TAVRIDA ELECTRIC
Excellence in Engineering

VCB

VACUUM CIRCUIT BREAKER

17,5 kV, …31,5 kA, …3150 A
24 kV, …25 kA, …2500 A

USER GUIDE

VERSION 16

Contents

1. Product Description

This User Guide describes the Vacuum Circuit Breakers manufactured by Tavrida Electric.

Tavrida Electric circuit breakers are designed for rated voltages up to 24 kV.

Vacuum Circuit Breakers described in the current document can be used in various kinds of switchgear and RMUs and are intended to perform switching operations in network rated and faulty modes.

The breakers are comprised of following main components:

- Indoor Switching Module (ISM) - The air insulated ISM incorporates Tavrida Electric vacuum interrupters with monostable magnetic actuators and solid dielectric insulating materials. No SF-6 or oil insulation is used in the ISM;

- Control Module (CM) - The CM is a microprocessor based controller that provides ISM operation, protection and data logging functions;

- Kits - The kits of components are used to provide circuit breaker application properties.

This guide contains information on switching operations, required check-ups and maintenance, as well as service and disposal procedures. The purpose of the document is to provide necessary product information for users providing installation, commissioning and utilizing installed equipment.

1.1 Abbreviations

AC	Actuator Coil
AS	Auxiliary Switch
BIL	Basic Insulation Level
EMC	Electromagnetic Compatibility
CM	Control Module
CO	Close - Open Operations Cycle
Com	Common Point of Contact
I/O	Input / Output
ISM	Indoor Switching Module
LED	Light Emitting Diode
(P)MCB	Protective Miniature Circuit Breaker
PS	Position Switch
NA	Not Applicable
NC	Normally Closed Contact
NO	Normally Open Contact
PCD	Phase Center Distance
USB	Universal Serial Bus
VCB	Vacuum Circuit Breaker
VI	Vacuum Interrupter

1.2 Main Technical Parameters

Main technical data and circuit breaker technical parameters are presented in the tables below.

Table 1 - VCB15 Technical Parameters

	VCB15_									
Type	**LD1**		**LD3**	**LD6**	**LD8**	**MD1**	**MD3**	**Shell2**	**HD1**	
Rated voltage (Ur)	12 kV	17.5 kV	12 kV	12 kV	17.5 kV	17.5 kV	17.5 kV	17.5 kV	17.5 kV	
Phase centre distance (PCD), mm	150 180 210	180 210	-	133	150 210	150 180 210 275	-	150 210 275	210 275	275
Rated normal current (Ir)	800 A		800 A	630 A	800 A	1250 A	1250 A	1250 A[1] 2000 A	2500 A[2]	3150 A[3]
Rated power frequency withstand voltage (Ud)	28 (42) [4] kV	38 (42) [4] kV	28 (42) [4] kV	28 (42) [4] kV	38 (42) [4] kV	38 (42) [4] kV	38 (42) [4] kV	38 (42) [4] kV	38 (42) [4] kV	
Rated lightning impulse withstand voltage (peak) (Up)	75 kV	95 kV	75 kV	75 kV	95 kV	95 kV [5]	95 kV [5]	95 kV [6]	95 kV	
Rated short-circuit breaking current (Isc)	20 kA [7]		20 kA [7]	20 kA [7]	25 kA [19]	31.5 kA [7]	31.5 kA [7]	31.5 kA [7]	31.5 kA [7]	
Rated peak withstand current (Ip)	52kA		52kA	52 kA	65 kA	82 kA	82 kA	82 kA	82 kA	
Rated short-time withstand current (Ik)	20 kA		20 kA	20 kA	25 kA	31.5 kA	31.5 kA	31.5 kA	31.5 kA	
Rated duration of short circuit (tk)	4 s		4 s	4 s	4 s	4 s	4 s	4 s	4 s	
Rated frequency (fr)	50/60 Hz									
Mechanical life (CO-cycles)	50 000		50 000	20 000	50 000	30 000	50 000	30 000 [8]	30 000	
Maximum number of CO-cycles per hour	60									
Operating cycles, rated–short circuit breaking current	100		100	100	100	50	50	50	50	
Closing time	≤ 70 [9] ms		≤ 70 [9] ms	≤ 70 [9] ms	≤ 70 [9] ms	≤ 60 [9] ms	≤ 60 [9] ms	≤ 60 [9] ms	≤ 60 [9] ms	
Opening time	≤ 35 [9] ms									
Break time	≤ 45 [9] ms									
Rated operating sequence at rated normal current	O-0.3s-CO-10s-CO-10s-CO [10]									
Rated operating sequence at rated short-circuit breaking current	O-0.3s-CO-15s-CO									

Table 1 - VCB15 Technical Parameters

	VCB15_							
Type	**LD1**	**LD3**	**LD6**	**LD8**	**MD1**	**MD3**	**Shell2**	**HD1**
Auxiliary Circuits Insulation Strength [11]								
Power frequency test voltage (1 min) according to IEC60255-27	2 kV							
Lightning impulse 1.2 m s/50 m s/0.5 J according to IEC60255-27	5 kV							
Insulation resistance, 1000V DC according to IEC60255-27	≥ 5 MOhm							
Design class of switching module with regard to severity of service conditions in accordance with IEC 60932	Class 1	Class 1	Class 1	Class 1	Class 0	Class 0	Class 0	Class 0
Standards	IEC 62271-100 GB 1984- 2003							
Mechanical vibration withstand capability according to IEC 60721-3-4	Class 4M4							
Resistance of main circuit	≤ 40 µOhm	≤ 40 µOhm	≤ 40 µOhm	≤ 40 µOhm	≤ 17 µOhm	≤ 17 µOhm	≤ 18 µOhm	≤ 15 µOhm
Weight (depending on Phase centre distance)	34-36 kg	13 kg	55 kg	26 kg	33-35 kg	13 kg	51-55 kg	70-72 kg
Weight of CM	1 kg							
Overall dimensions of CM [12]	190x165x45 mm							
Altitude above sea level	1000 m [13]							
Relative humidity in 24 hours	≤ 95 %							
Relative humidity over 1 month	≤ 90 %							
Temperature Range	-25 °C ... +55 °C							
Degree of protection according to IEC 60529 of actuator compartment	IP40							
Type of driving mechanism	Monostable magnetic actuator							
Design, Switching Capacity of Silver Auxiliary Contacts								
Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC	2 NO + 2 NC	6 NO + 6 NC	Variable:Up to 12NO+12NC	6 NO + 6 NC	2 NO + 2 NC	6 NO + 6 NC	6 NO + 6 NC
Minimum current for 12 V AC / DC, ohmic load	100 mA							
Minimum current for 12 V AC / DC, inductive load (t=20 ms, cosj =0,3)	100 mA							
Maximum current for 30 V DC, ohmic load	10 A [15]							

Table 1 - VCB15 Technical Parameters

	VCB15_							
Type	**LD1**	**LD3**	**LD6**	**LD8**	**MD1**	**MD3**	**Shell2**	**HD1**
Maximum current for 30 V DC, inductive load (t=20 ms)	3 A							
Maximum current for 60 V DC, ohmic load	0.9 A							
Maximum current for 60 V DC, inductive load (t=20 ms)	0.9 A							
Maximum current for 125 V DC, ohmic load	0.5 A							
Maximum current for 125 V DC, inductive load (t=20 ms)	0.03 A							
Maximum current for 250 V DC, ohmic load	0.25 A							
Maximum current for 250 V DC, inductive load (t=20 ms)	0.03 A							
Maximum current for 125 V AC, ohmic load	10 A [14)]							
Maximum current for 125 V AC, inductive load (cosj =0,3)	5 A							
Maximum current for 250 V AC, ohmic load	10 A [14)]							
Maximum current for 250 V AC, inductive load (cosj =0,3)	5 A							
Design, Switching Capacity of Gold-Plated Auxiliary Contacts [15)]								
Number of available auxiliary contacts for three-phase ISM	-	-	-	-	-	-	-	-
Minimum current for 5 V AC / DC	1 mA							
Maximum current for 10 V AC / DC	300 mA							
Maximum current for 30 V AC / DC	100 mA							
Maximum voltage AC / DC	30 V							
CM Reaction Times								
Preparation time for the operation of the CM after switching on the auxiliary power supply	≤ 15 s							
Preparation time for the close operation of the CM after a previous close operation	≤ 10 s							
Preparation time for the trip operation of the CM after switching on the auxiliary power supply	≤ 0.1 s							
Trip capability after failure of the auxiliary power supply	≥ 60 s [16)]							

Table 1 - VCB15 Technical Parameters

	VCB15_							
Type	**LD1**	**LD3**	**LD6**	**LD8**	**MD1**	**MD3**	**Shell2**	**HD1**
CM Supply Voltage								
Rated range of supply voltage of CM_16_1(Par1_60.2_Par2Par3_Par4_Par5)	24V to 60V DC							
Rated range of supply voltage of CM_16_1(Par1_220.2_Par3_Par4_Par5)	110V to 220V AC/DC							
Operating range (80-120%) of CM_16_1(Par1_60.2_Par3_Par4_Par5)	19V to 72V DC							
Operating range (80-120%) of CM_16_1(Par1_220.2_Par3_Par4_Par5)	85V to 265V AC/DC							
CM Power Consumption								
Charging the close and trip capacitors of CM_16_1(Par1_60.2_Par3_Par4_Par5)	≤ 25 W							
Charging the close and trip capacitors of CM_16_1(Par1_220.2_Par3_Par4_Par5)	≤ 42 W AC [17] ≤ 37 W DC							
Permanent power consumption (standby) of CM_16_1(Par1_60.2_Par3_Par4_Par5)	≤ 5 W							
Permanent power consumption (standby) of CM_16_1(Par1_220.2_Par3_Par4_Par5)	≤ 7 W AC [18] ≤ 5 W DC							
Inrush current of CM_16_1(Par1_60.2_Par3_Par4_Par5) with discharged capacitors	≤ 120 A							
Inrush current of CM_16_1(Par1_220.2_Par3_Par4_Par5) with discharged capacitors	≤ 18 A							
Inrush time constant of CM_16_1(Par1_60.2_Par3_Par4_Par5) with discharged capacitors	≤ 0.5 ms							
Inrush time constant of CM_16_1(Par1_220.2_Par3_Par4_Par5) with discharged capacitors	≤ 4 ms							
Design, Switching Capacity of CM Inbuilt Relays								
Number of relays in CM	3							
Number of available contacts for one relay	1 NO + 1 NC with common point							

Table 1 - VCB15 Technical Parameters

	VCB15_							
Type	**LD1**	**LD3**	**LD6**	**LD8**	**MD1**	**MD3**	**Shell2**	**HD1**
Rated voltage	240 V							
Rated current AC	16 A							
Maximum breaking power AC	4000 VA							
Maximum switching current 250 V DC	0.35 A							
Maximum switching current 125 V DC	0.45 A							
Maximum switching current 48 V DC	1.3 A							
Maximum switching current 24 V DC	12 A							
Switching time	5 ms							
"Close" and "Trip" Dry Contacts Inputs of CM								
Output voltage	≥ 30 V							
Contacts closed current	≥ 50 mA							
Steady state current	≥ 5 mA							

1) For VCB ISM15_Shell with Low upper terminal – up to 1250 A, with High upper terminal – up to 2000 A.
2) Rating for metal enclosed switchgear with limited ventilation. Temperature rise type test at 2500 A in Cradle was successfully passed in KEMA.
3) 3150 A – for PCD 275 mm.
4) The information in brackets refers to the national Chinese standards GB1984-2003 at an installation altitude of 1000 m maximum.
5) Parameter valid only when ISM is used with insulation kit. For details see dimensional drawings and accessory information.
6) Parameter valid only when ISM is used with insulation caps. For details see dimensional drawings and accessory information.
7) At 40% d.c. component.
8) 10 000 CO – for ISM15_Shell_2(150_L) and ISM15_Shell_2(210_L) in horizontal actuator position.
9) Smaller timing on request.
10) The number of sequential Close-Trip operations with a 10 second interval should not exceed 10. The number of Close-Trip operations should not exceed 60 per hour. Sequence of 10s Close-Trip operations can be repeated only after 260 s pause.
11) Isolation resistance check is not applicable for "Actuator Coil" circuits of CM.
12) Overall dimensions of ISM are given in "Appendix 2. Overall Drawings".
13) Up to an installation altitude of 1000 m above sea level. Above 1000m, the external insulation measurement of the ISM must be increased by the atmospheric correction factor Ka according to IEC 62271-1 compared to the insulation measurement at sea level. The maximum allowed altitude is 2000 m above sea level.
14) At 5 min short-term duty. Continuous current – 5 A.
15) Gold-plated auxiliary contacts are availbale on request. Contact your nearest sales representatives.
16) In case of Dry contacts "Close" and "Trip" are open.
17) At Cos j >0.66.
18) At Cos j >0.33.
19) At 34% d.c. component.

Table 2 - VCB25 Technical Parameters

	VCB25_			
Type	**LD1**	**LD2**	**LD3**	**Shell2**
Rated voltage (Ur)	24 kV	24 kV	24 kV	24 kV
Phase centre distance (PCD), mm	210 275	150	-	210 275
Rated normal current (Ir)	800 A	800 A	800 A	2500 A
Rated power frequency withstand voltage (Ud)	50 kV	50 kV	50 kV	50 kV
Rated lightning impulse withstand voltage (peak) (Up)	125 kV	125 kV	125 kV	125 kV
Rated short-circuit breaking current (Isc)	20 kA [1.]	20 kA [1.]	20 kA [1.]	25 kA [1.]
Rated peak withstand current (Ip)	52 kA	52 kA	52 kA	65 kA
Rated short-time withstand current (Ik)	20 kA	20 kA	20 kA	25 kA
Rated duration of short circuit (tk)	3 s	3 s	3 s	4 s
Rated frequency (fr)	50/60 Hz			
Mechanical life (CO-cycles)	30 000			
Maximum number of CO-cycles per hour	60			
Operating cycles, rated–short circuit breaking current	50	50	50	25
Closing time	≤ 60 [2.] ms			
Opening time	≤ 35 [2.] ms			
Break time	≤ 45 [2.] ms			
Rated operating sequence at rated normal current	O-0.3s-CO-10s-CO-10s-CO [3.]			
Rated operating sequence at rated short-circuit breaking current	O-0.3s-CO-15s-CO			
Auxiliary Circuits Insulation Strength [4.]				
Power frequency test voltage (1 min) according to IEC60255-27	2 kV			
Lightning impulse 1.2 m s/50 m s/0.5 J according to IEC60255-27	5 kV			
Insulation resistance, 1000V DC according to IEC60255-27	≥ 5 MOhm			
Design class of switching module with regard to severity of service conditions in accordance with IEC 60932	Class 0	Class 1	Class 0	Class 0
Standards	IEC 62271-100			
Mechanical vibration withstand capability according to IEC 60721-3-4	Class 4M4			

Table 2 - VCB25 Technical Parameters

	VCB25_			
Type	**LD1**	**LD2**	**LD3**	**Shell2**
Resistance of main circuit	≤ 40 µOhm	≤ 40 µOhm	≤ 40 µOhm	≤ 17 µOhm
Weight (depending on Phase centre distance)	35-38 kg	35-37 kg	14 kg	53-55 kg
Weight of CM	1 kg			
Overall dimensions of CM [5.]	190x165x45 mm			
Altitude above sea level	1000 m [6.]			
Relative humidity in 24 hours	≤ 95 %			
Relative humidity over 1 month	≤ 90 %			
Temperature Range	-25 °C ... +55 °C			
Degree of protection according to IEC 60529 of actuator compartment	IP40			
Type of driving mechanism	Monostable magnetic actuator			
Design, Switching Capacity of Silver Auxiliary Contacts				
Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC	6 NO + 6 NC	2 NO + 2 NC	6 NO + 6 NC
Minimum current for 12 V AC / DC, ohmic load	100 mA			
Minimum current for 12 V AC / DC, inductive load (t=20 ms, cosj =0,3)	100 mA			
Maximum current for 30 V DC, ohmic load	10 A [8.]			
Maximum current for 30 V DC, inductive load (t=20 ms)	3 A			
Maximum current for 60 V DC, ohmic load	0.9 A			
Maximum current for 60 V DC, inductive load (t=20 ms)	0.9 A			
Maximum current for 125 V DC, ohmic load	0.5 A			
Maximum current for 125 V DC, inductive load (t=20 ms)	0.03 A			
Maximum current for 250 V DC, ohmic load	0.25 A			
Maximum current for 250 V DC, inductive load (t=20 ms)	0.03 A			
Maximum current for 125 V AC, ohmic load	10 A [7.]			
Maximum current for 125 V AC, inductive load (cosj =0,3)	5 A			
Maximum current for 250 V AC, ohmic load	10 A [7.]			
Maximum current for 250 V AC, inductive load (cosj =0,3)	5 A			

Table 2 - VCB25 Technical Parameters

	VCB25_			
Type	**LD1**	**LD2**	**LD3**	**Shell2**
Design, Switching Capacity of Gold-Plated Auxiliary Contacts [8.]				
Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC	-	-	-
Minimum current for 5 V AC / DC	1 mA			
Maximum current for 10 V AC / DC	300 mA			
Maximum current for 30 V AC / DC	100 mA			
Maximum voltage AC / DC	30 V			
CM Reaction Times				
Preparation time for the operation of the CM after switching on the auxiliary power supply	≤ 15 s			
Preparation time for the close operation of the CM after a previous close operation	≤ 10 s			
Preparation time for the trip operation of the CM after switching on the auxiliary power supply	≤ 0.1 s			
Trip capability after failure of the auxiliary power supply	≥ 60 s [9.]			
CM Supply Voltage				
Rated range of supply voltage of CM_16_1(Par1_60.2_Par2Par3_Par4_Par5)	24V to 60V DC			
Rated range of supply voltage of CM_16_1(Par1_220.2_Par3_Par4_Par5)	110V to 220V AC/DC			
Operating range (80-120%) of CM_16_1(Par1_60.2_Par3_Par4_Par5)	19V to 72V DC			
Operating range (80-120%) of CM_16_1(Par1_220.2_Par3_Par4_Par5)	85V to 265V AC/DC			
CM Power Consumption				
Charging the close and trip capacitors of CM_16_1(Par1_60.2_Par3_Par4_Par5)	≤ 25 W			
Charging the close and trip capacitors of CM_16_1(Par1_220.2_Par3_Par4_Par5)	≤ 42 W AC [10.] ≤ 37 W DC			
Permanent power consumption (standby) of CM_16_1(Par1_60.2_Par3_Par4_Par5)	≤ 5 W			
Permanent power consumption (standby) of CM_16_1(Par1_220.2_Par3_Par4_Par5)	≤ 7 W AC [11.] ≤ 5 W DC			
Inrush current of CM_16_1(Par1_60.2_Par3_Par4_Par5) with discharged capacitors	≤ 120 A			
Inrush current of CM_16_1(Par1_220.2_Par3_Par4_Par5) with discharged capacitors	≤ 18 A			
Inrush time constant of CM_16_1(Par1_60.2_Par3_Par4_Par5) with discharged capacitors	≤ 0.5 ms			
Inrush time constant of CM_16_1(Par1_220.2_Par3_Par4_Par5) with discharged capacitors	≤ 4 ms			

Table 2 - VCB25 Technical Parameters

	VCB25_			
Type	**LD1**	**LD2**	**LD3**	**Shell2**
Design, Switching Capacity of CM Inbuilt Relays				
Number of relays in CM	3			
Number of available contacts for one relay	1 NO + 1 NC with common point			
Rated voltage	240 V			
Rated current AC	16 A			
Maximum breaking power AC	4000 VA			
Maximum switching current 250 V DC	0.35 A			
Maximum switching current 125 V DC	0.45 A			
Maximum switching current 48 V DC	1.3 A			
Maximum switching current 24 V DC	12 A			
Switching time	5 ms			
“Close” and “Trip” Dry Contacts Inputs of CM				
Output voltage	≥ 30 V			
Contacts closed current	≥ 50 mA			
Steady state current	≥ 5 mA			

1. At 34 % d.c. component.
2. Smaller timing on request.
3. The number of sequential Close-Trip operations with a 10 second interval should not exceed 10. The number of Close-Trip operations should not exceed 60 per hour. Sequence of 10s Close-Trip operations can be repeated only after 260 s pause.
4. Isolation resistance check is not applicable for “Actuator Coil” circuits of CM.
5. Overall dimensions of ISM are given in “Appendix 2. Overall Drawings”.
6. Up to an installation altitude of 1000 m above sea level. Above 1000m, the external insulation measurement of the ISM must be increased by the atmospheric correction factor Ka according to IEC 62271-1 compared to the insulation measurement at sea level. The maximum allowed altitude is 2000 m above sea level.
7. At 5 min short-term duty. Continuous current – 5 A.
8. Gold-plated auxiliary contacts are availbale on request. Contact your nearest sales representatives.
9. In case of Dry contacts “Close” and “Trip” are open.
10. At Cos j >0.66.
11. At Cos j >0.33.

1.3 Disclaimers

Tavrida Electric will not accept any claims for damages caused by improper transport, storage as well as unpacking. Transport damage must be reported in writing to the supplier as soon as it is discovered.

The User Guide contains information necessary for the installation, commissioning and operation. It is absolutely necessary for the proper use of the Vacuum Circuit Breakers to read the User Guide carefully before starting and to adhere to the instructions and the relevant regulations. Tavrida Electric will not accept any claims for damages caused by improper usage of the Vacuum Circuit Breakers. In case of special configurations please contact Tavrida Electric prior of usage of the Vacuum Circuit Breakers.

1.4 Precautions

- Check whether the installation position (distances, spatial separation, and the surroundings) is suitable for the switching devices.
- Installation, operation and maintenance shall only be carried out by trained and experienced personnel who are familiar with the equipment and the electrical safety requirements.
- During installation, commissioning, operation and maintenance of the equipment the relevant legal regulations (such as DIN/VDE/IEC), accident prevention regulations and the connecting conditions of the electric utilities shall be followed.
- Take note that during operation of the Vacuum Circuit Breakers certain parts are subject to dangerous voltage. Mechanical parts, also remote-controlled, can move quickly. Failure to comply may result in death, severe personal injury or damage to equipment.
- Pay attention to the hazard statements located throughout the User Guide.
- The operating conditions of the Vacuum Circuit Breakers shall comply with the technical data specified in the User Guide.
- Personnel installing, operating and maintaining the equipment shall be familiar with the User Guide and its contents.

1.5 Warranty

Unless otherwise stated in the contract, the warranty period is stated in Standard warranty policy. If agreed to otherwise, the contract conditions apply. No warranty is given in the case of …

a) … the warranty period having run out during the period of storage with the customer;

b) … the operating conditions, ambient conditions, transport and storage conditions have not been adhered to according to the application description or the Installation and Operating Instructions;

c) … an unauthorized manipulation of the device has been carried out, such as opening the housing or damaging the seal;

d) … the device has not been properly installed, such as incorrect connection of supply voltage of auxiliary circuits.

2. Nameplates and Seals

The Vacuum Circuit Breakers itself does not have nameplates or seals but main components (ISM, CM and manual generators) it is comprised of have them.

2.1 ISM Nameplates and Seals

Each ISM has the following plate and labels:

- Label
- Serial number plate
- Seals

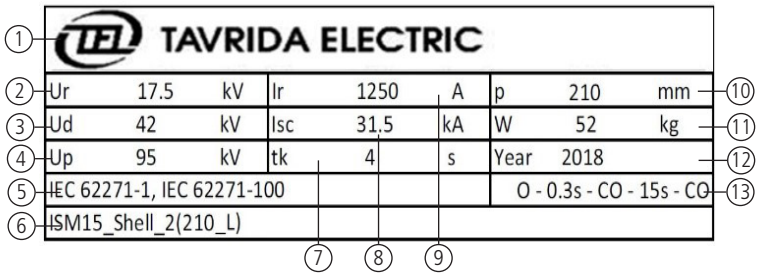


Figure 1
ISM label

1. Manufacturer
2. Rated voltage Ur
3. Rated power frequency withstand voltage Vd
4. Rated impulse withstand voltage Up
5. Applicable standards
6. ISM designation
7. Rated duration of short circuit tk
8. Rated short-circuit current Isc
9. Rated normal current Ir
10. Phase center distance p
11. Weight W
12. Year of manufacturing
13. Rated operating sequence

The serial number plate contains information about ISM type and serial number.

