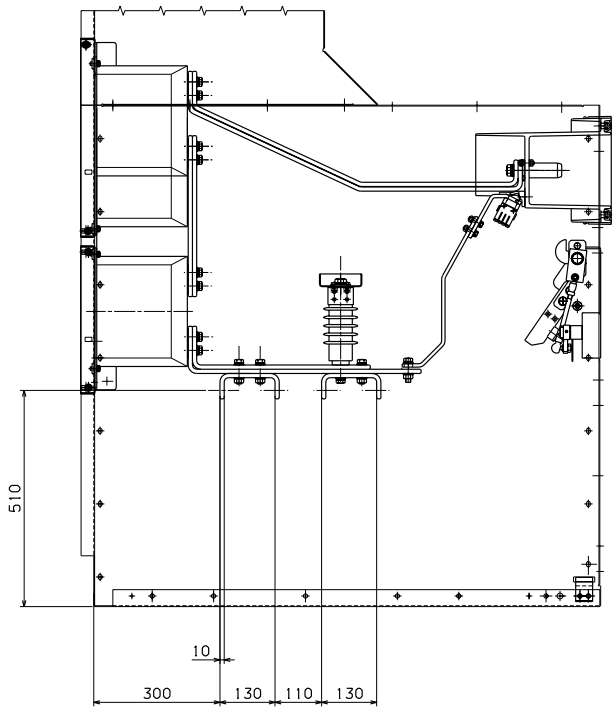
12-17.5 kV / Width 600 deeper / 1250 A with 6CTs



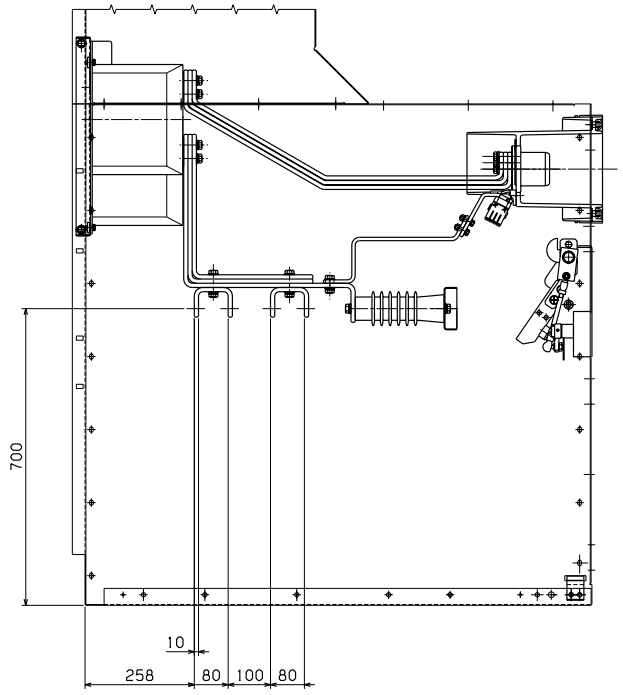
12-17.5 kV / Width 750 deeper / 1250 A with 3CTs



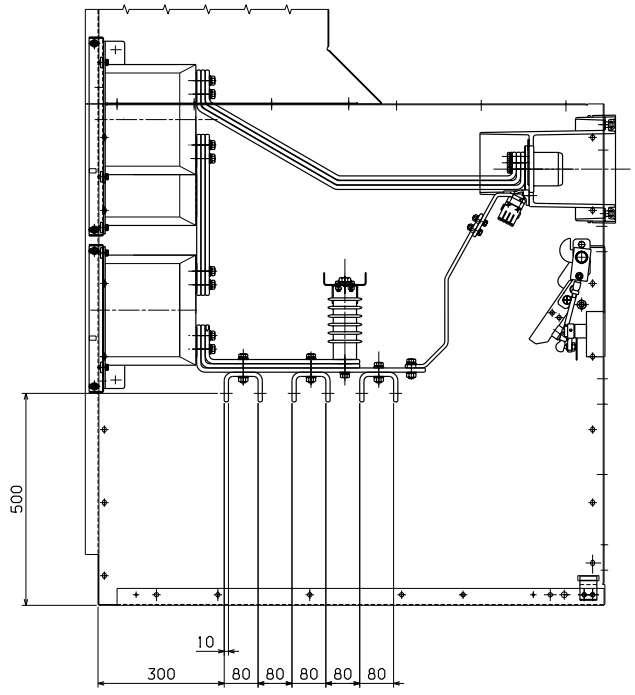
12-17.5 kV / Width 750 deeper / 1250 A with 6CTs