The label contains brief information about ISM technical parameters.

There are warranty seal labels on each side of the ISM metal frame.

Figure 2
Serial number plate placement

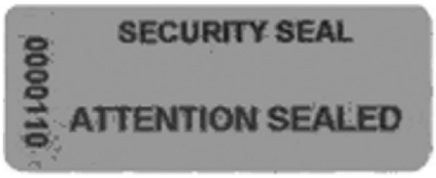
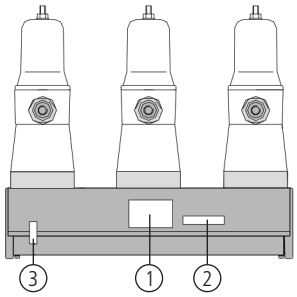
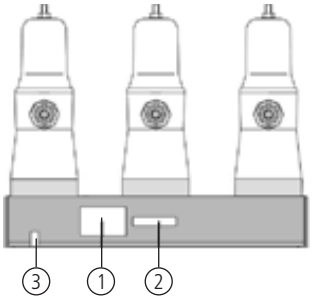


Figure 3
Warranty seal

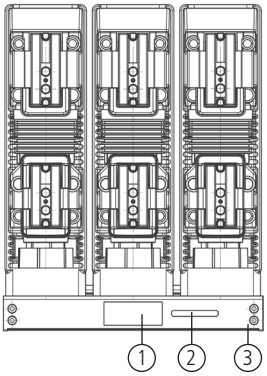
Label, serial number plate and seal arrangement is shown below.



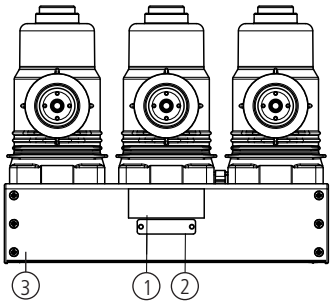
a) ISM15_LD (except LD_8) and ISM25_LD labeling



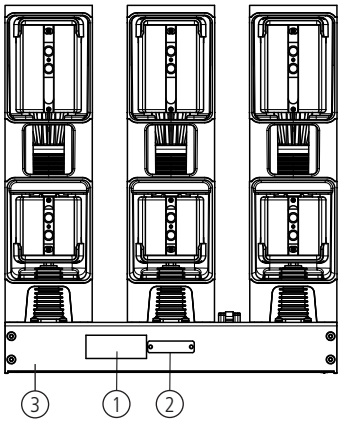
b) ISM15_LD_8 labeling



c) ISM15_Shell, ISM25_Shell labeling



d) ISM15_MD labeling



e) ISM15_HD labeling

1. Label
2. Serial number plate
3. Seal

Figure 5
Serial number plate and label arrangement

2.2 CM Nameplates and Seals

Each CM has the following labels:

- Serial number label
- Label with applicable ISM designation
- Warning label
- Firmware version label
- Information label with terminals connections and main parameters
- Seals

Figure 4
Serial number label

Figure 6
Label with applicable ISM designation

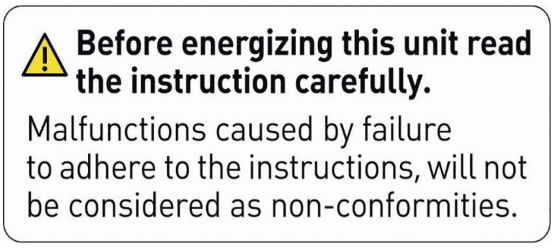


Figure 7

Warning label

Figure 8

Firmware version label

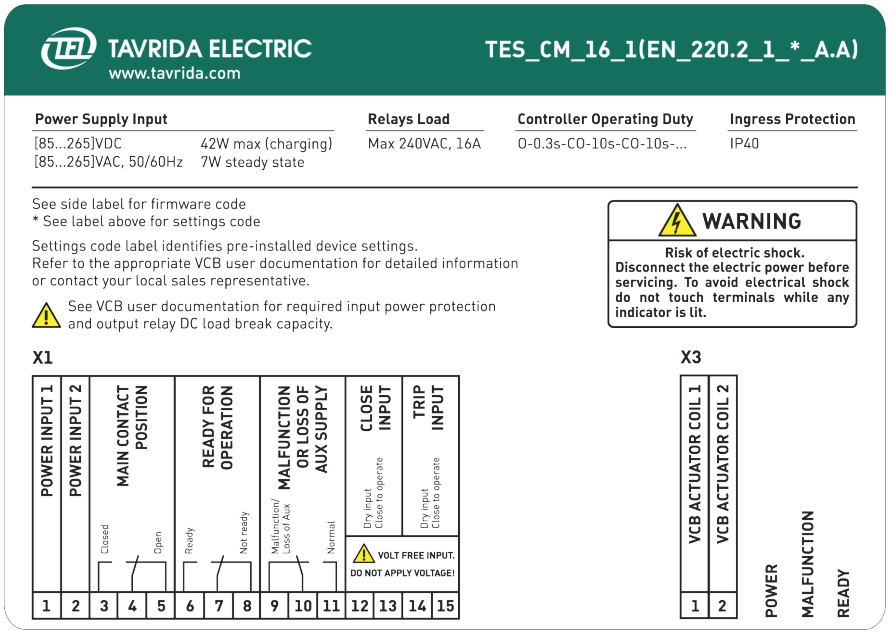
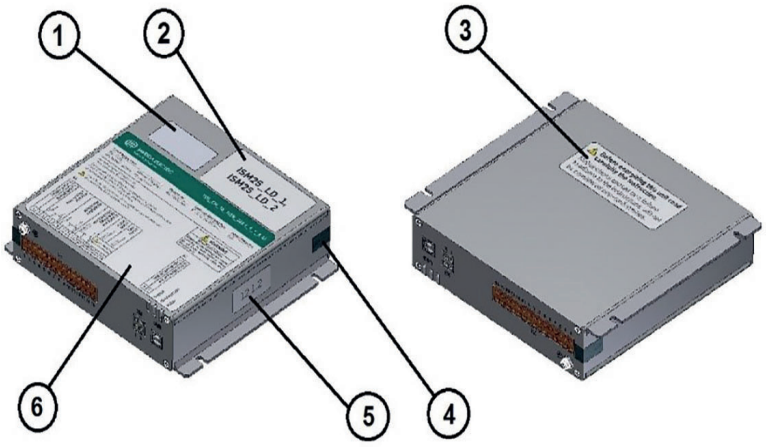


Figure 9

Information label with terminals connections and main parameters



1. Serial number label
2. Label with applicable ISM designation
3. Warning label
4. Warranty seal
5. Firmware version label
6. Information label with terminals connections and main parameters

Figure 10

CM labels arrangement

2.3 Manual Generator Nameplates

Each manual generator has the following labels:

- Designation label
- Serial number label

Figure 11

Designation label

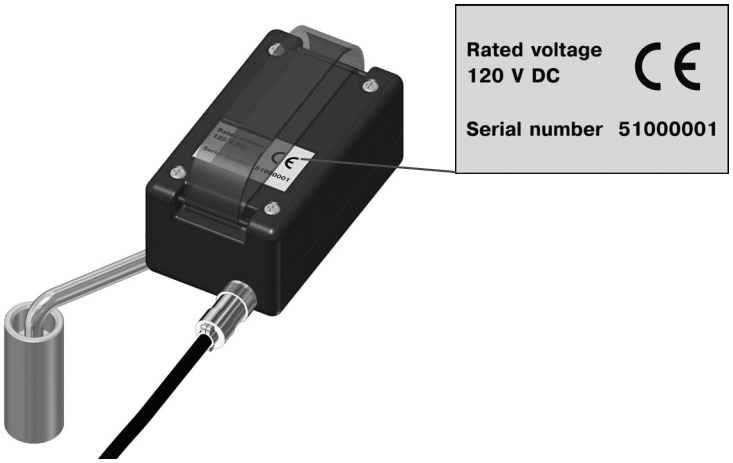


Figure 12

Serial number label

3. Product Handling

3.1 Transportation

The VCBs are transported in the original packing only. Any kind of transport and combinations thereof are applicable. Transportation shall be provided in waterproof compartments. If air transport is used all products shall be transported inside heated, pressurized compartments. The packed goods shall be handled in accordance with the handling symbols. Loading procedures for VCB packaging shall be carried out only with use of fork lifts, hoists or cranes. If possible the packaged VCB shall be placed on a pallet. During transportation the VCB must not be subjected to sharp impacts or dropped.

3.2 Storage

If immediate installation is not possible, the VCB shall be stored in the original packing under the following conditions:

- the ISM is switched off;
- desiccant must be placed in the packaging;
- storage must be dry, well ventilated and the room temperature should be between - 25°C and + 55°C.

Average humidity measured over 1 year period shall not exceed 75% at 50ºC. If several VCBs are stacked a maximum of two vertical layers are permitted.

In case the storage term exceeds one year from the production date it is recommended to perform the procedure of CM's electrolytic capacitor conditioning:

- apply power to the CM for 20 seconds;
- switch off the power supply and wait for 60 seconds;
- repeat the above actions 2 times;
- apply power to the CM continuously for 8 hours.

This procedure shall be performed annually during storage of the CM.

3.3 Unpacking and Inspection

3.3.1 VCB Unpacking and Check

Before unpacking, check the carton for damage. Removal of the products from the original packaging must be carried out with care and in accordance with lifting procedures. Every VCB component shall be checked for completeness against the packing list included within the routine test certificate supplied with the CM and ISM. These shall also be verified against the BOM list on the VCB packing list for VCB components and kits. Unloading procedures for ISM shall be carried out only with use of hoists or cranes. Lifting gear must not be attached to the support insulators; methods of lifting the ISM out of the carton shown below and must be strictly followed.

Figure 13
Lifting of ISM15_LD_1, ISM15_LD_3, ISM15_LD_8, ISM25_LD_1, ISM25_LD_2, ISM15_LD_3

Figure 14
Lifting of ISM15_Shell_2, ISM25_Shell_2

Figure 15
Lifting of ISM15_HD_1

All items should be checked visually for:

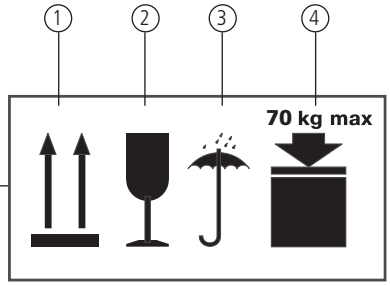
- mechanical damage, scratches, discoloration, corrosion;
- damage to the seals Figure 3, Figure 4).

Any transport damage must be reported immediately to the carrier in writing. Damages shall be photographically documented.

3.3.2 VCB Packaging and Scope of Supply

The VCB are placed in cardboard boxes (Figure 18):

- handling symbols label for transport and storage of the delivery unit (Figure 16);
- labels for manufacturers and product information (Figure 19);
- label for logistics data (Figure 17).



1. This side up
2. Fragile
3. Protect from rain
4. Max. weight on the delivery unit

Figure 16

Label 1 Handling symbols

Figure 18

Carton box

TAVRIDA ELECTRIC

Mark:	**TEG-C-000111**
	Place of delivery:
Consignee:	***Address***
	Address
	Address
	Address
	Address
	Phone:
	Contact person
P/O Number:	***Customer reference***
Article:	***Article description***
Serial Number:	111999/16402484

TAVRIDA ELECTRIC GmbH, Im Leimen 14, 88069 Tettnang/Tannau, Germany, Phone: 0049-7542-946785-1

Figure 17

Label 2 Logistics data

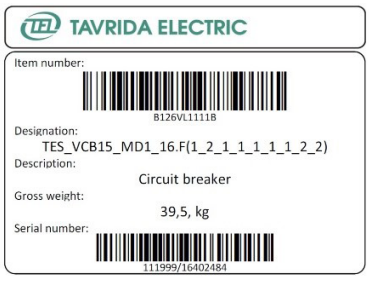


Figure 19

Label 3 for manufacturers' and product information

VCB has in its package:

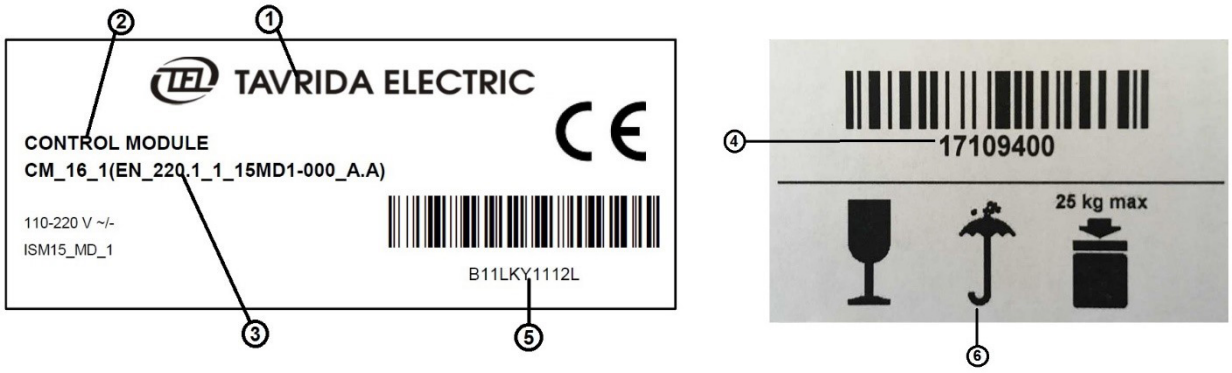
1. Indoor Switching Module (ISM);
2. Control Module (CM);
3. Additional kits and/or components (if applicable);
4. Routine test certificate of VCB.

The ISM shall have undamaged warranty seals (appearance of seal is shown in Figure 3, its placement on the ISM (there are two warranty seals on each side of the ISM metal frame) - in Figure 4). The ISM designation and serial number shall comply with data in the VCB packing list and the VCB routine test certificate (appearance of serial number plate is shown in Figure 2, its placement on ISM - in Figure 4).

3.3.3 CM Packaging and Scope of Supply

As part of the VCB the CM are delivered inside of the VCB package. If the CM are delivered as spare part of the VCB they are packed in cardboard boxes.

Figure 20
CM packaging



1. Manufacturer
2. Product name
3. Type of device
4. Serial number
5. Product code
6. Handling symbols

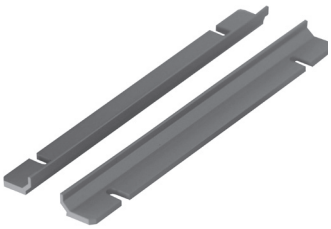
Figure 21
CM packaging labels

The CM shall have undamaged warranty seals (its placement on the CM is shown in Figure 10). The CM designation and serial number shall comply with data in the VCB packing list and the CM routine test certificate (appearance of the CM serial number label and designation label are shown in Figure 5 and Figure 6, their placement on the CM – in Figure 10).

Each CM is supplied with the following components:

a) CM

b) Screwdriver Unit_Screwdriver_1



c) Brackets Det_Holder_84

Figure 22
CM scope of supply

3.3.4 ISM Packaging and Scope of Supply

As part of the VCB the ISM are delivered inside of the VCB package. If the ISM are delivered as spare part of the VCB they are packed in cardboard boxes like the VCB.

Each ISM15_LD_1, LD_3, ISM25_LD1, LD_2, LD_3 is supplied with the following components:

a) ISM

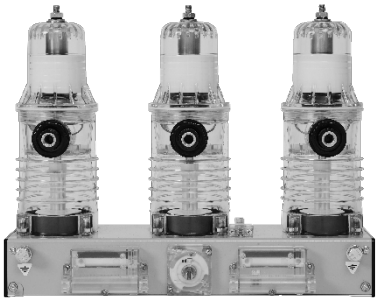
b) Screwdriver Unit_Screwdriver_1

Figure 23

ISM15_LD_1, ISM15_LD_3, ISM25_LD_1, ISM25_LD_2, ISM25_LD_3 scope of supply

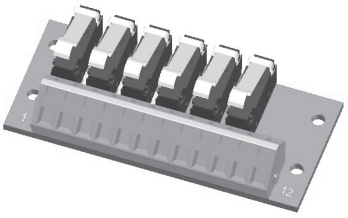
ISM15_LD_8 has different supply options. Depending on the order ISM15_LD_8 can be supplied with 1 set or 2 sets of auxiliary switches boards (with 3NO + 3NC, 4NO + 4NC, 6NO + 6NC contacts) or without them. In addition, the optional position indicator can be included in the package.

Each ISM15_LD_8 is supplied with the following components:



a) ISM

b) Screwdriver Unit_Screwdriver_1



c) Optional Auxiliary Board EA_ASboard_28
(with 3NO + 3NC or 4NO + 4NC or 6NO + 6NC contacts)

d) Optional Position Indicator CBkit_PosInd_1(1000)

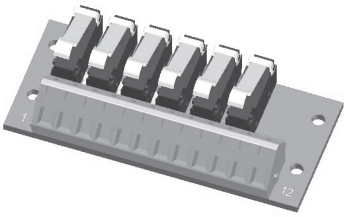
Figure 24

ISM15_LD_8 scope of supply

Each of ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2, ISM15_HD_1 and ISM25_Shell_2 is supplied with the following components:

a) ISM

b) Screwdriver Unit_Screwdriver_1



c) Auxiliary Board EA_ASboard_28

d) Position Indicator CBkit_PosInd_1(1000)

Figure 25

ISM15_MD_1 scope of supply

a) ISM

b) Screwdriver Unit_Screwdriver_1

c) Position Indicator CBkit_PosInd_1(1000)

Figure 26

ISM15_MD_3 scope of supply

a) ISM

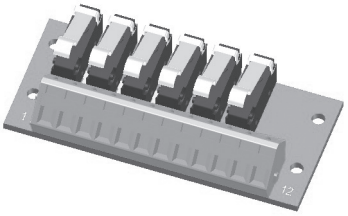
b) Screwdriver Unit_Screwdriver_1

c) Position Indicator CBkit_PosInd_1(1000)

Figure 27
ISM15_Shell_2 scope of supply

a) ISM

b) Screwdriver Unit_Screwdriver_1



c) Auxiliary Board EA_ASboard_28

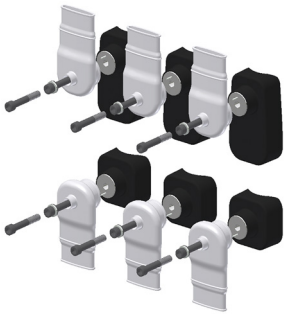
d) Position Indicator CBkit_PosInd_1(1000)

Figure 28
ISM15_HD_1 scope of supply

a) ISM

b) Screwdriver Unit_Screwdriver_1

c) Position Indicator CBkit_PosInd_1(1000)



d) Circuit Breaker Kit CBkit_Shell25_1

Figure 29
ISM25_Shell_2 scope of supply

CBkit_Ins_3 Scope of Supply

24 kV variants of VCB25_LD1_16.F and VCB25_LD3_16.F include CBkit_Ins_3. As part of a VCB CBkit_Ins_3 is placed inside the VCB package. If the kit is delivered separately as a spare part of the VCB it is packed in a plastic bag.

The kit includes for each pole of the ISM:

Gasket
Det_Gasket_38

Plastic Insulator
Det_PlastIns_48

Rubber Insulator
Det_RubberIns_19

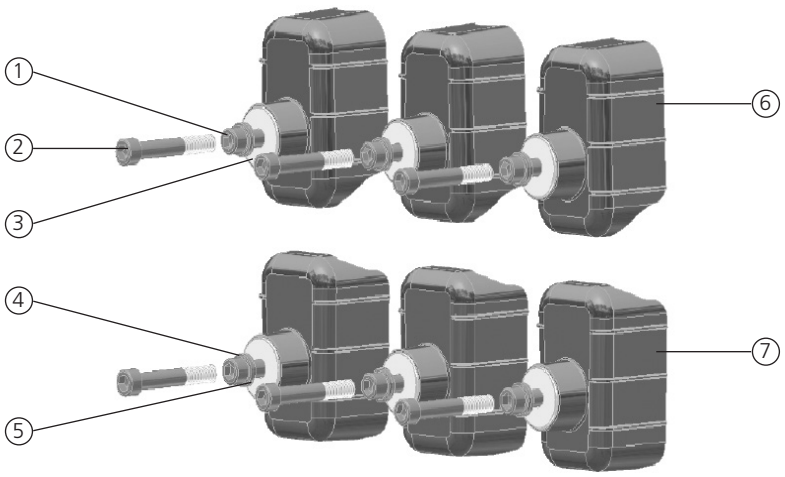
Plastic Insulator
Det_PlastIns_49

Figure 30
CBkit_Ins_3 scope of supply

CBkit_Shell15_1 Scope of Supply

17.5 kV variants of VCB15_Shell15_16.F include CBkit_Shell15_1 for flat busbar connection to ISM terminals. As part of a VCB CBkit_Shell15 is placed inside the VCB package. If the kit is delivered separately as a spare part of the VCB it is packed in a plastic bag.

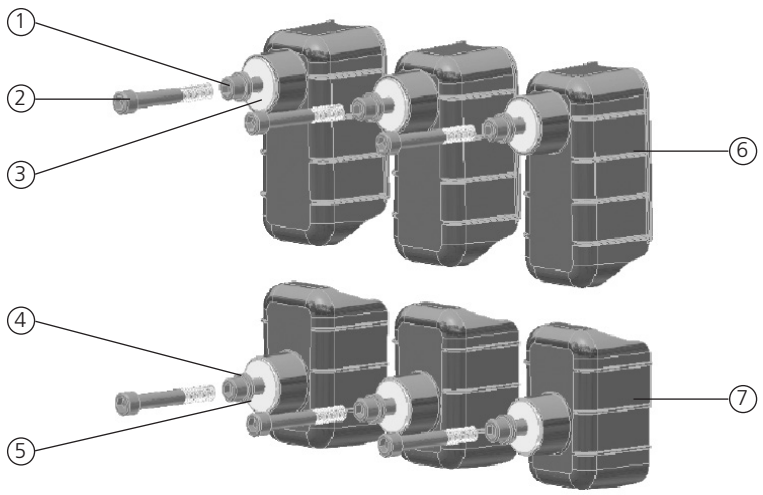
The kit CBkit_Shell15_1(205) for ISM15_Shell_2(150_L) and ISM15_Shell_2(210_L) includes:



1. Screw StandDet_Screw_DIN912(M16_100_Fe88-Zn)
2. Screw StandDet_Screw_DIN912(M16_110_Fe88-Zn)
3. Terminal CBdet_Terminal_1
4. Washer StandDet_Washer_DIN125-1A(17_Fe-Zn)
5. Washer CBcomp_Washer_1
6. Plastic insulation CBdet_PlastIns_2(205_50_L)
7. Plastic insulation CBdet_PlastIns_1(50)

Figure 31
CBkit_Shell15_1(205) scope of supply

The kit CBkit_Shell15_1(310) for ISM15_Shell_2(210_H) and ISM15_Shell_2(275_H) includes:



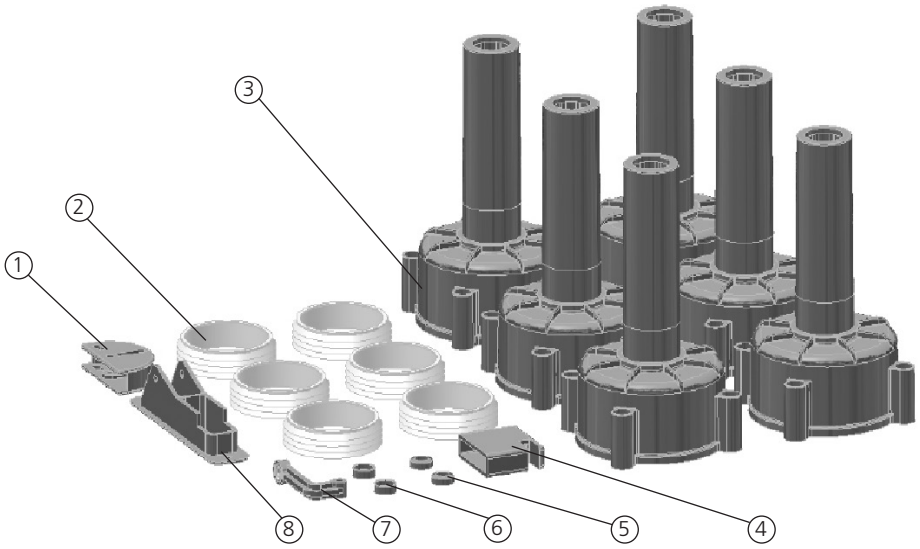
1. Screw StandDet_Screw_DIN912(M16_100_Fe88-Zn)
2. Screw StandDet_Screw_DIN912(M16_110_Fe88-Zn)
3. Terminal CBdet_Terminal_1
4. Washer StandDet_Washer_DIN125-1A(17_Fe-Zn)
5. Washer CBcomp_Washer_1
6. Plastic insulation CBdet_PlastIns_2(310_50_H)
7. Plastic insulation CBdet_PlastIns_1(50)

Two variants of bolts are included in CBkit_Shell15_1:

- StandDet_Screw_DIN912(M16_100_Fe88-Zn) - for case of single busbar connection (10 mm thickness);
- StandDet_Screw_DIN912(M16_110_Fe88-Zn) - for case of double busbar connection (20 mm thickness).

CBkit_LD15_2 and CBkit_LD15_3 scope of supply

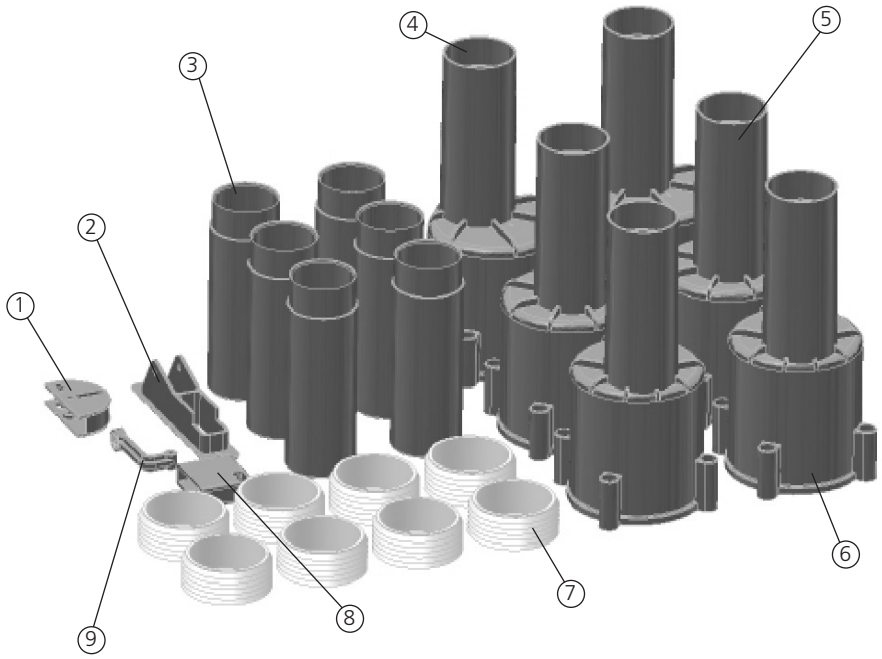
VCB15_LD6_16.RD includes the plastic parts kit CBkit_LD15_2 for LMT Retrofit Draw-out type VCB or CBkit_LD15_3 for AG16 Retrofit Draw-out type VCB. As part of a VCB CBkit_LD15_2 and CBkit_LD15_3 are placed inside the VCB package. If the kits are delivered separately as a spare part of the VCB it is packed in a plastic bag.



1. Indicator CBdet_Indicator_1
2. Rubber ring Det_RubberRing_7(68)
3. Plastic insulation CBdet_PlastIns_5
4. Plastic button CBdet_PlastBut_1
5. Plastic washer CBdet_PlastWasher_1
6. Plastic washer CBdet_PlastWasher_2
7. Lever CBunit_Lever_1
8. Guide CBdet_Guide_1

Figure 32

CBkit_LD15_2 scope of supply



1. Indicator CBdet_Indicator_1
2. Lever CBunit_Lever_1
3. Plastic insulation CBdet_PlastIns_4
4. Plastic insulation CBdet_PlastIns_3(1)
5. Plastic insulation CBdet_PlastIns_3(2)
6. Plastic insulation CBdet_PlastIns_3(3)
7. Rubber ring Det_RubberRing_12
8. Guide CBdet_Guide_1
9. Lever CBunit_Lever_1

Figure 33

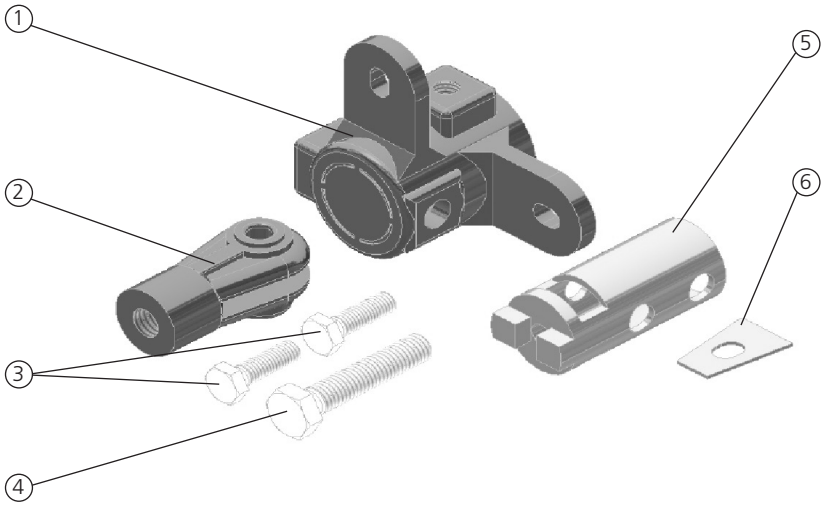
CBkit_LD15_3 scope of supply

3.3.5 VCB Accessories Unpacking and Check

CBkit_Interlock_1 Packaging and Scope of Supply

CBkit_Interlock_1 can be used with the VCB15_LD1_16.F and VCB25_LD1_16.F as an interface for various manual trip / indication / lockout accessories. The kit is packed in a plastic bag.

The kit includes:



1. Holder Det_Holder_22
2. Holder Det_Holder_20
3. Bolt StandDet_Bolt_DIN933(M6_20_Fe88-Zn)
4. Bolt StandDet_Bolt_DIN933(M8_40_Fe88-Zn)
5. Shaft CBdet_Shaft_1
6. Stopper CBdet_Stopper_1

Figure 34
CBkit_Interlock_1 scope of supply

ISM15_LD_3 and ISM25_LD_3 are already equipped with the CBkit_Interlock_1 pre-installed.

CBkit_Ins_4 Scope of Supply

CBkit_Ins_4 provides the dielectric strength of busbars connection to the VCB15_MD1_16.F. The kit has components for one pole of ISM15_MD, so three such kits are necessary for one VCB15_MD1_16.F insulation and one – for VCB15_MD3_16.F. The kit is delivered separately and packed in a plastic bag.

The kit includes one variant of the following options depending on the parameter value:

Rubber insulator CBdet_RubberIns_2
(for bars 40x10 mm) - 2 pcs.

Figure 35
CBkit_Ins_4(1) scope of supply

Rubber insulator CBdet_RubberIns_3
(for bars 80x10 mm) - 2 pcs.

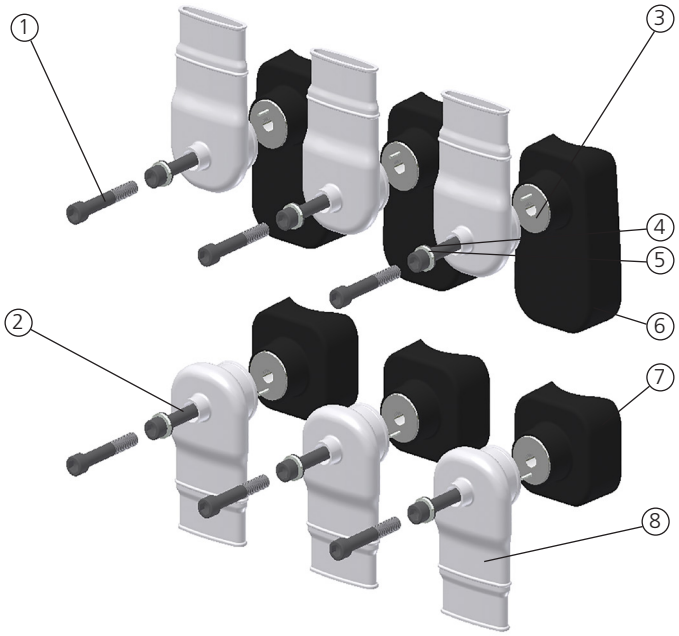
Figure 36
CBkit_Ins_4(2) scope of supply

CBkit_Shell25_1 Scope of Supply

VCB25_Shell15_16.F includes CBkit_Shell25_1 for flat busbar connection to ISM terminals.

As part of a VCB CBkit_Shell25 is placed inside the VCB package. If the kit is delivered separately as a spare part of the VCB it is packed in a cardboard box.

The kit CBkit_Shell25_1 includes:



1. Screw StandDet_Screw_DIN912 (M16_100_Fe88-Zn)
2. Screw StandDet_Screw_DIN912 (M16_110_Fe88-Zn)
3. Terminal CBunit_Terminal_4
4. Washer StandDet_Washer_DIN125-1A(17_Fe-Zn)
5. Washer CBcomp_Washer_1
6. Plastic insulation CBdet_PlastIns_19(50_U)
7. Plastic insulation CBdet_PlastIns_19(50_L)
8. TES_CBdet_RubberIns_9

Figure 37
CBkit_Shell25_1 scope of supply

CBmount_ISM15_1

To provide 95 kV BIL between ISM15_HD_1 main terminals and external frame, it is required to use the additional spacers. Spacers are included in the CBMount_ISM15_1 kit. The kit is delivered separately and packed in a plastic bag.

The kit includes:

Stud Det_Stud_66 - 12 pcs.

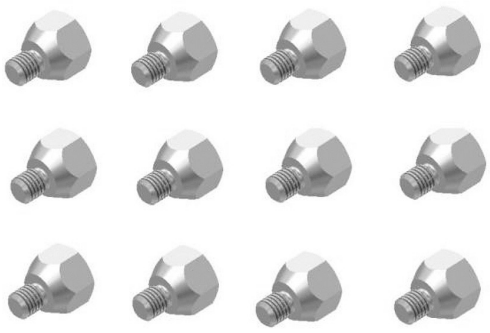


Figure 38
CBmount_ISM15_1 packing

CBkit_Interlock_8 Packaging and Scope of Supply

CBkit_Interlock_8 can be used with the VCB15_Shell2_16.F only as an accessory. It is an interface for manual trip/ lockout accessories connection to the ISM. The kit is packed in a cardboard box.

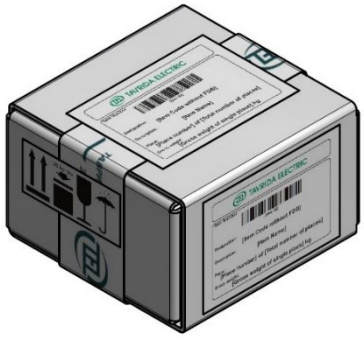
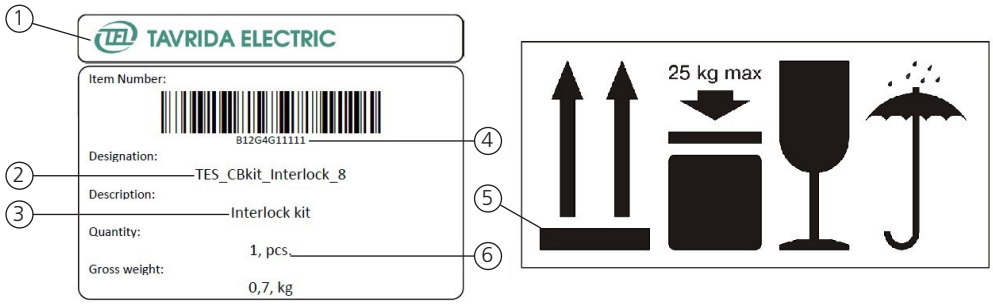


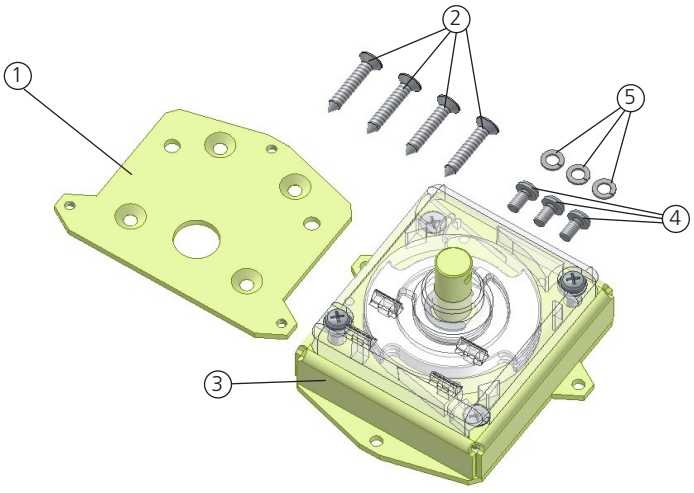
Figure 39
CBkit_Interlock_8 packing



1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Product quantity in the package

Figure 40
CBkit_Interlock_8 package labeling

The kit includes:



1. Holder CBdet_Holder_14
2. Screw StandDet_Screw_DIN7982(4.2_25_Fe-Zn)
3. Interlock unit CBunit_Interlock_3
4. Screw StandDet_Screw_DIN7985-Ph(M4_8_Fe48-Zn)
5. Washer StandDet_Washer_DIN127-A(4_Fe-Zn)

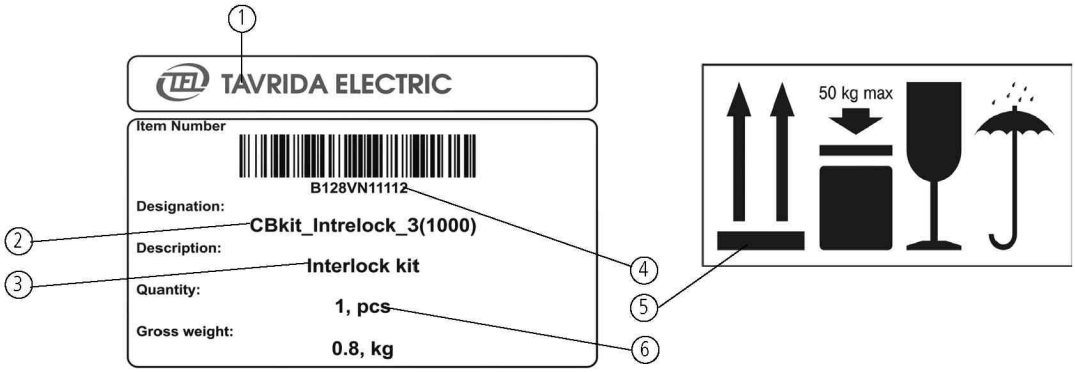
Figure 41
CBkit_Interlock_8 scope of supply

CBkit_Interlock_3 packaging and scope of supply

CBkit_Interlock_3 can be used with the VCB15_Shell2_16.F via CBkit_Interlock_8 installed on this ISM, with the VCB15_LD8_16.F, VCB15_MD1_16.F, VCB15_MD3_16.F, VCB15_HD1_16.F and VCB25_Shell2_16.F as an accessory for manual trip/lockout of the ISM by key switch. The kit is packed in a cardboard box.

Figure 42

CBkit_Interlock_3 packing

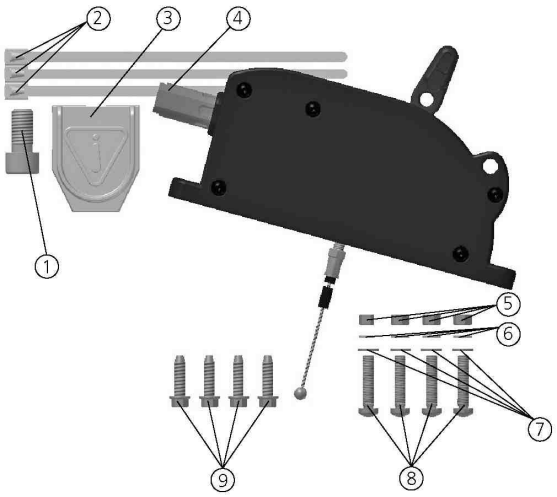


1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Product quantity in the package

Figure 43

CBkit_Interlock_3 package labeling

The kit includes:



1. Screw StandDet_Screw_DIN912(M10_20_Fe88-Zn)
2. Cable tie StandDet_CableTie_LS(4.6_150_40)
3. Stopper CBdet_Stopper_2
4. Interlock unit CBunit_Interlock_1(1)
5. Nut StandDet_Nut_DIN555(M5_Fe-Zn)
6. Washer StandDet_Washer_DIN127-A(5_Fe-Zn)
7. Washer StandDet_Washer_DIN125-1A(5.3_Fe-Zn)
8. Screw StandDet_Screw_DIN7985-Ph(M5_25_Fe48-Zn
9. Screw StandDet_Screw_DIN7504-K(4.8_19_Fe-Zn)

Figure 44

CBkit_Interlock_3 scope of supply

CBkit_Interlock_3 is used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2.

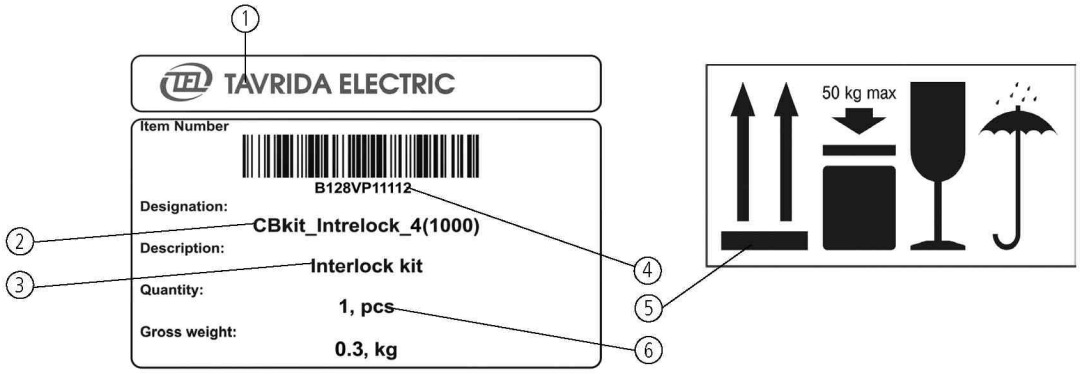
In addition CBkit_Interlock_3 is used with the ISM15_Shell_2 via CBkit_Interlock_8

CBkit_Interlock_4 Packaging and Scope of Supply

CBkit_Interlock_4 can be used with the VCB15_Shell2_16.F via CBkit_Interlock_8 installed on this ISM, with the VCB15_LD8_16.F, VCB15_MD1_16.F, VCB15_MD3_16.F, VCB15_HD1_16.F and VCB25_Shell2_16.F as an accessory for manual trip / lockout of the ISM by rotary switch. The kit is packed in a cardboard box.

Figure 45

CBkit_Interlock_4 packing

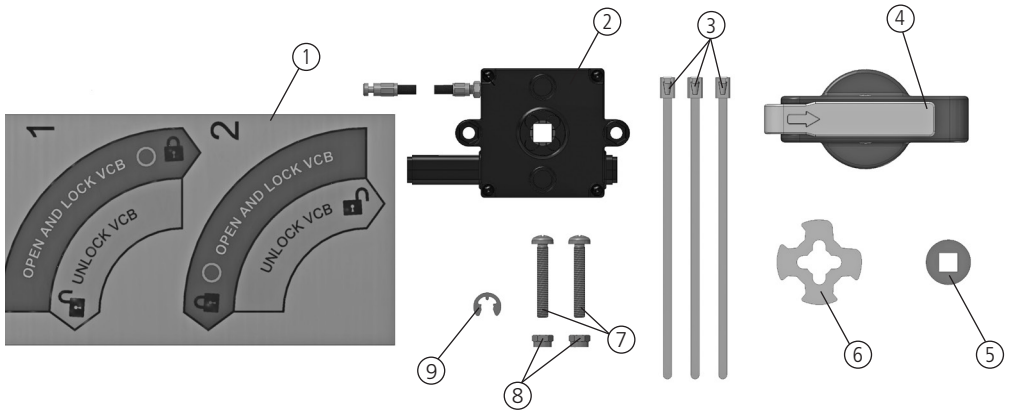


1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Product quantity in the package

Figure 46

CBkit_Interlock_4 package labeling

The kit includes:



1. Label CBdet_Label_10(EN)
2. Interlock unit CBunit_Interlock_12(1)
3. Cable tie StandDet_CableTie_LS(4.6_150_40)
4. Handle CBunit_Handle_1
5. Washer CBdet_Washer_7
6. Stopper CBdet_Stopper_28
7. Screw StandDet_Screw_DIN7985-Ph(M6_40_Fe48-Zn)
8. Nut StandDet_Nut_DIN985(M6_Fe8-Zn)
9. Washer StandDet_Washer_DIN6799(7_Fe-Zn)

Figure 47

CBkit_Interlock_4 package labeling

CBkit_Interlock_4 is used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2.

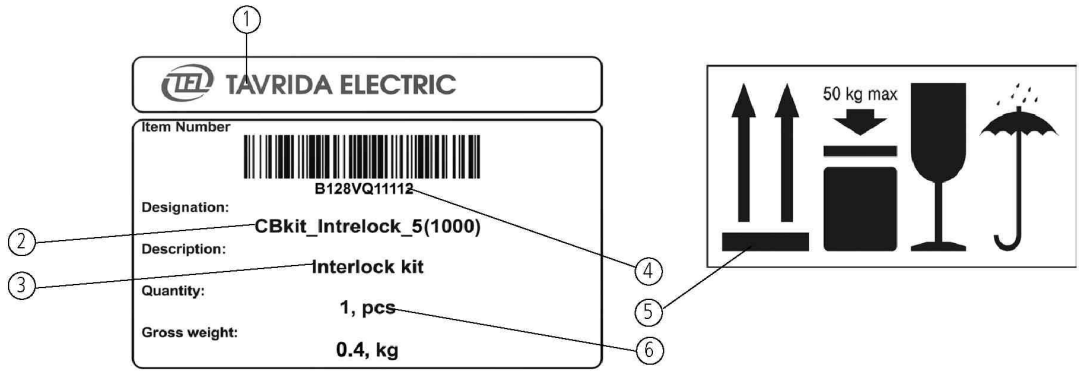
In addition CBkit_Interlock_4 is used with the ISM15_Shell_2 via CBkit_Interlock_8

CBkit_Interlock_5 Packaging and Scope of Supply

CBkit_Interlock_5 can be used with the VCB15_Shell2_16.F via CBkit_Interlock_8 installed on this ISM, with the VCB15_LD8_16.F VCB15_MD1_16.F, VCB15_MD3_16.F, VCB15_HD1_16.F and VCB25_Shell2_16.F as an accessory for manual trip of the ISM as a manual trip button. The kit is packed in a cardboard box.