12-17.5 kV / Width 750-1000 deeper / 1600-2000-2500 A with 3CTs

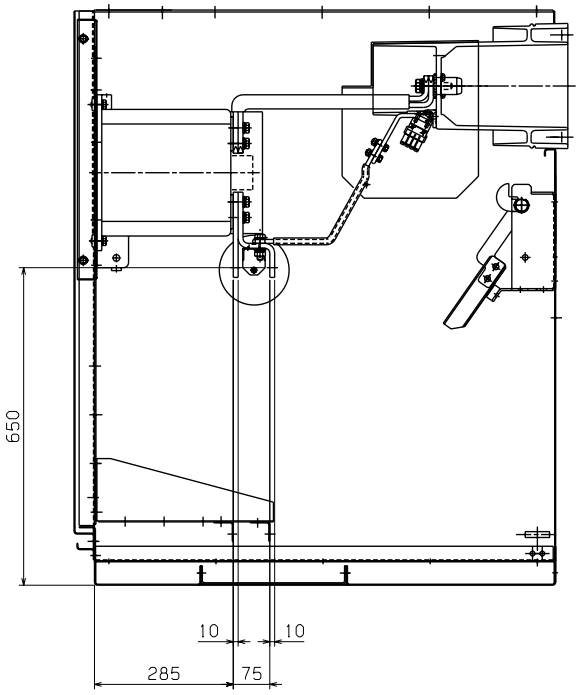


12-17.5 kV / Width 750-1000 deeper / 1600-2000-2500 A with 6CTs

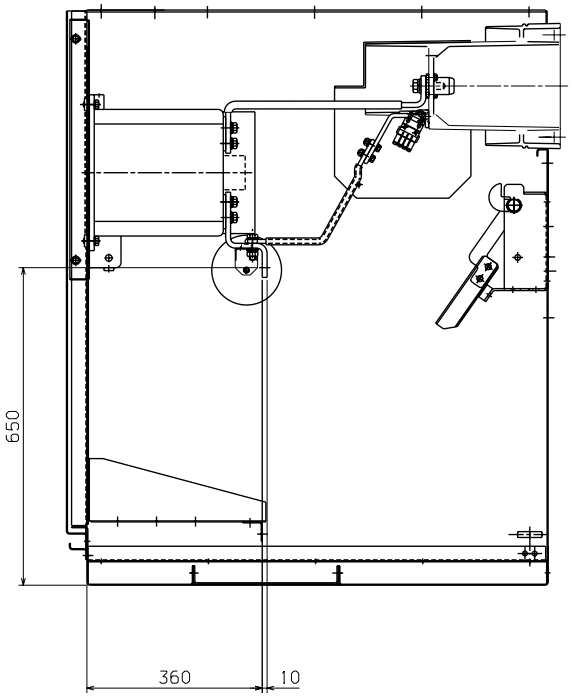


9. Data

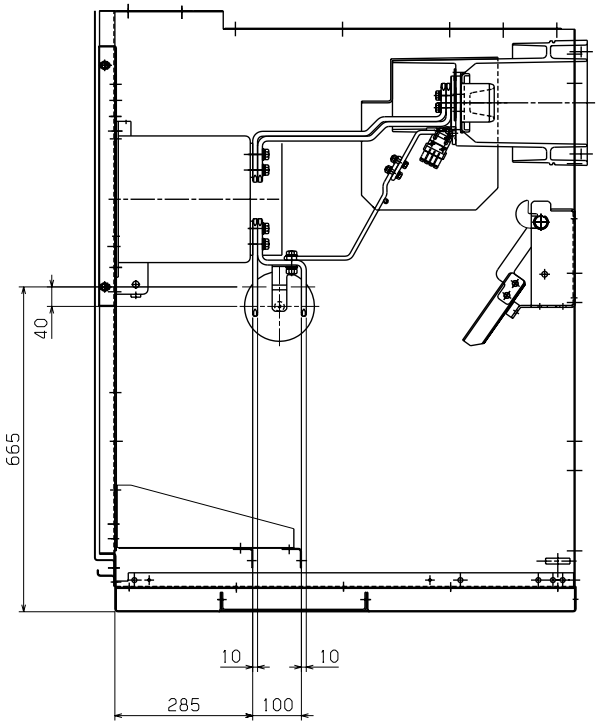
24 kV / Width 750 / 1250 A



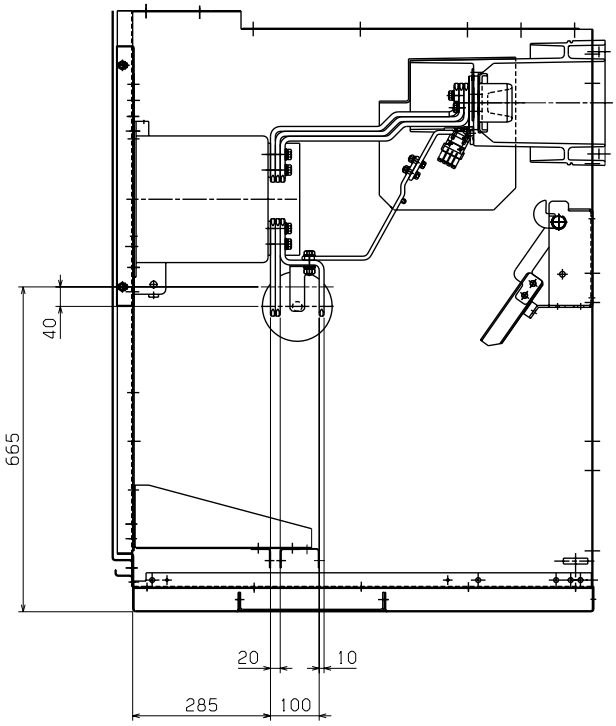