Figure 48

CBkit_Interlock_5 packing

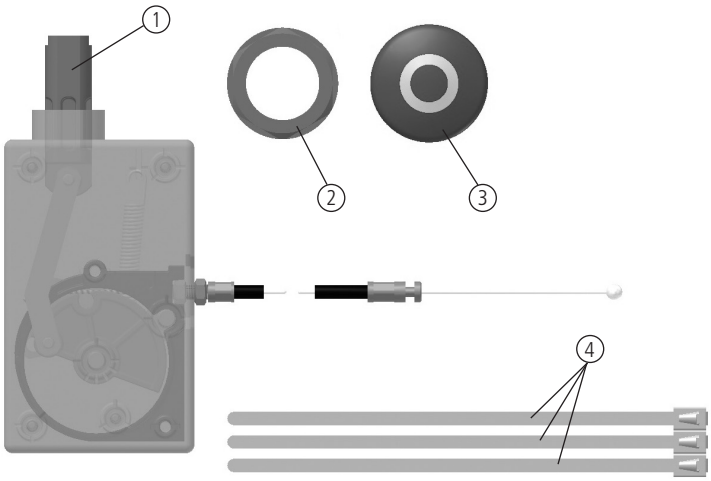


1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Product quantity in the package

Figure 49

CBkit_Interlock_5 package labeling

The kit includes:



1. Manual trip unit CBunit_ManualTrip_1(1000)
2. Plastic nut StandDet_PlastNut_1(M25_gr)
3. Handle CBunit_Handle_2
4. Cable tie StandDet_CableTie_LS(4.6_150_40)

Figure 50

CBkit_Interlock_5 scope of supply

CBkit_Interlock_5 is used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2.

In addition CBkit_Interlock_5 is used with the ISM15_Shell_2 via CBkit_Interlock_8.

CBunit_ ManGen_1 and CBunit_ ManGen_2 Packaging and Scope of Delivery

CBunit_ManGen is used to charge the CM_16_1 in cases where the main auxiliary power supply is not available. It is packed in a cardboard box.

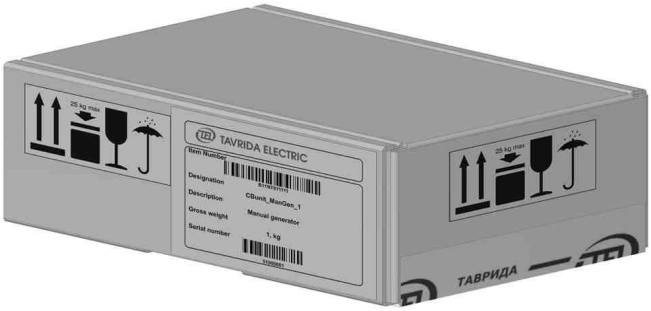
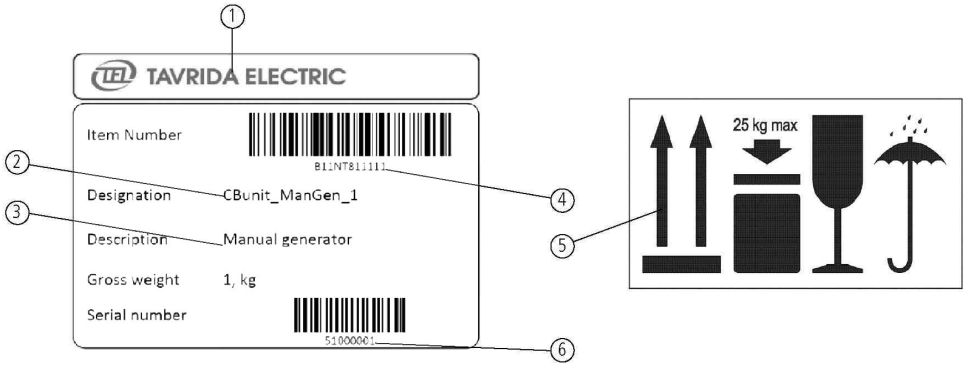


Figure 51

CBunit_ ManGen_1 and CBunit_ ManGen_2 packing



1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Serial number

Figure 52

CBunit_ ManGen_1 package labeling

Figure 53

CBunit_ ManGen_1 and CBunit_ ManGen_2 scope of supply

CBkit_PosInd_1(1000) Packaging and Scope of Supply

CBkit_PosInd_1(1000) is used to indicate the ISM main circuit position. VCB15_MD1_16.F, VCB15_MD3_16.F, VCB15_Shell2_16.F,, VCB15_HD1_16.F, VCB25_Shell2_16.F and ISM15_Shell_2 already include CBkit_PosInd_1(1000). In case of separate delivery the position indicator is packed in a plastic bag.

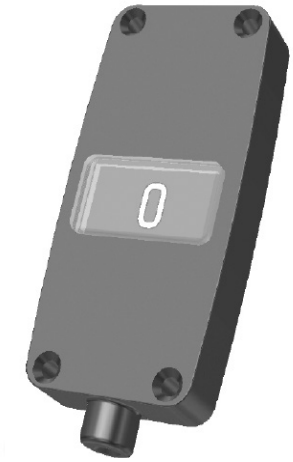


Figure 54
CBkit_PosInd_1(1000) scope of supply

CBcomp_RelCable_3 Packaging and Scope of Supply

CBcomp_RelCable_3 is a flexible trip and lock cable used for connection of ISM manual trip or interlock connection to the ISM. The cable is packed in a plastic bag.

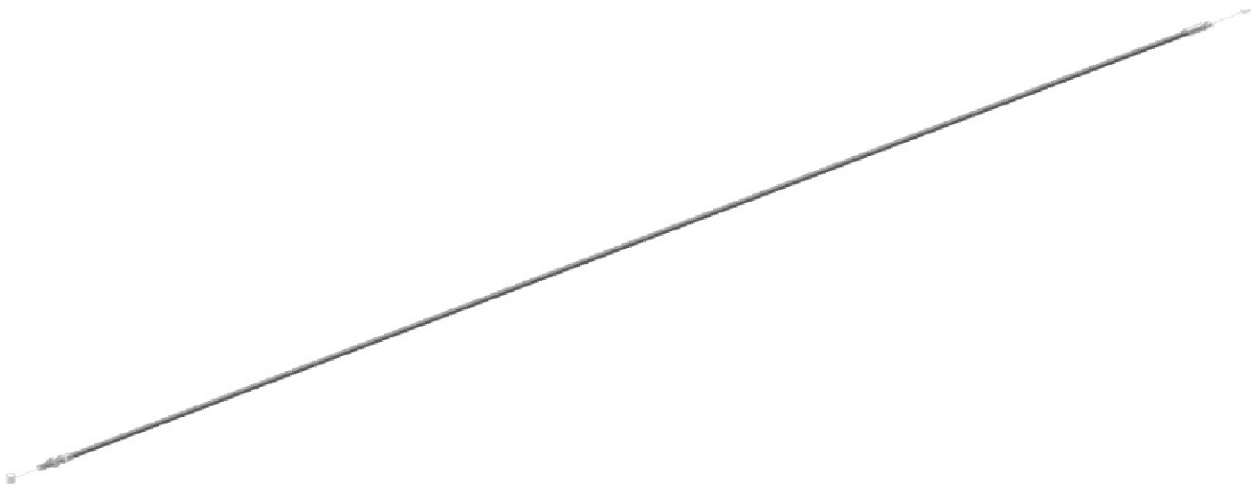


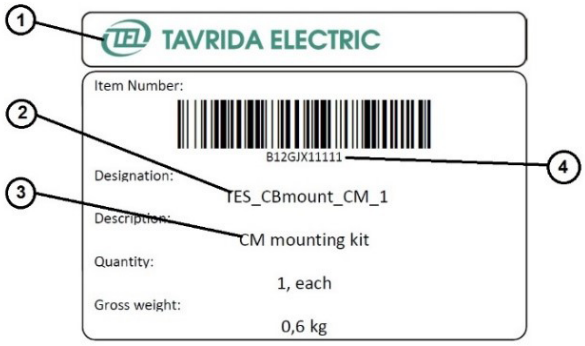
Figure 55
CBcomp_RelCable_1 scope of supply

CBmount_CM_1 Packaging and Scope of Supply

CBmount_CM_1 is used to mount CM_16_1 on a DIN rail.

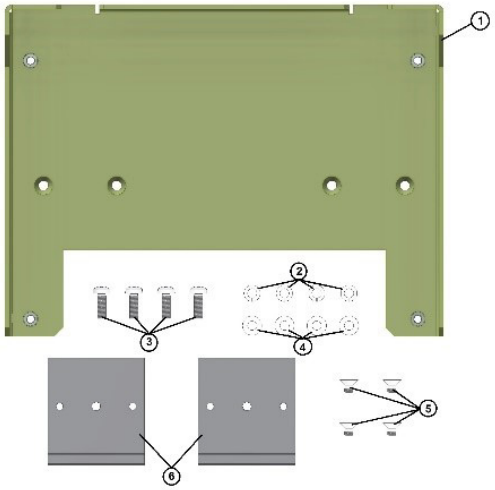
It is packed in a cardboard box.

Figure 56
CBmount_CM_1 packaging



1. Manufacturer
2. Type of device
3. Product name
4. Product code

Figure 57
CBmount_CM_1 package labeling



1. Holder CBunit_Holder_15
2. Washer StandDet_Washer_DIN127-A(4_Fe-Zn)
3. Screw StandDet_Screw_DIN7985 Ph(M4_12_Fe48 Zn)
4. Washer StandDet_Washer_DIN125-1A(4.3_Fe-Zn)
5. Screw StandDet_Screw_ISO7046-Ph(M4_6_Fe48-Zn)
6. Holder StandComp_Holder_DIN(1)

Figure 58
CBmount_CM_1 delivery set

3.4 Handling

To avoid equipment damage follow the handling recommendations listed below:

1. handling in accordance with pictorial symbols;

2. elimination of drops from any heights;

3. elimination of any mechanical impacts which can cause damage of the package;

4. the boxes are to be stowed to ensure complete tightness. The boxes should be hitched and lashed tightly so that it could not shift inside of a container under any conditions of carriage;

5. the modules shall be tied up with 16 mm polyester band twice. Top edges of the boxes shall be protected with plastic corners. The boxes can be additionally wrapped with stretch film.

4. Installation

4.1 Primary Part

4.1.1 Preparation

The following regulations must be adhered to during installation, commissioning and operation:

- IEC 62271-1//DIN VDE 0101, General specification for high-voltage switchgear and control gear standards;
- VDE 0105, Operation of electrical installations;
- DIN VDE 0141, Earthing systems for electrical power installations with nominal voltages above 1 kV;
- All rules for accident prevention applicable in the respective countries.

Wearing of gloves for handling the parts during installation is recommended. Insulating material surfaces must be cleaned with clean and dry rags. The contact surfaces of connections must be cleaned before installation. If the contacts have become oxidized during transport or storage then the following actions must be followed:

- Clean contact surfaces with a rough, dry cloth;
- In case of hard oxidation, clean with a hard plastic sponge, the coating layer must not be removed;

The nuts, washers and conical spring washers shall be used for connecting the terminals of the ISM with the busbars.

If additional fastening material is required, steel bolts according to EN ISO 898 class 8.8 (yield point 800 N/mm^2), nuts according to EN ISO 890 class 8 (yield point 880 N/mm^2), washers to DIN 125, conical spring washers to DIN 6796 (for ISM15_LD_1, LD_3, LD_6, LD_8 and ISM25_LD_1, LD_2, LD_3) and high load conical spring washers (#431540 in Schnorr catalogue - for ISM15_MD and #431560 in Schnorr catalogue - for ISM15_HD) shall be used. Bolts and washers for ISM15_Shell_2 and ISM25_Shell_2 connection are already included in the CBkit_Shell15_1 and CBkit_Shell25_1 kits kit. ISM mounting and shall be made with a calibrated torque wrench only.

4.1.2 Installation of the ISM

Mounting

In any switchgear application, the ISM15_Shell and, ISM15_HD and ISM25_Shell may be installed in position "actuator up", as well "actuator down" (Figure 59 - Figure 63). The ISM15_LD, ISM15_MD and ISM25_LD can be installed in any position (Figure 64).

Additionally ISM15_Shell_2(150_L) and ISM15_Shell_2(210_L) can be installed in horizontal actuator position. In this case the plane of all ISM terminals surfaces shall be horizontal as well and terminals surfaces shall be up oriented.

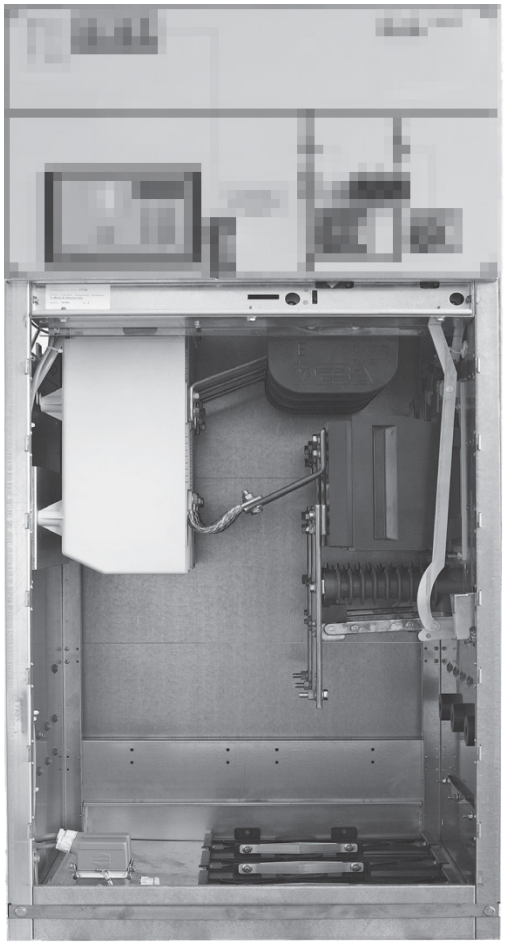


Figure 59
Fixed compact installation of ISM15_Shell_2, vertical arrangement, actuator up

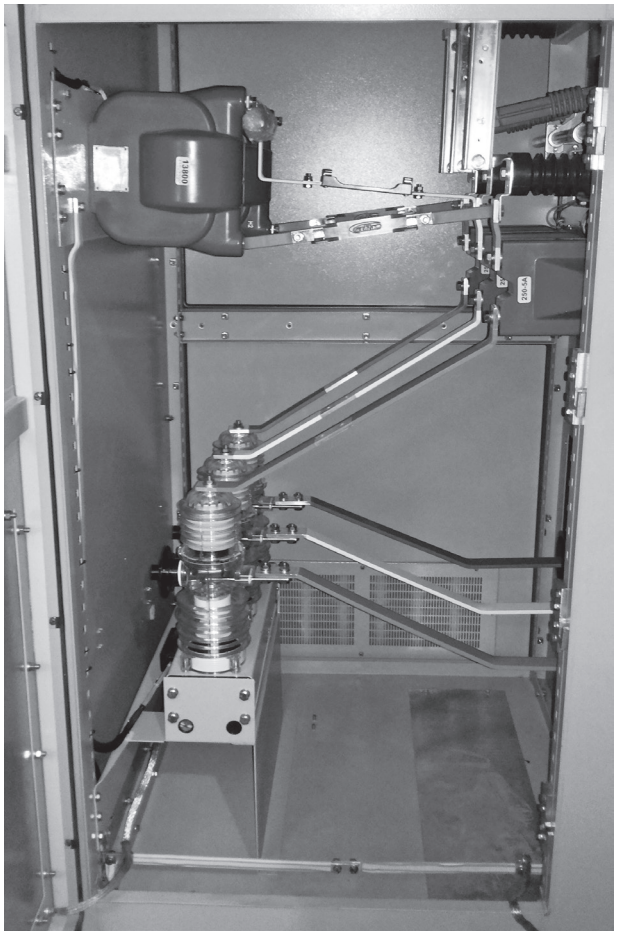


Figure 60
Fixed compact installation of ISM LD series, vertical arrangement, actuator down

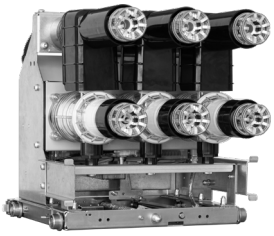


Figure 61
Withdrawable unit with ISM15_LD8, vertical arrangement, actuator down

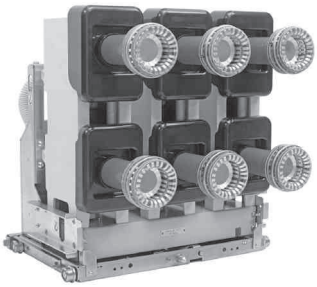


Figure 62
Withdrawable unit with ISM15_HD_1, vertical arrangement, actuator down

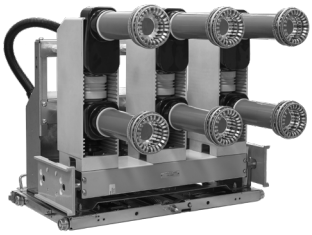


Figure 63
Withdrawable unit with ISM25_Shell2, vertical arrangement, actuator down

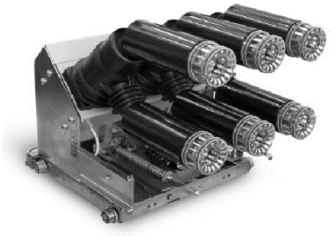
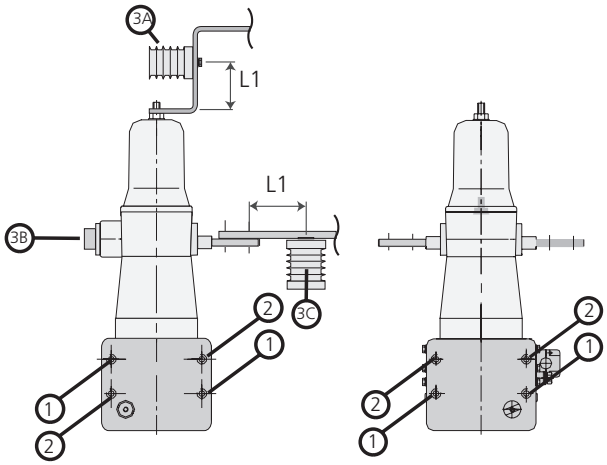


Figure 64
Withdrawable unit with ISM15_MD_1, tilted arrangement

Busbars and cables shall be connected with the ISM primary terminals mechanically in a stress-free manner. No pressure, tension or torsion forces shall act on the ISM. To avoid unacceptable high mechanical loads on the ISM, the busbar connections shall be supported by additional insulators (Figure 65).

Calibrated torque wrenches shall be used for mounting of switching modules and the connection of busbars. Points shown below should be used for mounting the ISM.

ISM15_LD Mounting



1. Required mounting points
2. Optional mounting points
3. Each two mounting points are required, either 3A+3B or 3A+3C

Figure 65

ISM15_LD (except ISM15_LD_8) and ISM25_LD mounting points

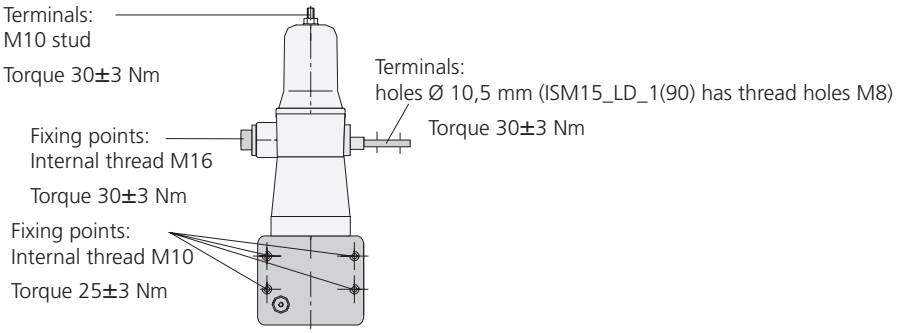
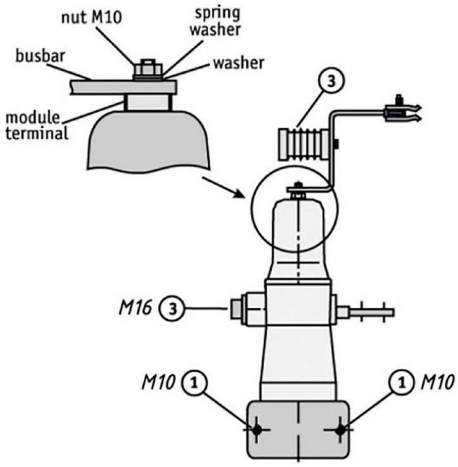


Figure 66

Bolt sizes and torques



1 - mandatory mounting points;

3 - additional mounting points (required in case uncontrolled horizontal force will be applied to ISM terminals, ex. draw-out unit).

Figure 67

ISM15_LD_8 mounting points

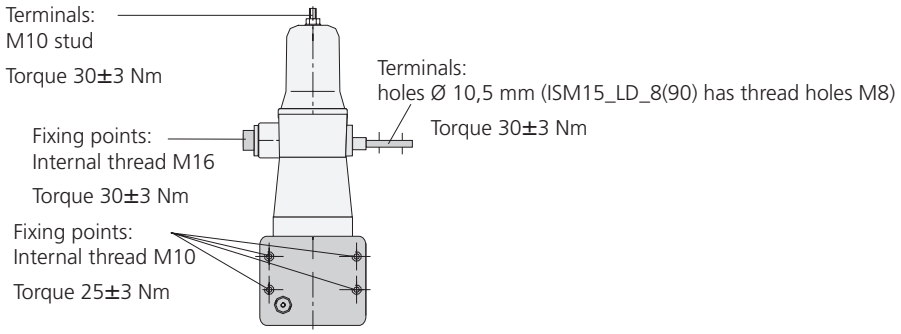
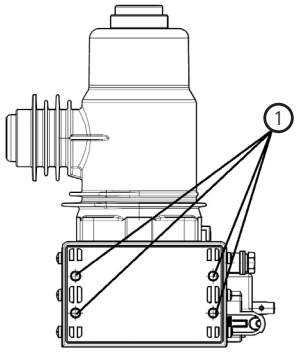


Figure 68

Bolt sizes and torques for ISM15_LD_8

Important: It is not allowed to perform any close or trip operation for ISM LD series while the nut M10 on the stud of the ISM upper terminal (Figure 66 and Figure 68) is not tightened.

ISM15_MD Mounting

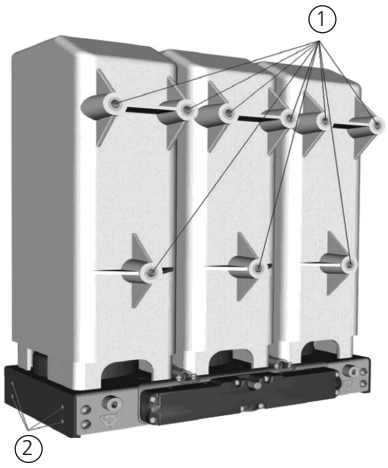


1. Eight threads on both sides of the frame for obligatory ISM fixing (M10, torque is 25±3 Nm).

Figure 69

ISM15_MD_1, ISM15_MD_3 mounting points

ISM15_Shell Mounting



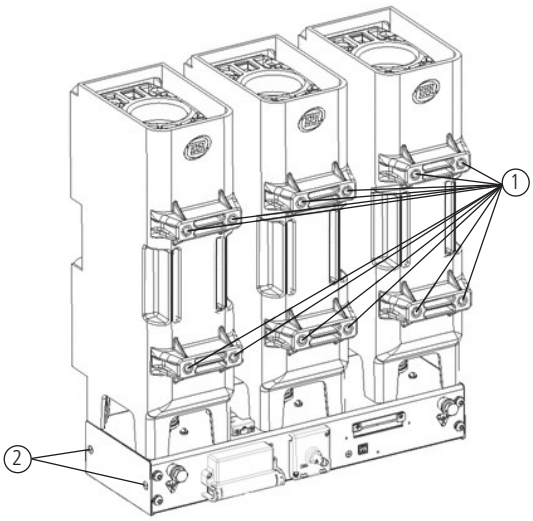
1. Nine internal threads for obligatory ISM fixing which are formed in the module support insulator (M12, torque 40±4 Nm).
2. Eight threads on both sides of the frame for optional ISM fixing (M8, torque is 10±1 Nm).

Figure 70

ISM15_Shell_2 mounting points

Ensure that the frame to which the ISM will be fixed does not create static load to the switching module.

ISM15_HD Mounting



1. Twelve internal threads for obligatory ISM fixing which are formed in the module support insulator (M12, torque 40±4 Nm).
2. Eight threads on both sides of the frame for optional ISM fixing (M10, torque is 25±3 Nm).

Figure 71
ISM15_HD_1 mounting points

To provide 95 kV BIL between ISM15_HD_1 main terminals and external frame, it is required to use the additional spacers. Spacers are included in the CBMount_ISM15_1 kit.

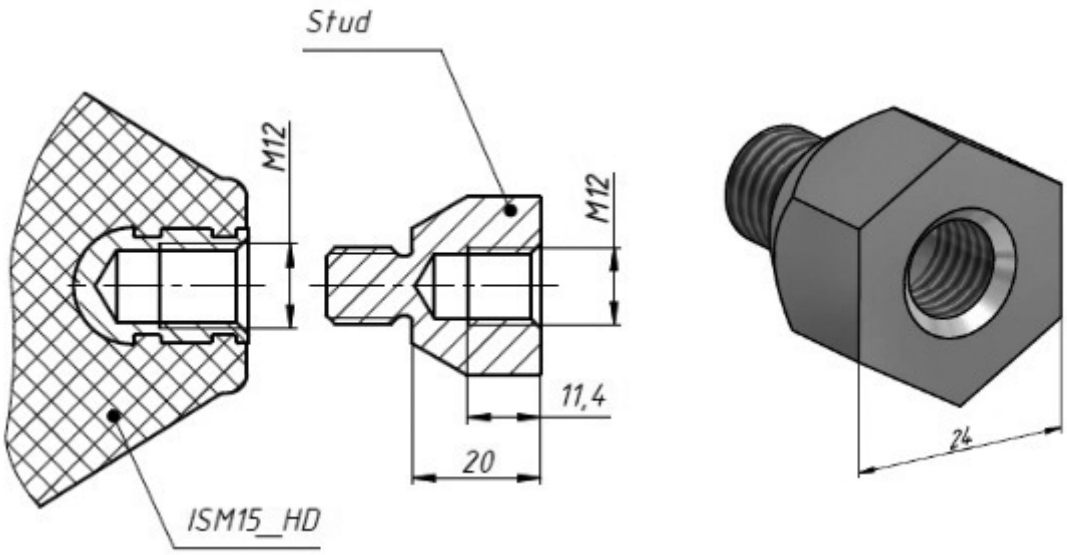
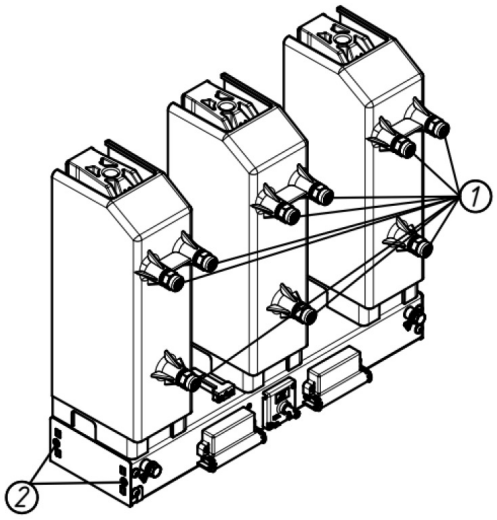


Figure 72
ISM15_HD_1 mounting with help of spacers from CBmount_ISM15_1

ISM25_Shell Mounting



1. Nine internal threads for obligatory ISM fixing which are formed in the module support insulator (M12, torque 30±3 Nm).
2. Four threads on both sides of the frame for optional ISM fixing (M10, torque is 25±3 Nm).

Figure 73
ISM25_Shell_2 mounting points

ISM25_Shell_2 for 125 kV BIL installation extension studs are included in the ISM delivery set:

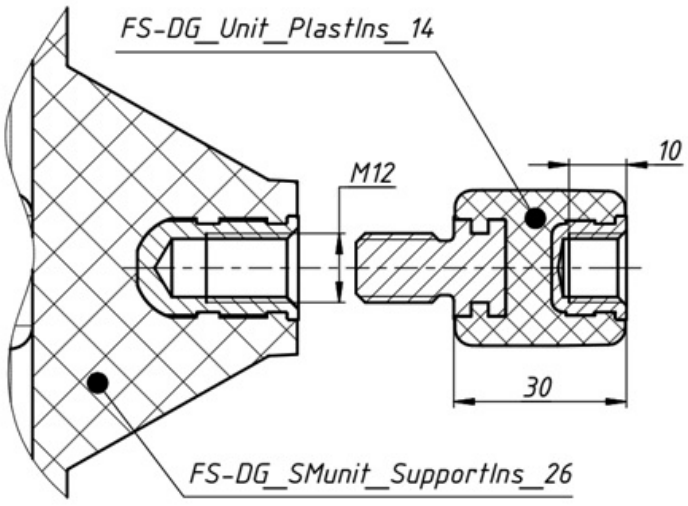


Figure 74
ISM25_Shell_2 mounting with help of studs

4.1.3 Main Terminal Connections of ISM15_LD_1, ISM15_LD_3, ISM15_LD_6,ISM15_LD_8 , ISM25_LD_1, ISM25_LD_2, ISM25_LD_3

Primary Terminals Connection

Busbars can be connected to terminals of ISM LD series by means of M10 screws. M10 bolts and nuts fixing busbars to ISM LD series terminals should be tightened with a torque of 30±3 Nm. To connect busbars to lower terminal of ISM15_LD_1(90) M8 bolt should be used with a torque of 10±1 Nm.

To prevent static load to the ISM poles it is not allowed to fasten busbars to the ISM terminal if there is a gap of more than one millimeter between the busbar and the ISM terminal just before this fastening. Bars shall be accurately prepared to avoid bending and (or) twisting forces to terminals when these bars are fastened.

Electrodynamic Forces Clearances

To avoid unacceptable high electrodynamic impact on the ISM, additional support insulators are required if the unsupported busbars are longer than specified in the Table 3.

Table 3 - Additional Support Insulators Installation Minimum Distances

ISM	Short-Circuit Current	
	16 kA	20 kA
	L1, mm	
ISM15_LD series	980	700
ISM25_LD series	980	NA

Electromagnetic Clearances

Short-circuit current magnetic field influences the ISM magnetic actuator. To avoid unwanted tripping, the minimum clearances between busbars and the ISM frame should be not less than 120 mm (Figure 75).

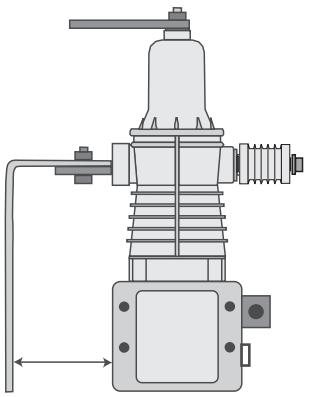


Figure 75

Electromagnetic clearances

Insulation Clearances

The recommended minimum phase-to-phase and phase-to-ground air clearances are stated in Table 4. Shorter clearances shall be verified by a voltage test.

Table 4 - Insulation Clearances

Power frequency rated voltage	Impulse test vol-tage (BIL)	Minimum clearance (b) for LD ISM
12 kV	75 kV	120 mm
17.5 kV	95 kV	140 mm (160 mm for ISM15_LD_8)
24 kV	125 kV	220 mm

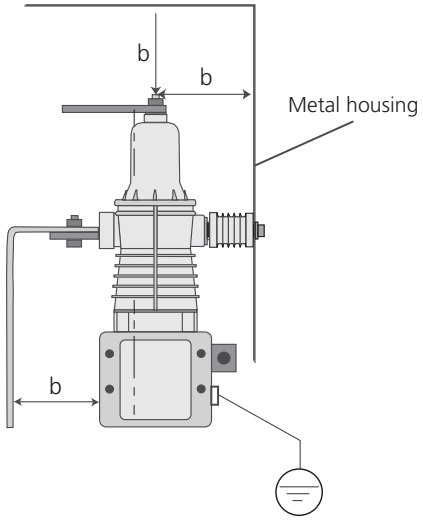


Figure 76

LD series ISM dielectric clearances

Coordination of Minimum Clearances

Based on electromagnetic influence (a) and rated insulation voltage (b), the greater clearance should be selected.

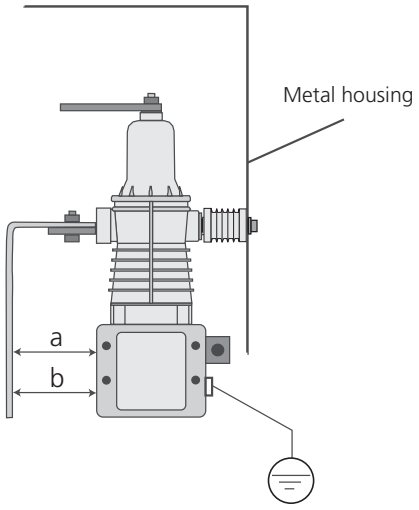


Figure 77

Clearance coordination

Insulation Cap Set CBkit_Ins_3 for ISM25_LD

To comply with the rated impulse withstand voltage of 125 kV according to IEC 62271-1 it is recommended to cover the top terminals of the ISM25_LD_1 and ISM25_LD_3 with insulation cap set CBkit_Ins_3. The arrangement is shown in Figure 78.

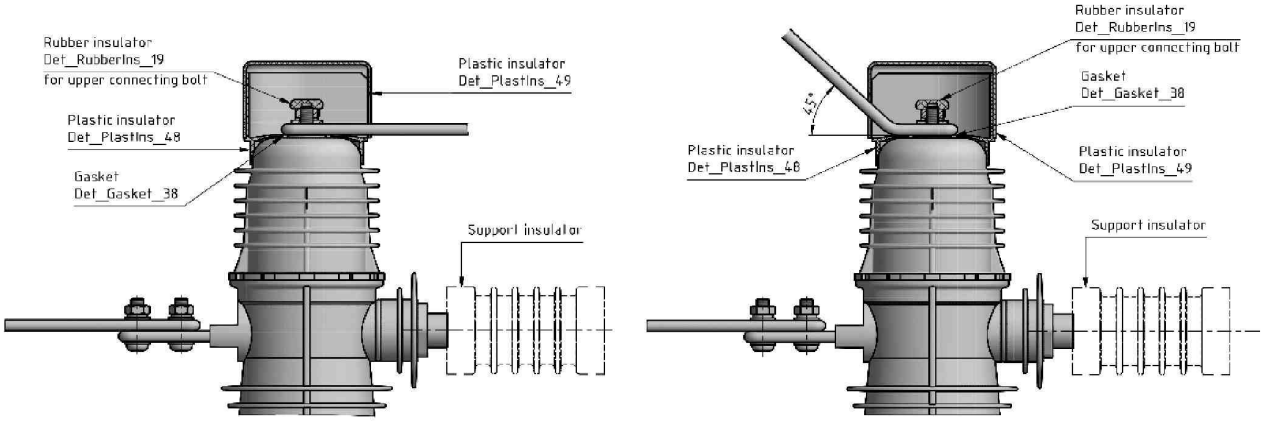


Figure 78

CBkit_Ins_3 installation

If the insulation cap set CBkit_Ins_3 will not be used the compliance with the rated insulation level shall be verified by a voltage test.

Busbar for 24 kV ISM

If the PCD of the ISM25_LD_1 is 210 mm, the connected busbars shall have the shape as shown in Figure 79.

If external busbars have rectangular cross-section, additional insulation barriers between poles shall be used if air clearance between busbars is less than 190 mm.

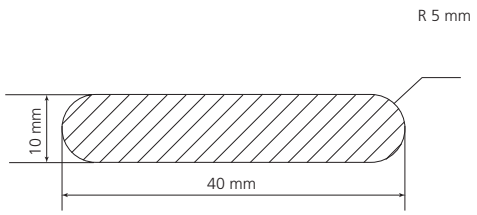


Figure 79

Cross-section of the busbar connected to the pole

4.1.4 Main Terminal Connections of ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2, ISM15_HD_1, ISM25_Shell_2

Primary Terminals Connection

To comply with the rated impulse withstand voltage according to IEC 62271-1 it is recommended to use:

1. for ISM15_MD_1 or ISM15_MD_3:

Table 5 - Insulation of ISM15_MD_1 Main Terminals

PCD, mm	BIL, kV	Busbars	Insulation Kit
150	75	40x10 mm	Not required CBkit_Ins_4(1)
	95	40x10 mm	
210	75	40x10 mm 80x10 mm	Not required
	95	40x10 mm 80x10 mm	CBkit_Ins_4(1) CBkit_Ins_4(2)

Note: Selection of single or double bars 40x10 mm depends on the rated normal current of VCB application. It is recommended to use additional busbar insulation (for example, shrinkable tube) to provide 95 kV BIL with 150 mm PCD circuit breaker.

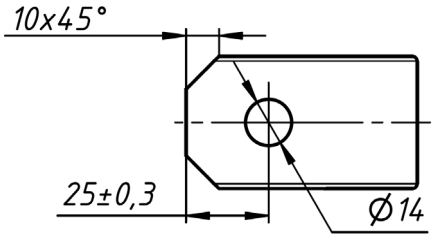


Figure 80
Edges of bars 40x10 mm at the place to ISM terminal connection

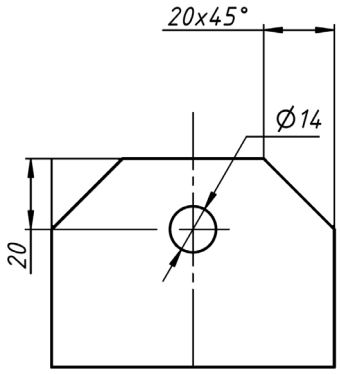


Figure 81
Edges of bars 80x10 mm at the place to ISM terminal connection

M12 bolts fixing busbars (or contact arms) to ISM15_MD_1 or ISM15_MD_3 terminals should be tightened with a torque of 50±2 Nm.

2. for ISM15_Shell_2 – CBkit_Shell15_1 for 95 kV BIL (75 kV BIL for PCD 150 mm).

3. for ISM15_HD_1 – busbars with width no more than 100 mm (selection of single or double bars depends on the rated normal current of VCB application). For BIL 95 kV and PCD 210 mm the bars shall have radius at least 3 mm on their edges and shall be insulated (for example, by shrinkable tube).

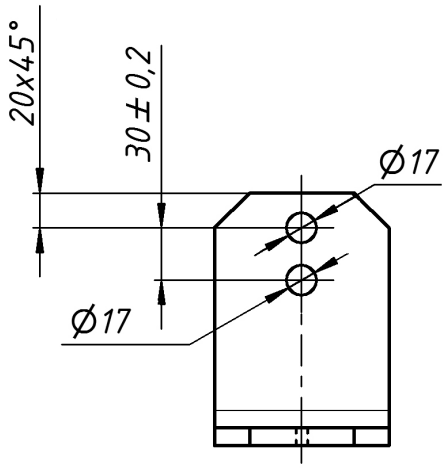


Figure 82

Edges of bars 100x10 mm at the place to ISM terminal connection

4. for ISM25_Shell_2 – CBkit_Shell25_1 for 125 kV BIL. For BIL 125 kV the bars shall be insulated (for example, by shrinkable tube).

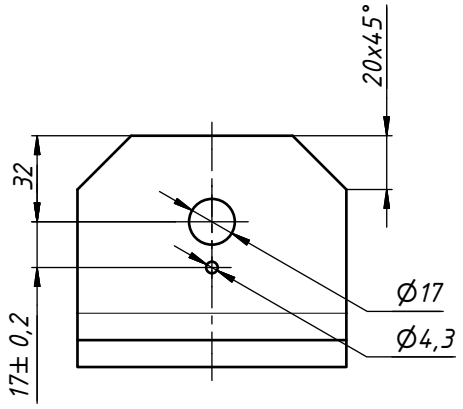


Figure 83

Edges of bars 100x10 mm at the place to ISM terminal connection

If insulation kit will not be used compliance with the rated insulation level shall be verified by a voltage test. M16 bolts fixing busbars (or contact arms) to ISM15_Shell_2, ISM15_HD_1 and ISM25_Shell_2 terminals should be tightened with a torque of 60±2 Nm.

To prevent static load on the ISM poles it is not allowed to fasten busbars to the ISM terminal if there is a gap of more than one millimeter between the busbar and the ISM terminal just before this fastening. Bars shall be accurately prepared to avoid bending and (or) twisting forces to terminals when these bars are fastened.

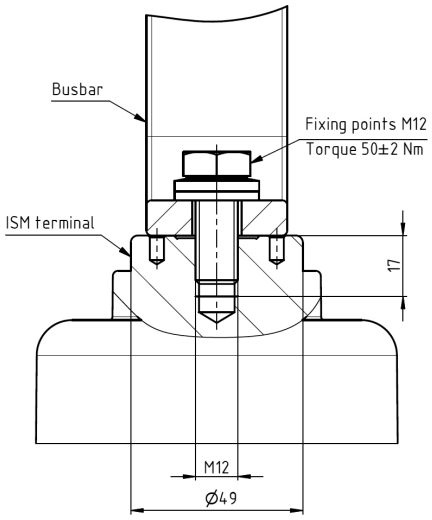


Figure 84

Details of ISM15_MD terminals connection to rectangular cross-shaped busbars (at fixed installation, for example)

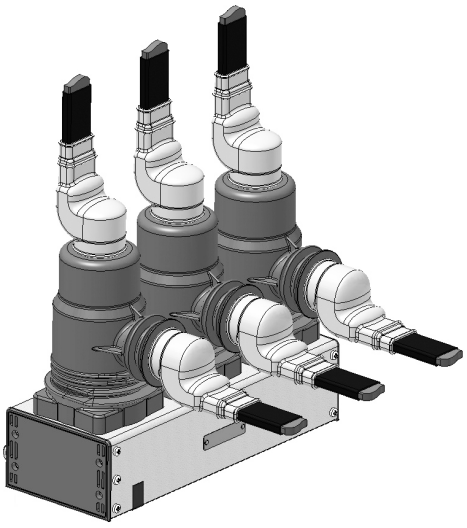


Figure 85

Details of ISM15_MD terminals connection to rectangular cross-shaped busbars with help of CBkit_Ins_4(1) (at fixed installation, for example)

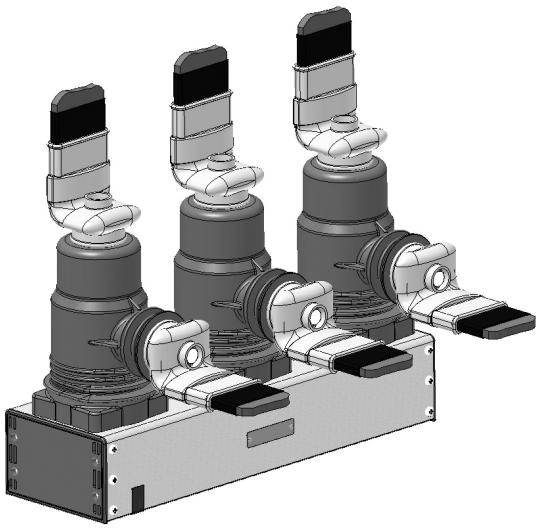
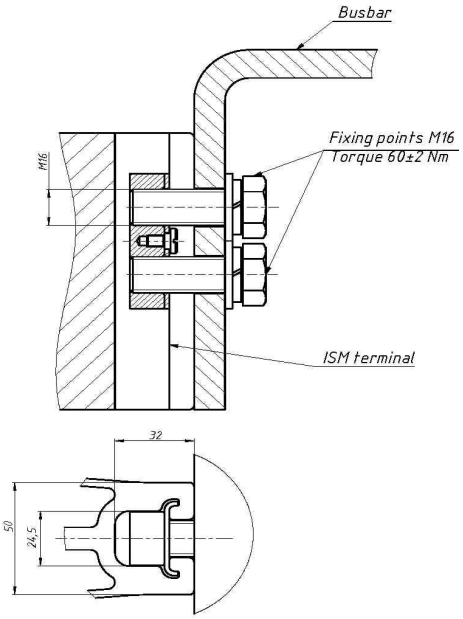


Figure 86

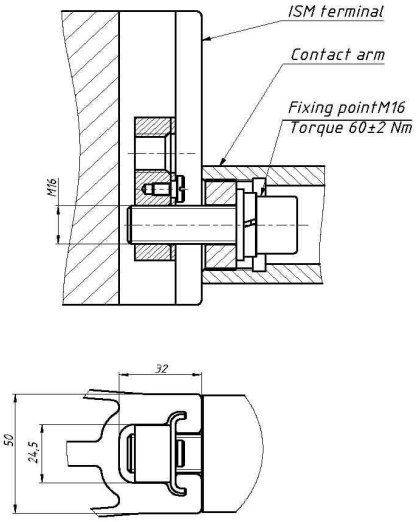
Details of ISM15_MD terminals connection to rectangular cross-shaped busbars with help of CBkit_Ins_4(2) (at fixed installation, for example)

ISM15_Shell

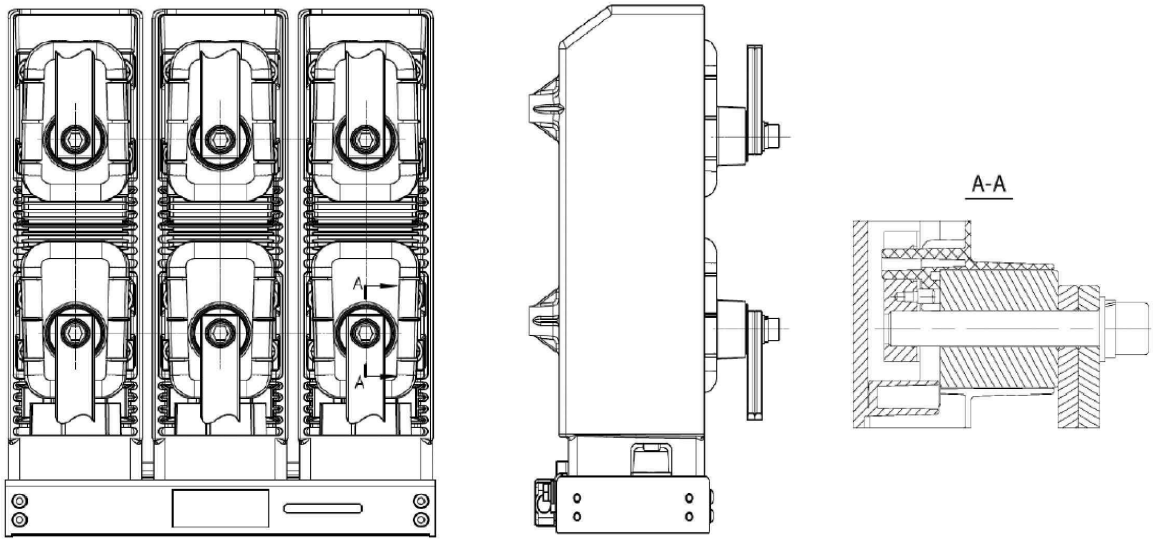
The gap between the busbar and the ISM terminal just before this fastening should be not more than one millimeter.



a) Details of ISM15_Shell_2 terminals connection to rectangular cross-shaped busbars (at fixed installation, for example)



b) Details of ISM15_Shell_2 terminals connection to cylindrical cross-shaped busbars (withdrawable unit contact arm, for example)



c) Details of ISM15_Shell_2 terminals connection to rectangular cross-shaped busbars with help of CBkit_Shell15_1 (at fixed installation, for example)

Figure 87

Busbar fixation to ISM15_Shell_2 terminal

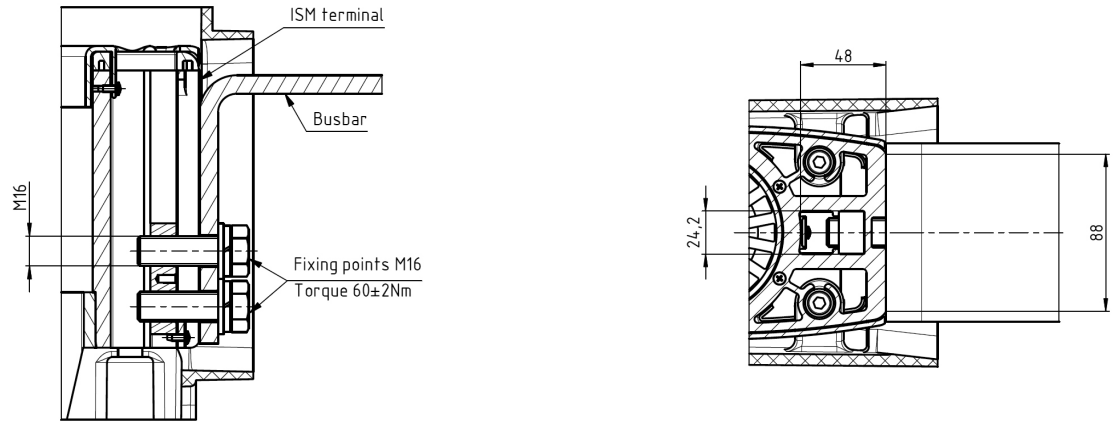


Figure 88

Details of ISM15_HD_1 terminals connection to rectangular cross-shaped busbars (at fixed installation, for example)