24 kV / Width 750 / 630 A



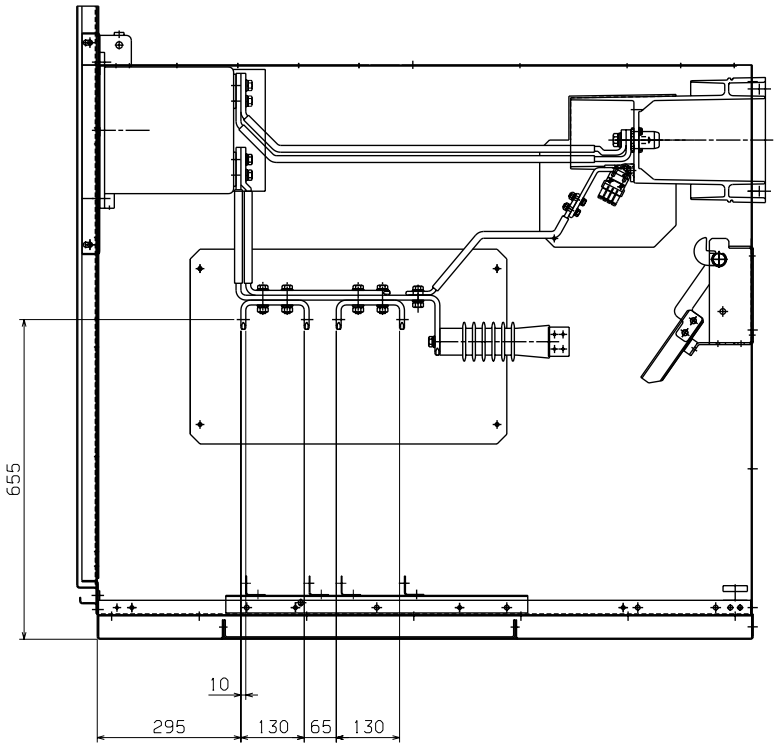
24 kV / Width 1000 / 1600 A



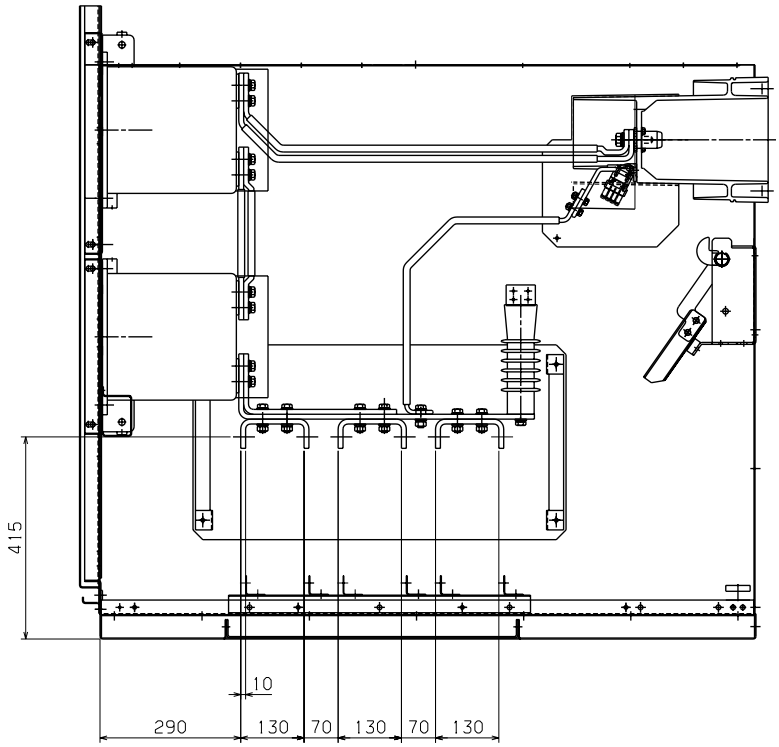
24 kV / Width 1000 / 2000-2500 A



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



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



Contacts

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