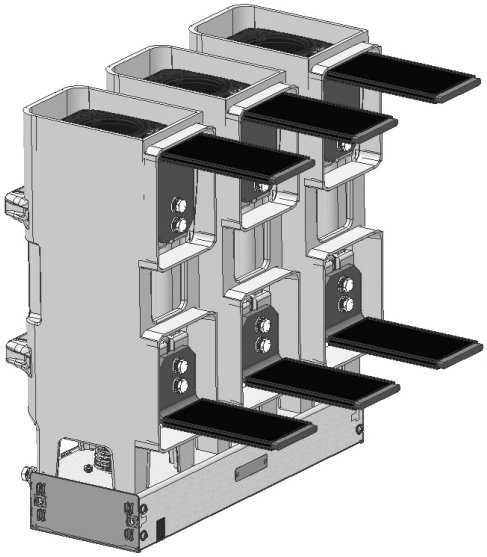


Figure 89

Details of ISM15_HD_1 terminals connection to single rectangular cross-shaped busbars (at fixed installation, for example)

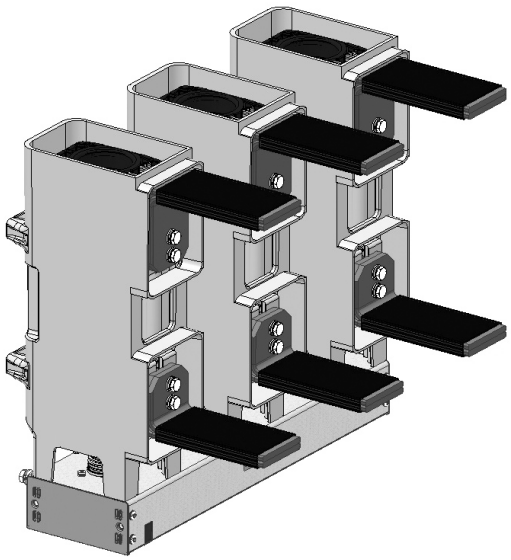
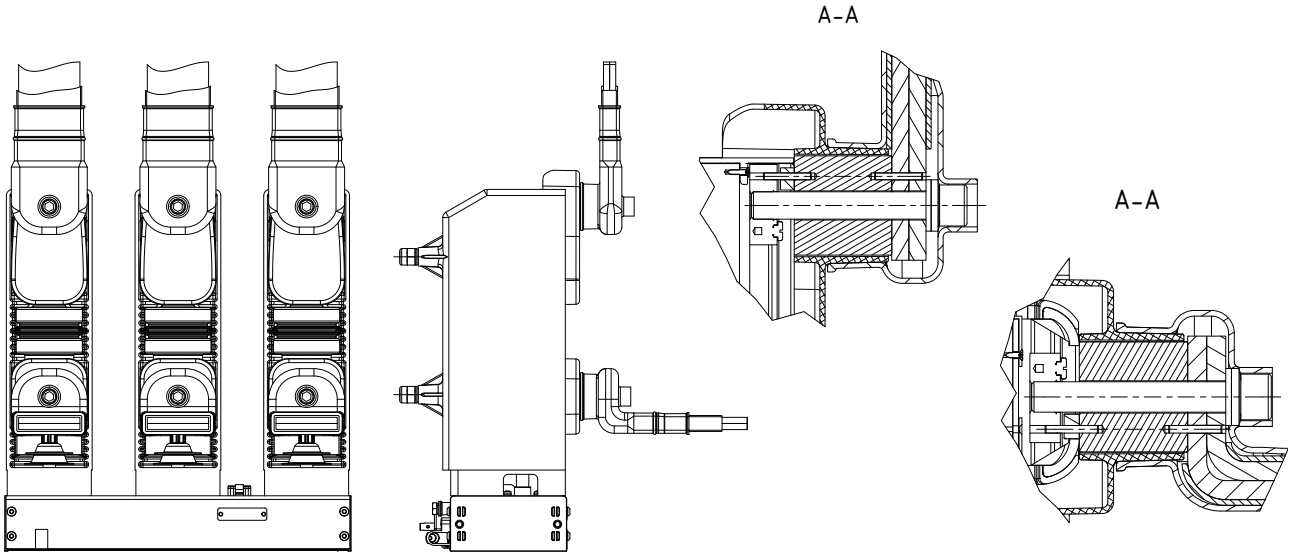


Figure 90

Details of ISM15_HD_1 terminals connection to double rectangular cross-shaped busbars (at fixed installation, for example)

ISM25_Shell



Details of ISM25_Shell_2 terminals connection to rectangular crossshaped busbars with help of CBkit_Shell25_1 (at fixed installation,for example)

Figure 91

Busbar fixation to ISM25_Shell_2 terminal

Electrodynamic Forces Clearances

To avoid unacceptable high electrodynamic impact on the ISM, additional support insulators are required if the unsupported busbars are longer than specified in the Table 6

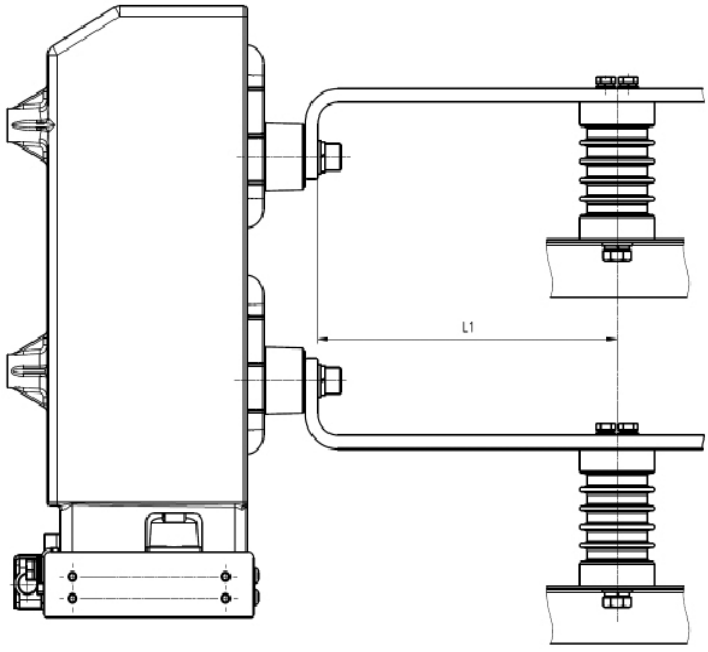


Figure 92

ISM support insulators installation distance

Table 6 - Additional Support Insulators Installation Minimum Distances

ISM	Short-Circuit Current		
	20 kA	25 kA	31.5 kA
	L1, mm		
ISM15_MD_1(150_L)	700	450	300
ISM15_MD_1(210_L)	980	630	420
ISM15_MD_3 [1)]	930	600	400
ISM15_MD_3 [2)]	1100	820	500
ISM15_Shell_2(150_L)	700	450	300
ISM15_Shell_2(210_L)	980	630	420
ISM15_Shell_2(210_H)	980	630	420
ISM15_Shell_2(275_H)	1200	820	550
ISM15_HD_1(210)	1000	850	500
ISM15_HD_1(275)	1000	1000	650
ISM25_Shell_2(210)	980	630	-
ISM25_Shell_2(275)	730	470	-

1) In case ISM15_MD_3 is installed close to the other ISM15_MD_3.
2) In case ISM15_MD_3 is installed separately from other ISM15_MD_3.

Electromagnetic Clearances

To avoid primary current effect on ISM actuator, the minimum clearance between busbars and the ISM frame (Figure 93) should be no less than stated in the Table 7.

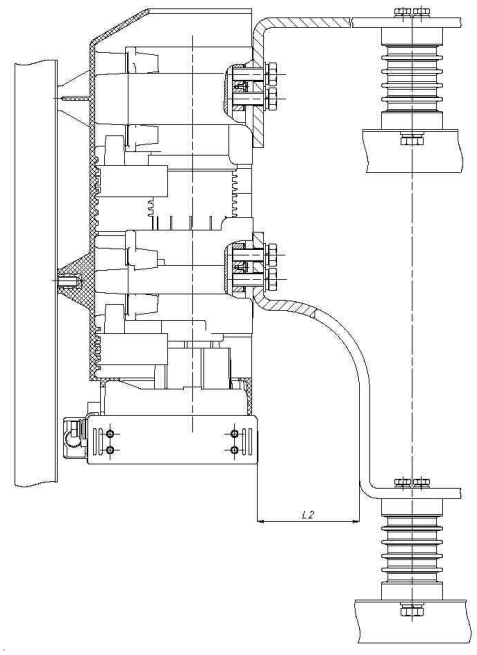


Figure 93
Electromagnetic clearances

Table 7 - Electromagnetic Clearances

Short Circuit Current	Minimum Clearance (L2)	Applicable for
≤20 kA	100 mm	ISM15_MD_1
	100 mm	ISM15_MD_3
	120 mm	ISM15_Shell_2, ISM15_HD_1
	120 mm	ISM15_HD_1
	190 mm	ISM25_Shell_2
25 kA	120 mm	ISM15_MD_1
	120 mm	ISM15_MD_3
	150 mm	ISM15_Shell_2
	190 mm [1)]	ISM15_HD_1
	240 mm	ISM25_Shell_2
31.5 kA	150 mm	ISM15_MD_1
	150 mm	ISM15_MD_3
	190 mm	ISM15_Shell_2
	240 mm [1)]	ISM15_HD_1

1) Smaller clearance on request.

Electromagnetic Clearances

The recommended minimum phase-to-phase and phase-to-ground air clearances are stated in Table 8. Shorter distances shall be verified by a voltage test.

Table 8 - Insulation Clearances

Power Frequency Rated Voltage	Impulse Test Voltage (BIL)	Minimum Clearance (L2)
12 kV	75 kV	120 mm
17.5 kV	95 kV	140 mm

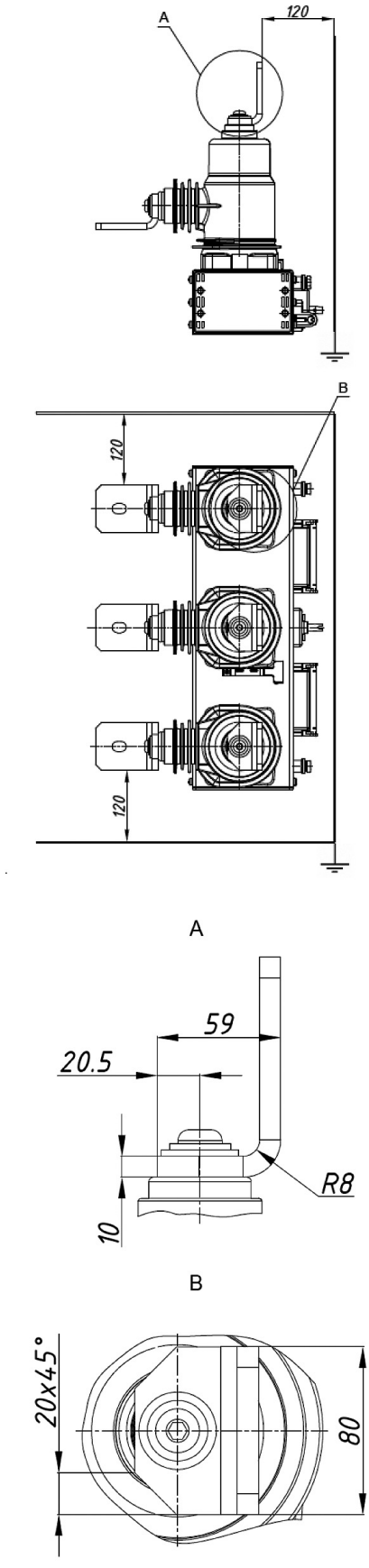


Figure 94
ISM15_MD insulation clearances - 75 kV BIL

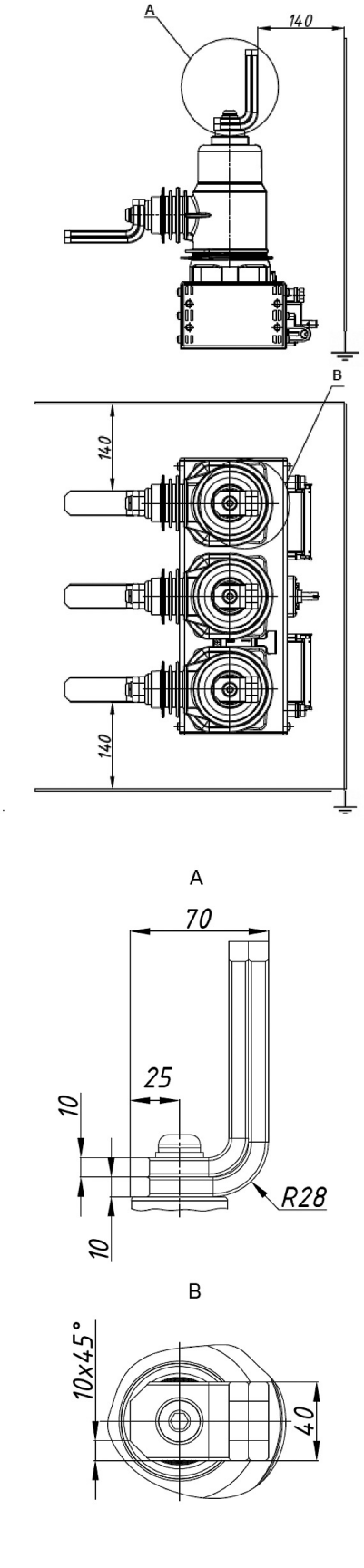


Figure 95
ISM15_MD insulation clearances - 95 kV BIL

ISM15_Shell

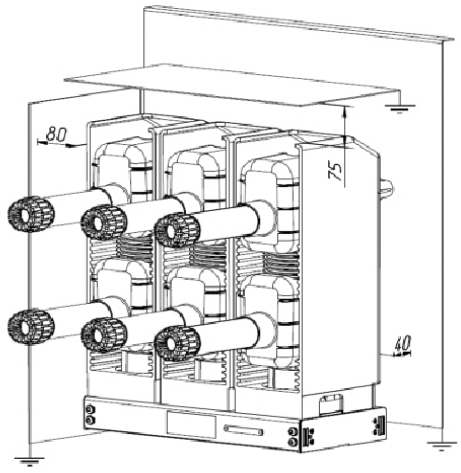


Figure 96

ISM15_Shell_2 with low upper terminal insulation clearances

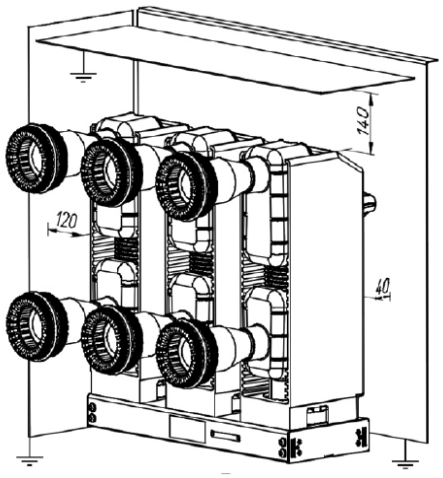


Figure 97

ISM15_Shell_2 with high upper terminal insulation clearances

ISM15_HD

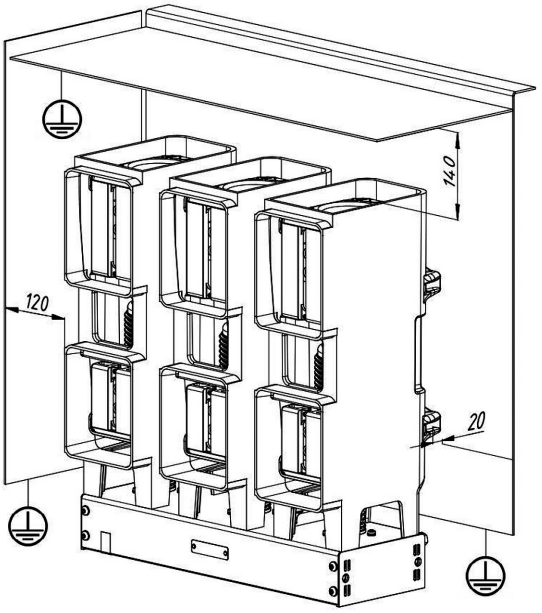


Figure 98

ISM15_HD_1 insulation clearances

ISM25_Shell

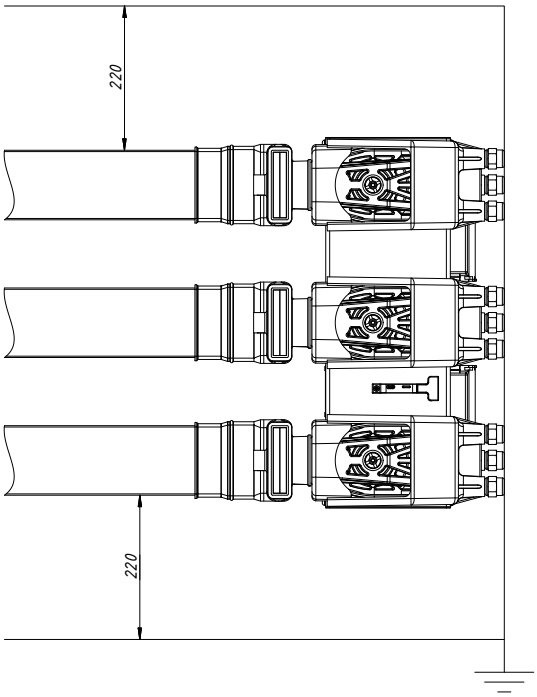


Figure 99

ISM25_Shell_2 insulation clearances

Coordination of Minimum Clearances

Based on electromagnetic influence and rated insulation voltage, the largest value clearance should be selected.

4.1.5 ISM15_LD_1, LD_3, LD_6, ISM25_LD_1, LD_2, LD_3 Interlocks

The ISM15_LD1, ISM15_LD6, ISM25_LD1, ISM25_LD2 provide the following interfaces for interlocking (Figure 101):

- stub shafts at both sides with grooves and tapped holes Figure 101, details 1 and 3);
- two interlocking pins with tapped holes (Figure 101, detail 2).

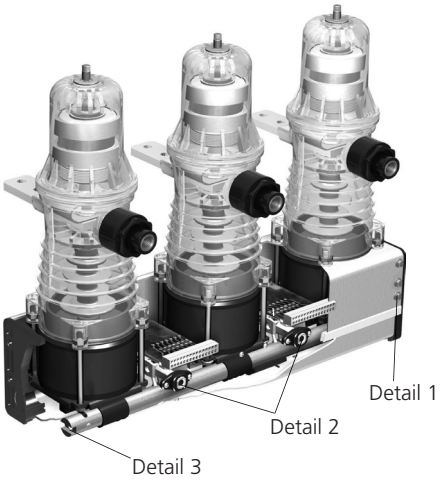
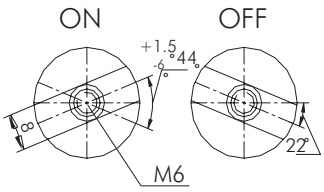


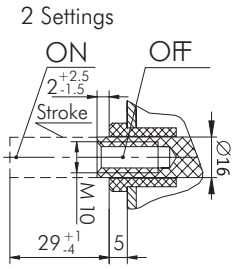
Figure 100

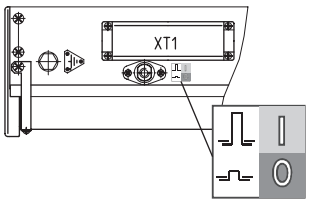
Interlocking interface of ISM15_LD_1, ISM25_LD_1, LD_2

Detail 1

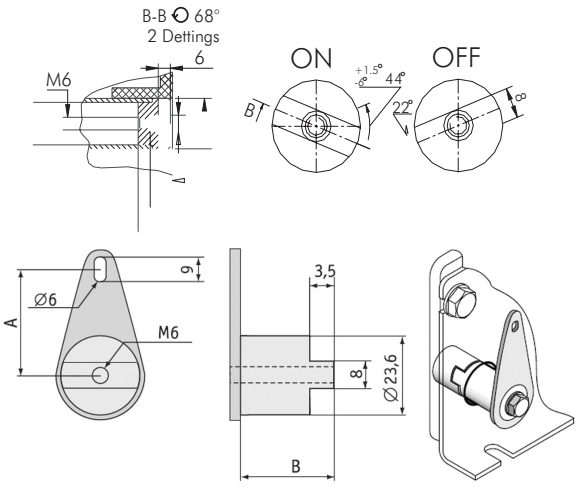


Detail 2





Detail 3



A = 19,5...50 mm; B = 22...50 mm; the length of A, B depends on the particular installation.

Figure 101

Example of connection between interlocking lever and synchronizing shaft

The Following Conditions Must Be Fulfilled When Designing Mechanical Interlocking:

- If the interlocking mechanism is attached to one of the interlocking pins, the weight of the directly attached movable part to the interlocking pins shall not exceed 0.35 kg. If both interlocking pins are used, the sum of the attached weights shall not exceed 0.35 kg (Figure 102).
- If the attached part is joined with a lever mechanism, the weight (including directly moved parts) shall be decreased in proportion of the lever (Figure 103).
- If the interlocking mechanism is directly attached with the synchronizing shaft the moment of inertia of the attached mechanism shall not exceed 4.3 x 10^{-4} kg*m^2. If both stub shafts of the synchronizing shaft are used, the sum of the attached moments of inertia shall not exceed 4.3 x 10^{-4} kg*m^2 respectively 1.2 x 10 4 kg*m^2 (Figure 101).
- For manual-emergency-tripping a force of up to 250 N may be applied to the interlocking pins. But no static force shall be applied (Figure 102).
- It is not allowed to perform electrical trip/close commands while the interlocking pins or the synchronizing shaft are blocked mechanically.

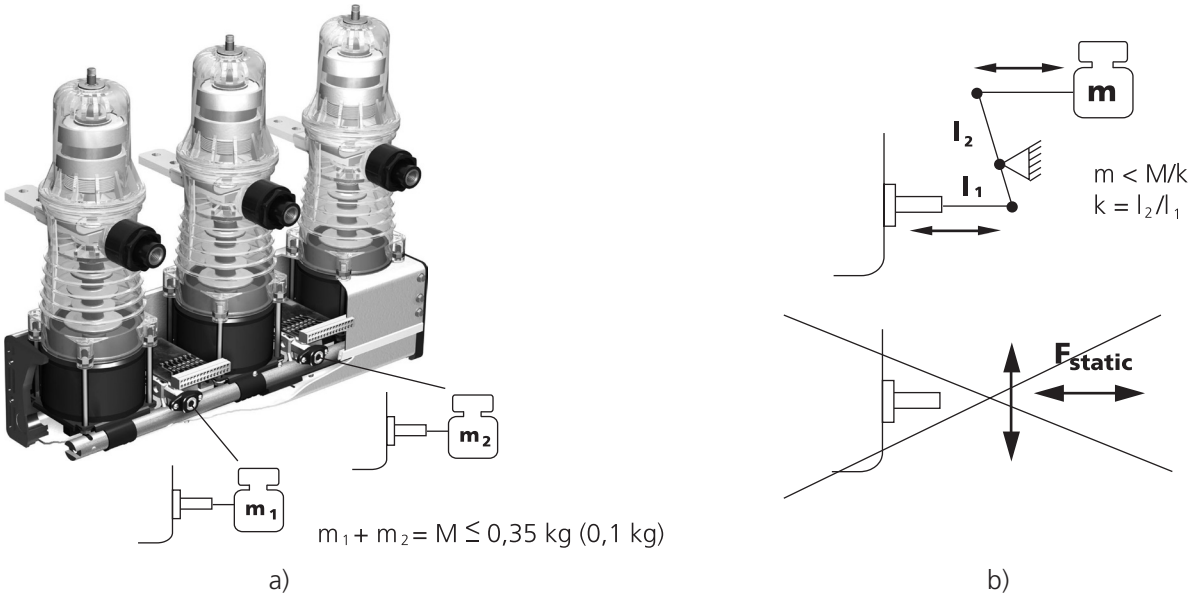


Figure 102

Mechanical interlocking by interlocking pins

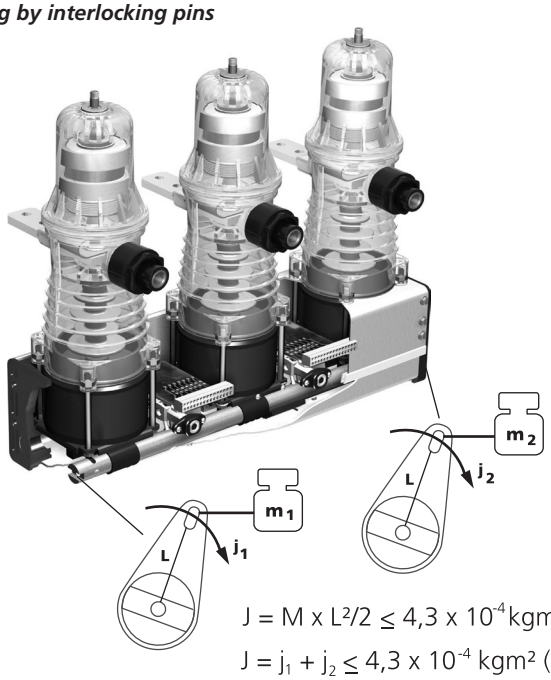
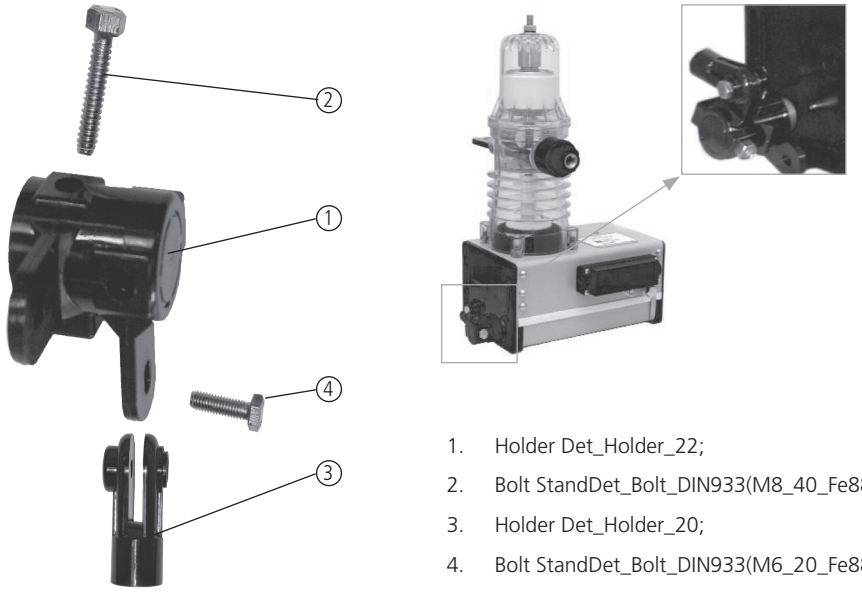


Figure 103

Direct connection of the interlocking mechanism to the synchronizing shaft

Single phase ISM15_LD_3 and ISM25_LD_3 are supplied with an installed interlocking lever:

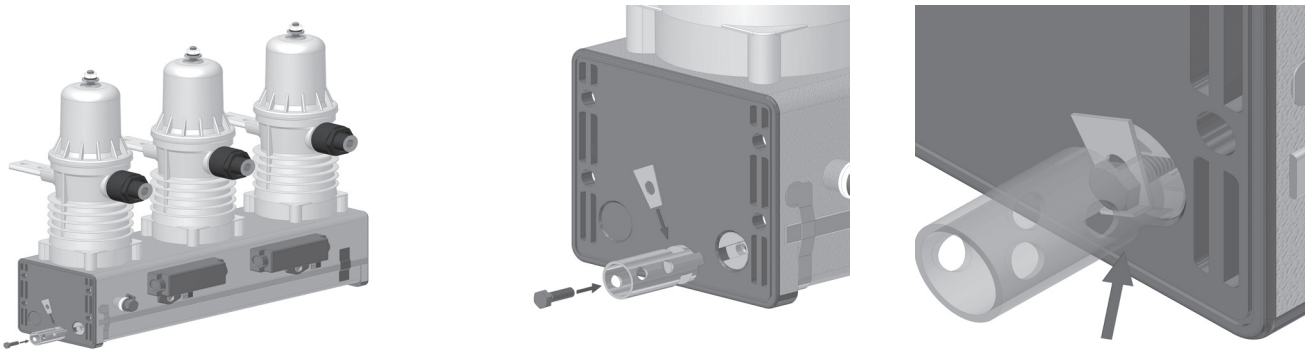


1. Holder Det_Holder_22;
2. Bolt StandDet_Bolt_DIN933(M8_40_Fe88-Zn) - bolt M8x40;
3. Holder Det_Holder_20;
4. Bolt StandDet_Bolt_DIN933(M6_20_Fe88-Zn) - bolt M6x20.

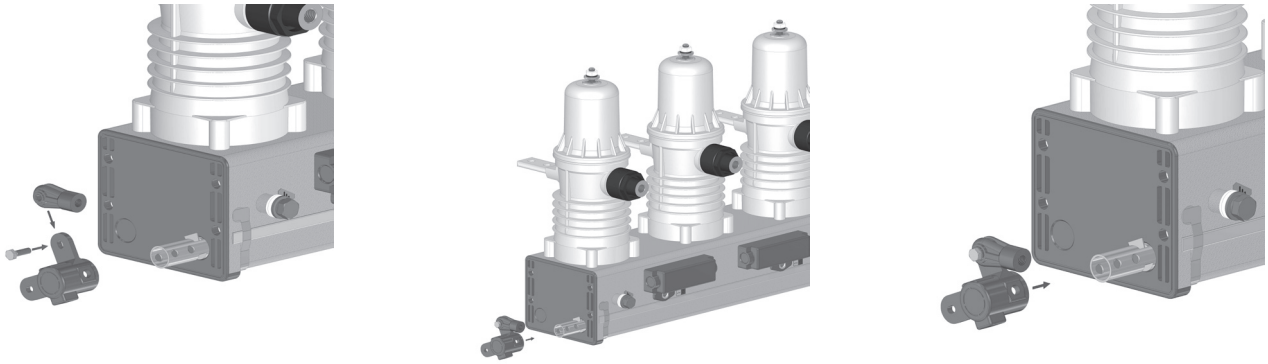
Figure 104

Interlocking lever assembly design for single phase ISM

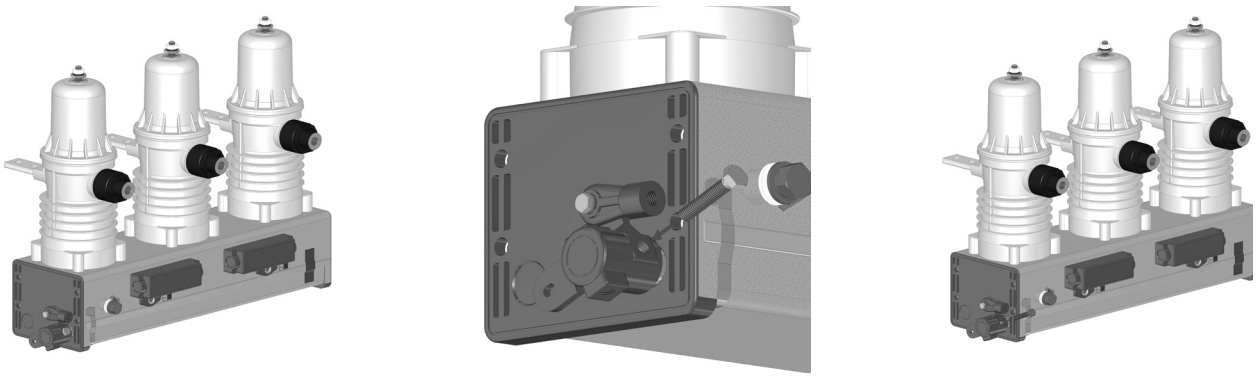
An interlocking lever can be installed on three phase ISM15_LD_1 and ISM25_LD_1, LD_2 as shown below.



a) Install CBdet_Shaft_1 on ISM synchronizing shaft output and fix with help of CBdet_Stopper_1 and StandDet_Bolt_DIN933(M8_40_Fe88-Zn)



b) Attach Det_Holder_20 to the Det_Holder_22 and fix with StandDet_Bolt_DIN933(M6_20_Fe88-Zn). Then install Det_Holder_22 on CBdet_Shaft_1

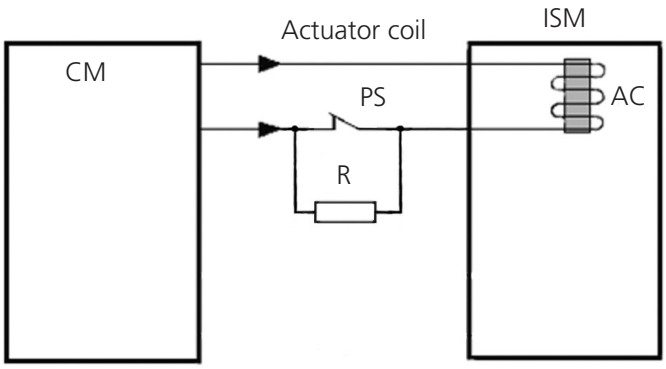


c) Fix Det_Holder_22 on the CBdet_Shaft_1 with StandDet_Bolt_DIN933(M6_20_Fe88-Zn)

Figure 105

Interlocking lever assembly design for three phase ISM

An electrical interlock can be provided by connecting the ISM actuator coil in series with the contacts of a position switch of the relevant device (disconnector or draw-out truck, etc.) as shown in the Figure 106.



AC — actuator coil;

PS — position switch with current not less than 10 A;

R — resistor 22 kOhm±5%,average power 0.15 W, peak power 8 W

Figure 106

Electrical interlock diagram

The position switch must be positively driven in both directions and must fully operate before the interlocked ISM starts to move to its alternative position. Resistor ‚R' is used to prevent the CM alarm "Actuator Coil Isolated" while position switch PS is open.

Connection of CBkit_Interlock_3, _4, _5 to ISM15_LD_1, LD_3, LD_6, ISM25_LD_1, LD_2, LD_3 Interlocking Shaft:

CBkit_Interlock_LD(0_0_1) can be used with the ISM15_LD series as an accessory for manual trip / interlock and main contacts position indicator connection to the ISM.

The installation of the CBkit_Interlock_LD(0_0_1) is shown below.
Notes:

- CBkit_Interlock_LD(0_0_1) is used to provide the connection of interlocking interface and position indicator.
- One of the 3 interlocks can be connected to CBkit_Interlock_LD(0_0_1) (CBkit_Interlock_3, CBkit_Interlock_4 or CBkit_Interlock_5). Also the CBkit_Interlock_LD(0_0_1) can be used without any of the interlocks but only with the position indicator installed.
- Position indicator can be attached to CBkit_Interlock_LD(0_0_1) as an optional item.

CBkit_Interlock_LD(0_0_1) can be installed either on the left or the right side of the circuit breaker. Depending on the side interlock installation have slight differences, see the figures below.

First, install the flexible release and interlocking cables to the interface.

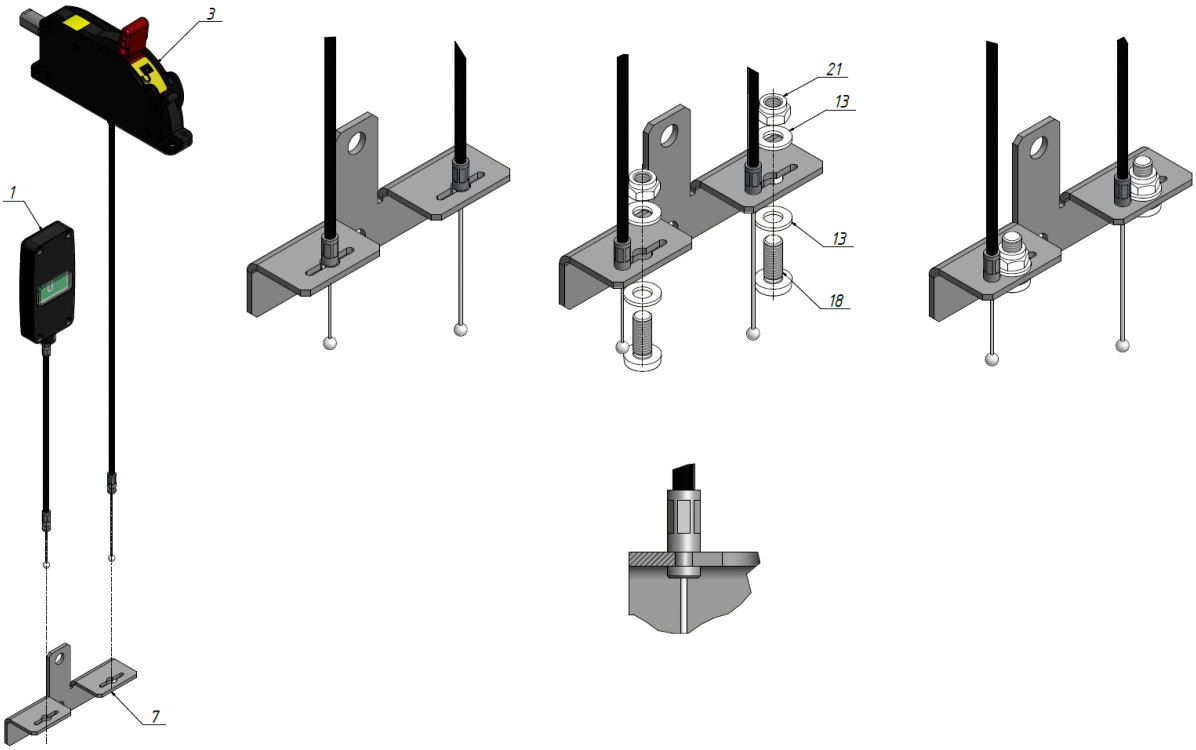


Figure 107

(Left side) Flexible release and interlocking cables connection to CBkit_Interlock_LD(0_0_1)

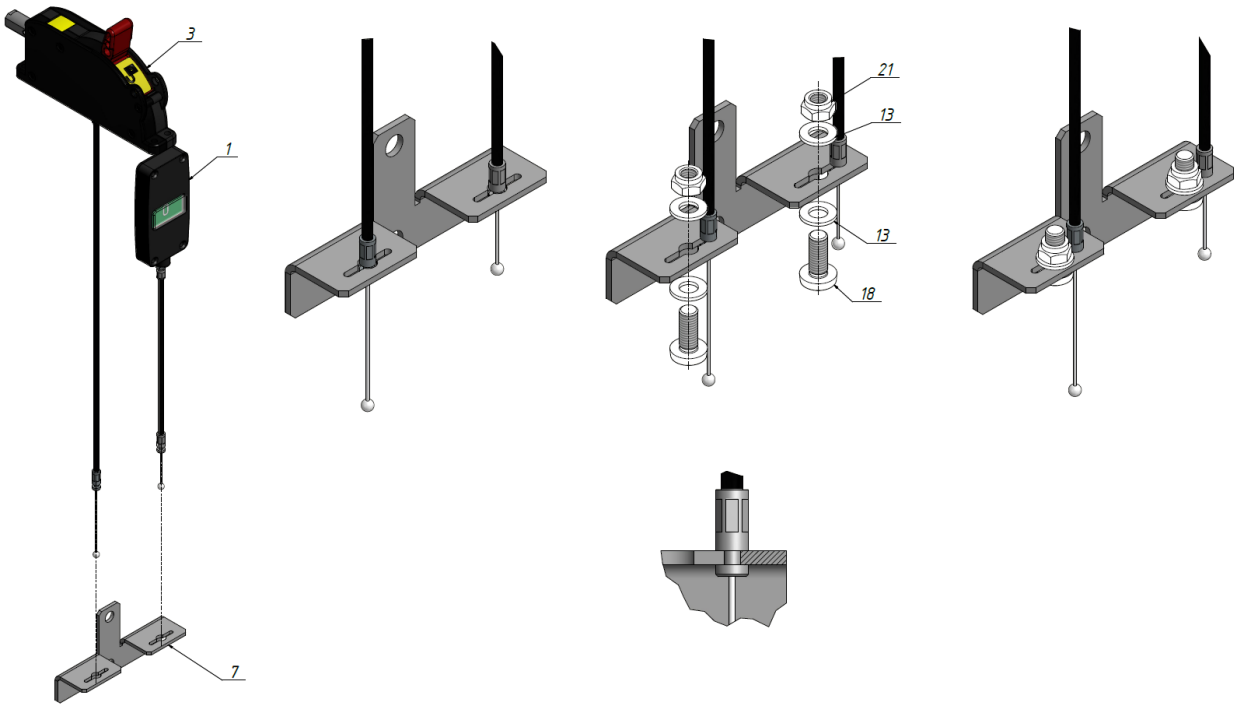


Figure 108

(Right side) Flexible release and interlocking cables connection to CBkit_Interlock_LD(0_0_1)

Then install the TES_CBdet_Guide_2 on the position indicator cable.

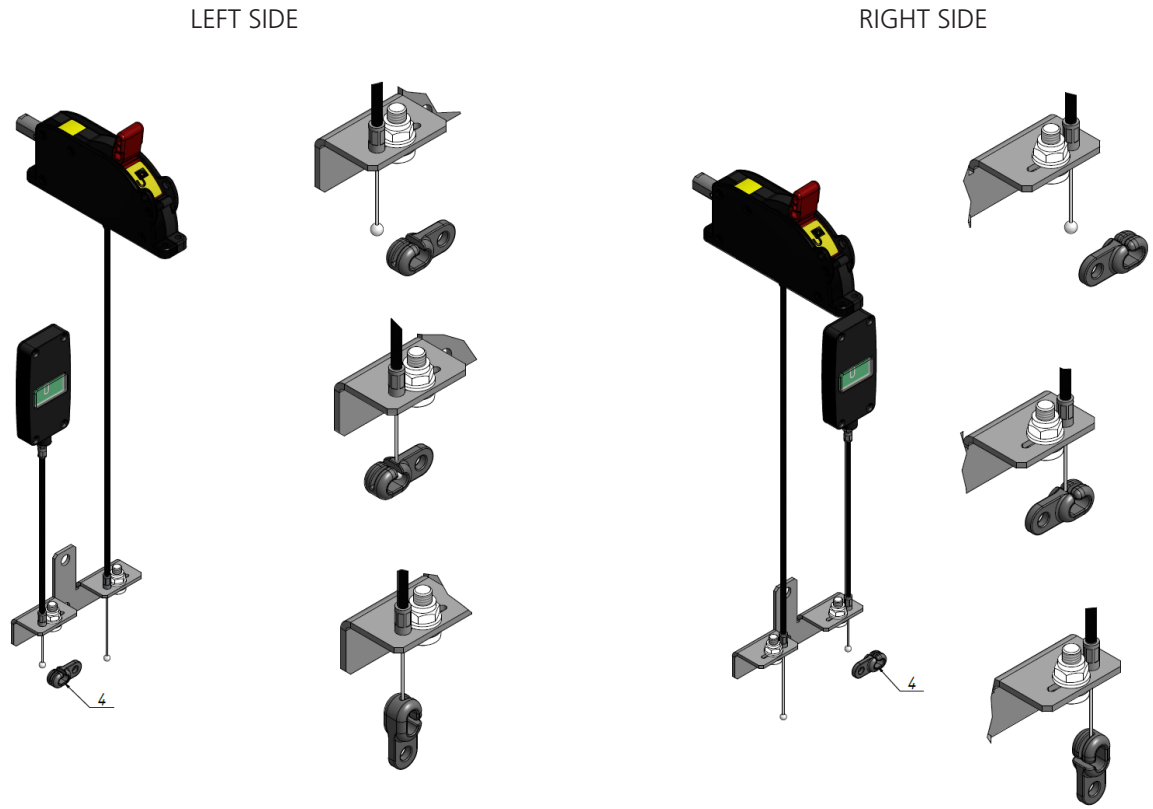


Figure 109

Position indicator installation

Assemble the CBkit_Interlock_LD(0_0_1) as shown below.

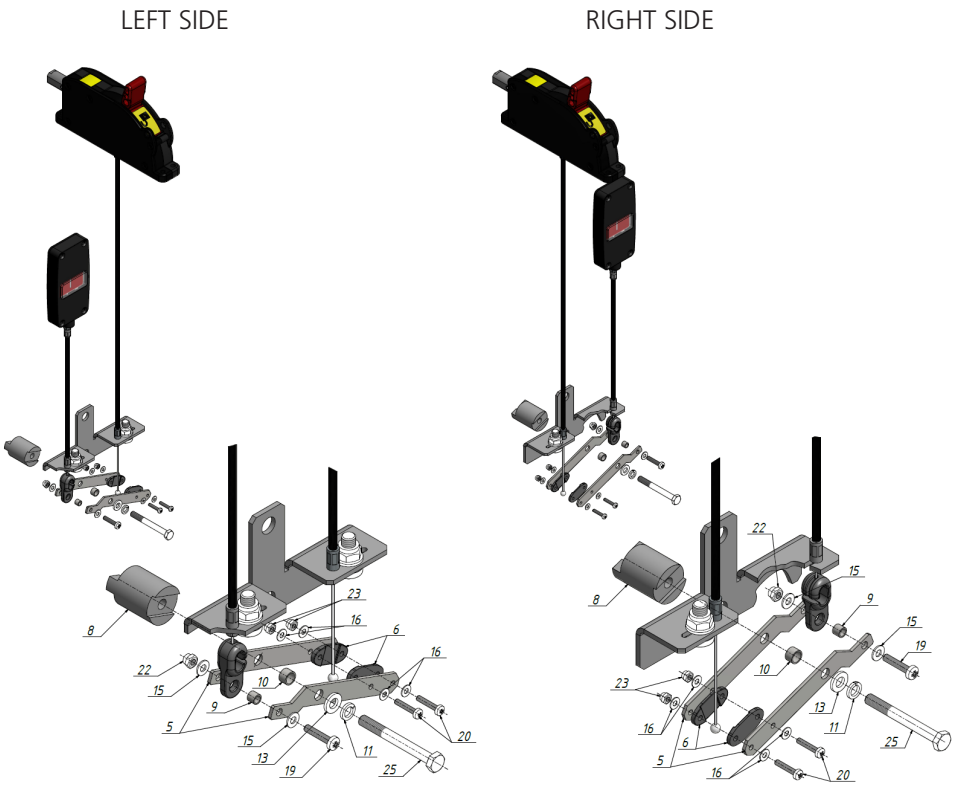


Figure 110

CBkit_Interlock_LD(0_0_1) installation

Install the plate on the ISM.

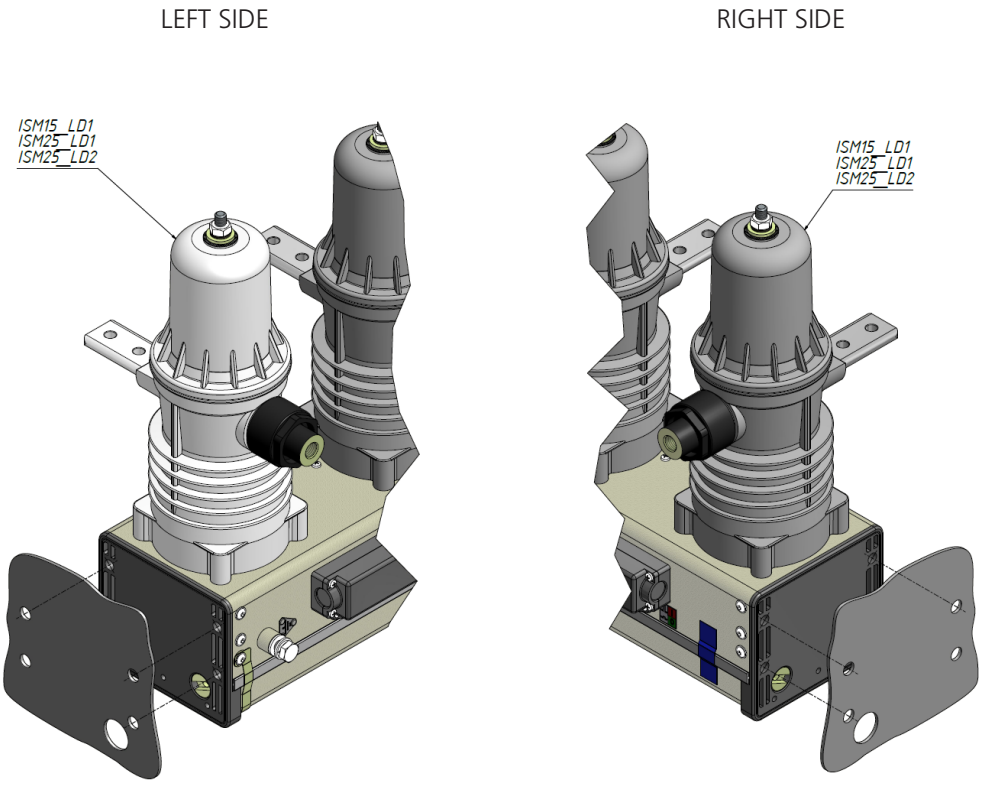


Figure 111

The plate installed on the ISM

Attach the CBkit_Interlock_LD(0_0_1) to the ISM.

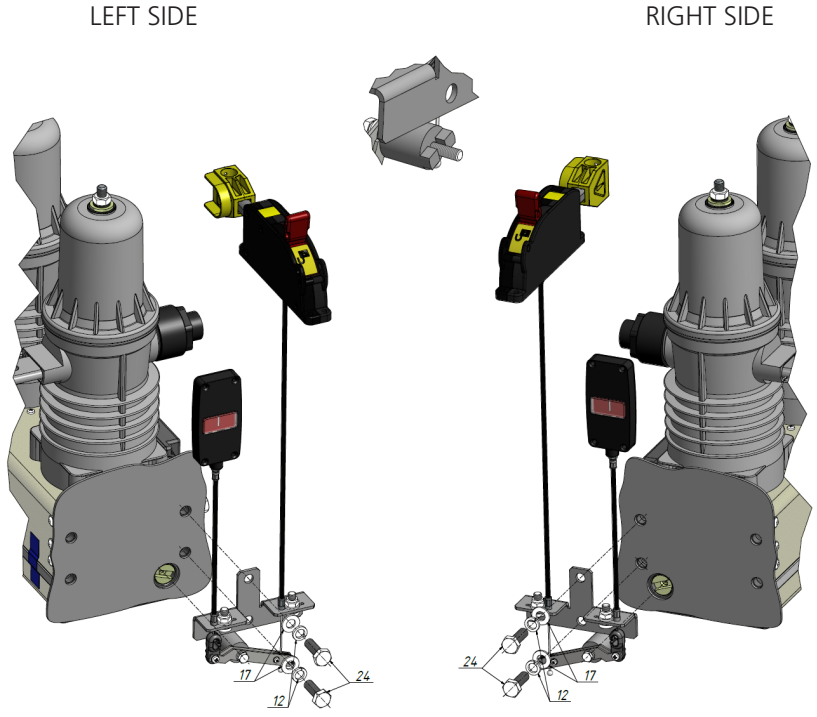


Figure 112

CBkit_Interlock_LD(0_0_1) on the ISM installation

CBkit_Interlock_LD(0_0_1) installed on the ISM is shown below.

LEFT SIDE

RIGHT SIDE

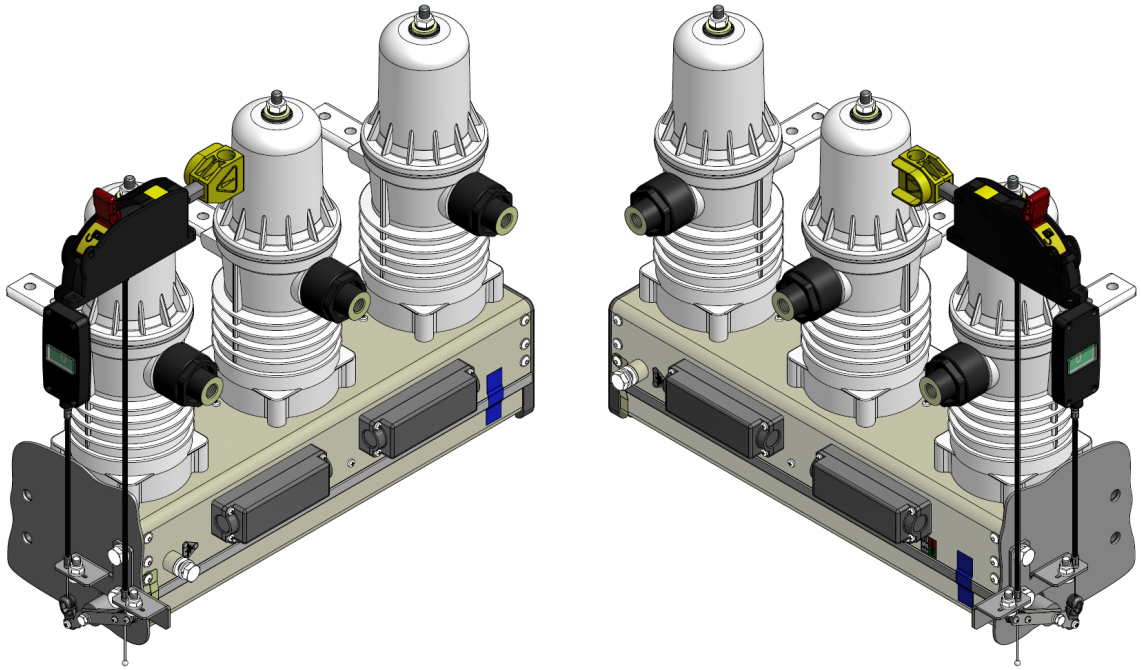
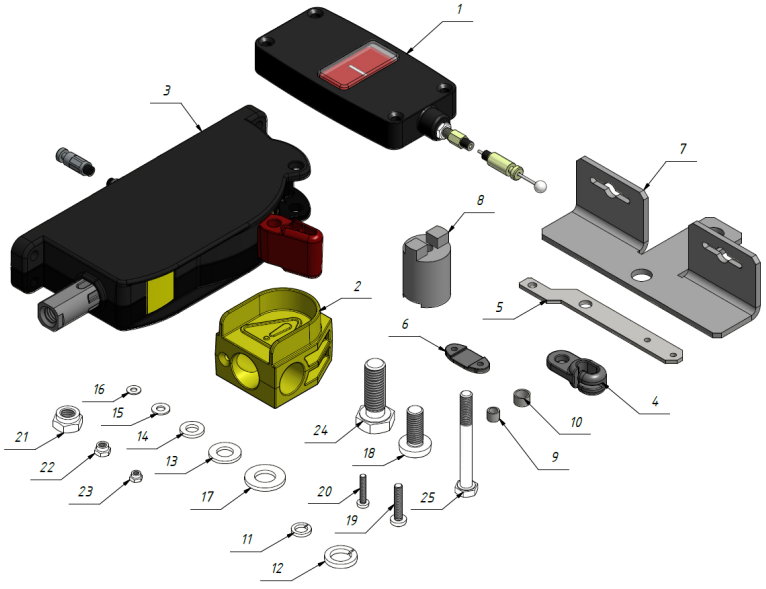


Figure 113

CBkit_Interlock_LD(0_0_1) installed

CBkit_Interlock_LD(0_0_1) installed on the ISM is shown below.

All the components that are used are presented below:



1. *FS-SM_Unit_PosInd_5*
2. *TER_CBdet_Stopper_2*
3. *TER_CBunit_Interlock_1(1.5)*
4. *TES_CBdet_Guide_2*
5. *TES_CBdet_Plate_11*
6. *TES_CBdet_Stopper_3*
7. *TES_CBdet_Holder_52*
8. *TES_CBdet_Shaft_3*
9. *TES_CBdet_Spacer_5(6_5)*
10. *TES_CBdet_Spacer_5(8_5)*
11. *FS-DG_StandDet_Washer_DIN7980(6_Fe-Zn)*
12. *FS-DG_StandDet_Washer_DIN7980(10_Fe-Zn)*
13. *FS-DG_StandDet_Washer_DIN125-1A(8.4_Fe-Zn)*
14. *FS-DG_StandDet_Washer_DIN125-1A(6.4_Fe-Zn)*
15. *FS-DG_StandDet_Washer_DIN125-1A(4.3_Fe-Zn)*
16. *FS-DG_StandDet_Washer_DIN125-1A(3.2_Fe-Zn)*
17. *FS-DG_StandDet_Washer_DIN125-1A(10.5_Fe-Zn)*
18. *FS-DG_StandDet_Screw_DIN7985-Ph(M8_20_Fe48-Zn)*
19. *FS-DG_StandDet_Screw_DIN7985-Ph(M4_20_Fe48-Zn)*
20. *FS-DG_StandDet_Screw_DIN7985-Ph(M3_16_Fe48-Zn)*
21. *FS-DG_StandDet_Nut_DIN985(M8_Fe8-Zn)*
22. *FS-DG_StandDet_Nut_DIN985(M4_Fe8-Zn)*
23. *FS-DG_StandDet_Nut_DIN985(M3_Fe8-Zn)*
24. *FS-DG_StandDet_Bolt_DIN933(M10_30_Fe88-Zn)*
25. *FS-DG_StandDet_Bolt_DIN931(M6_55_Fe88-Zn)*

Figure 114

CBkit_Interlock_LD(0_0_1) components

4.1.6 LD_8, MD_1, MD_3, SHELL_2, HD_1 Interlocks

Interlocking Mechanism

Each of LD_8, MD_1, MD_3, SHELL_2, HD_1 is equipped with an interlocking shaft that can be rotated clockwise to the "unlatched" position or counter-clockwise to the "open and locked" position. In the "unlatched" position the ISM can perform "close" and "open" operations.

In the "open and locked" position the ISM the interlocking shaft prevents the actuator mechanically from closing. In addition the actuator coils are disconnected from the CM.

If the ISM is closed, rotation of the interlocking shaft from "unlatched" to "open and locked" position leads to manual tripping. The CM indicates alarm "Manual Trip".

The interlocking shaft of ISM15_Shell is fixed in the „open and locked" position. To return it in the „unlatched" position the opposite direction force shall be applied to the shaft as shown in the Figure 117. The interlocking shafts of LD_8, MD_1, MD_3,HD_1 are not fixed in the „open and locked" position since these ISMs have shaft return spring that returns them back to the „unlatched" position. To leave their shafts in the „open and locked" position the external force shall be applied to the shaft to hold it in this position as shown in the Figure 117.

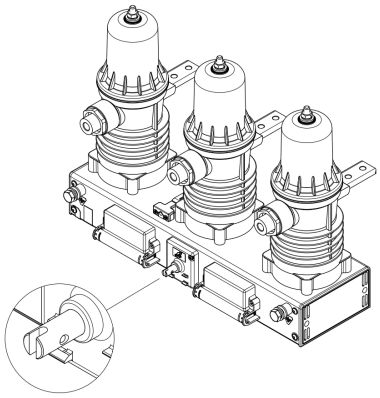
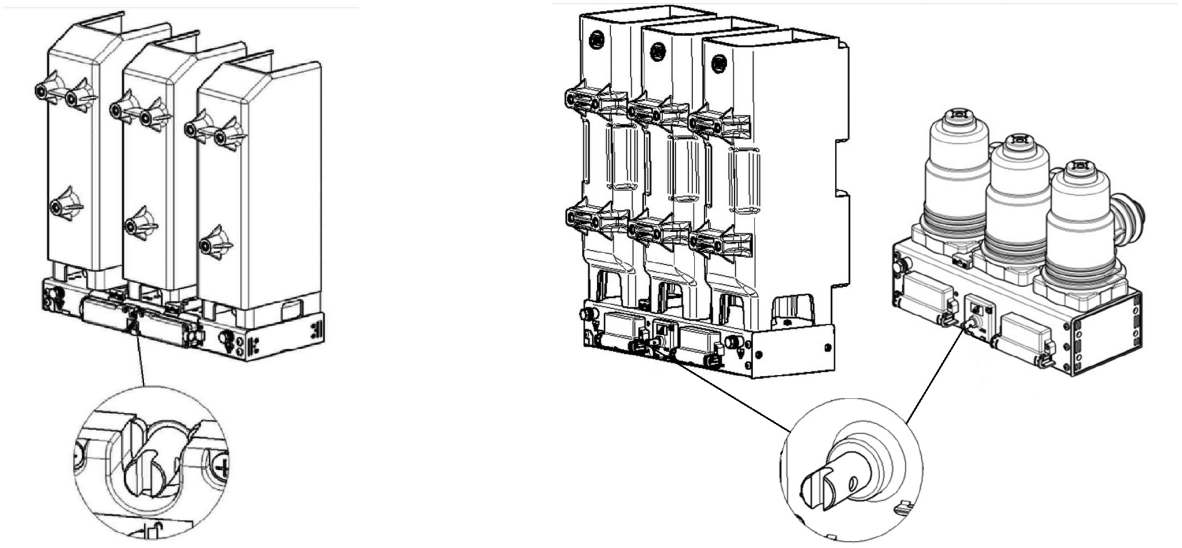


Figure 115

ISM15_LD_8 interlocking shaft



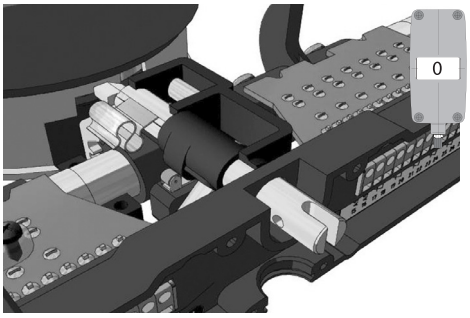
ISM15_Shell interlocking shaft

ISM15_HD, ISM15_MD and ISM25_Shell interlocking shafts

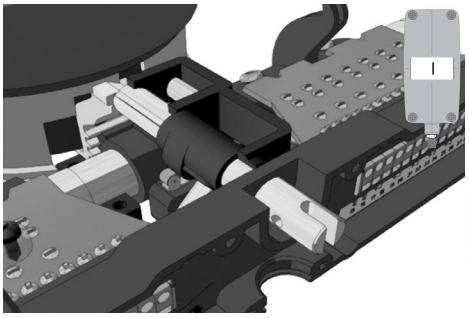
Figure 116

ISM15_Shell_2, ISM15_HD_1, ISM15_MD_1, ISM25_Shell interlocking shafts

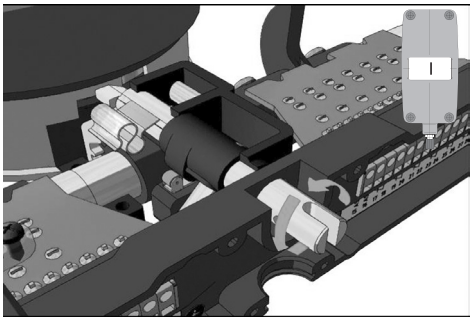
Figure 117
Interlocking shaft positions



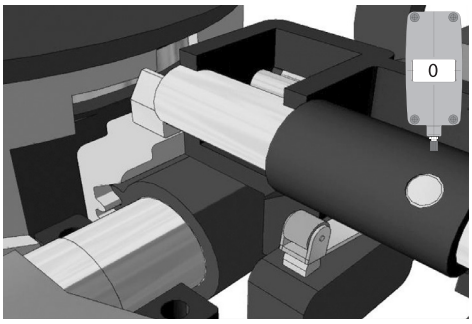
a) Interlocking shaft in unlatched position. ISM is open



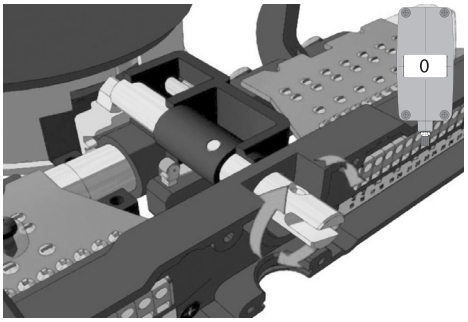
b) Interlocking shaft in unlatched position. ISM is closed



c) Initial state. ISM is closed. Turn interlocking shaft counterclockwise to "open and locked" position (manual tripping)



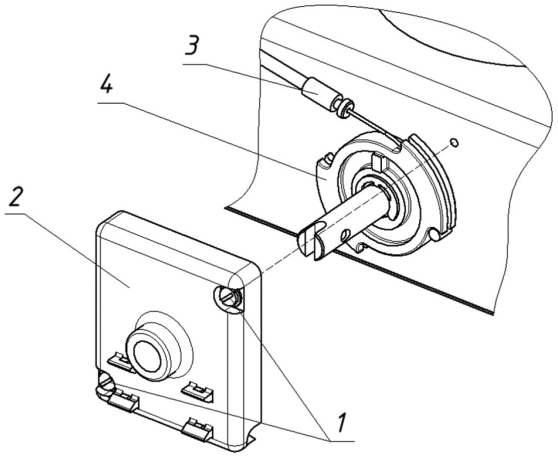
d) Interlocking shaft in "open and locked" position. ISM is open



e) Initial state: ISM is open and locked. Turn interlocking shaft clockwise to unlatched position

Figure 118
ISM15_Shell_2 interlock operating principle

Mechanical interlocking of ISM15_LD_8 ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 can be performed by remote interlocking unit. It connects with switching module via release cable. Follow the instructions below to install it:



1. Unscrew two captive screws 1 as shown in the
2. Figure 119;
3. Take off the plastic cover 2;
4. Install release cable 3 in cam 4 as show below;
5. Put the plastic cover back and tighten two screws 1.

Figure 119

Release cable connection to the interlocking shaft of ISM15_LD_8, MD_1, MD_3, HD_1 and ISM25_Shell_2

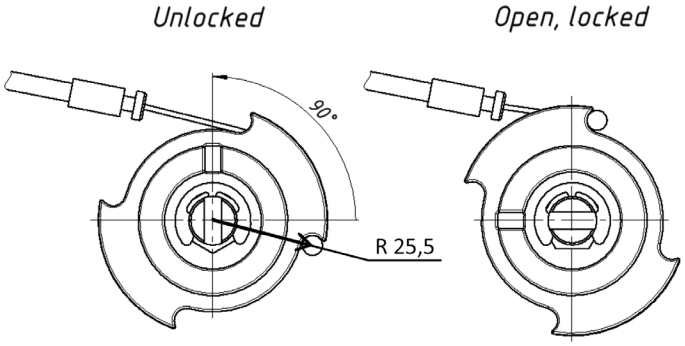


Figure 120

Interlocking shaft of ISM15_LD_8, MD_1, MD_3, HD_1 and ISM25_Shell_2 operation by release cable

The release cable operating stroke is 37±0,5 mm, which is equal 90 degrees rotation angle of cam as shown in the Figure 117. Minimal bend radius for cable is 100 mm.

There is a possibility to install two remote interlocks which can operate independently of each other.

For ISM15_LD_8, MD_1, MD_3, HD_1 interlocking shaft torque is as follows:

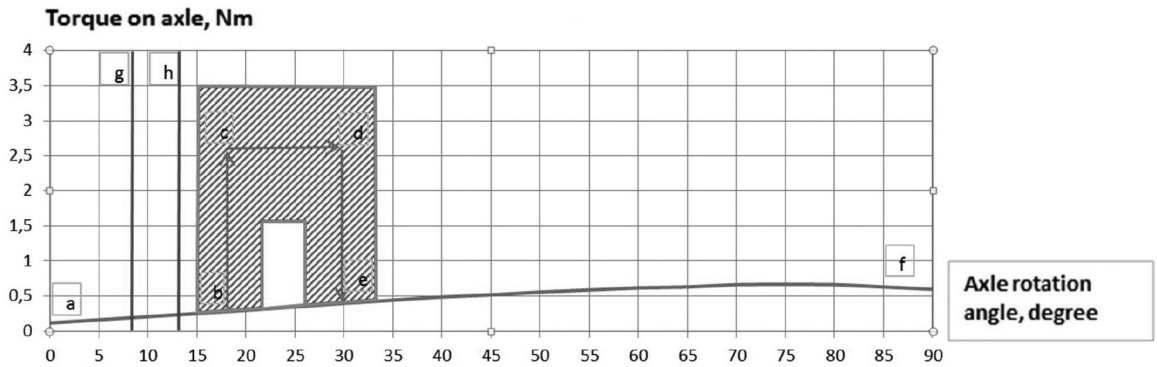


Figure 121

ISM15_MD or ISM15_HD interlocking shaft torque

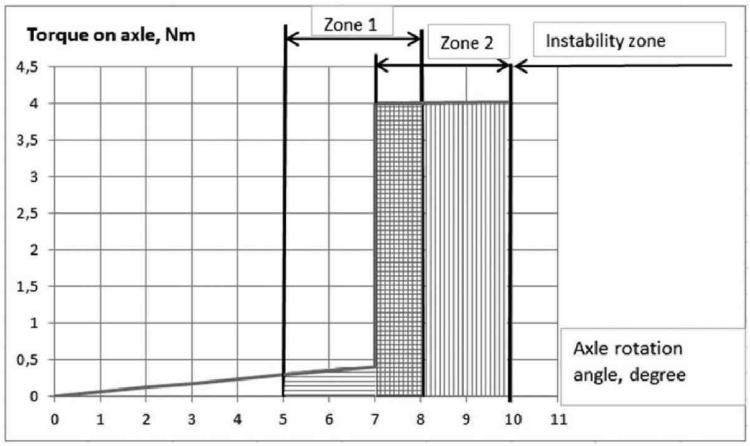
The interlocking process might be divided into next steps:

- "a-b" – backlash;
- "b-c" – blocker contacts the magnetic actuator plate;
- "c-d" – blocker interacts the magnetic actuator plate;
- "d-e" – switching module turns off;
- "e-f" – switching module turns to "open and locked" position (point "f");
- "f-a" – turning switching module to "unlatched" position (point "a").
- "g-h" -- electrical interlock action.
-

The allowed deviations are indicated by hatching.

For ISM15_Shell_2 interlocking shaft torque is as follows:

When ISM15_Shell_2 is closed and interlocking shaft is counterclockwise rotated:



where:

- zone 1 – zone where electrical interlock microswitch is opened;
- zone 2 – zone where manual trip is occurred.

Figure 122

ISM15_Shell_2 interlocking shaft torque when ISM is closed

When ISM15_Shell_2 is open and interlocking shaft is rotated from the „open and locked" to „unlatched" position and vice versa:

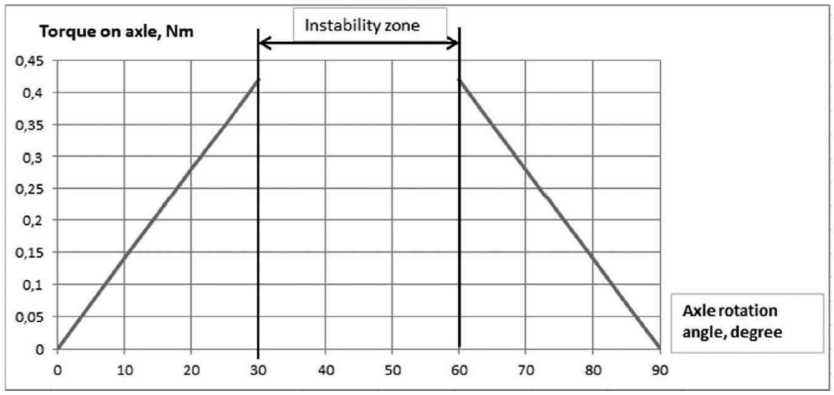


Figure 123

ISM15_Shell_2 interlocking shaft torque when ISM is open

For ISM25_Shell_2 interlocking shaft torque is as follows:

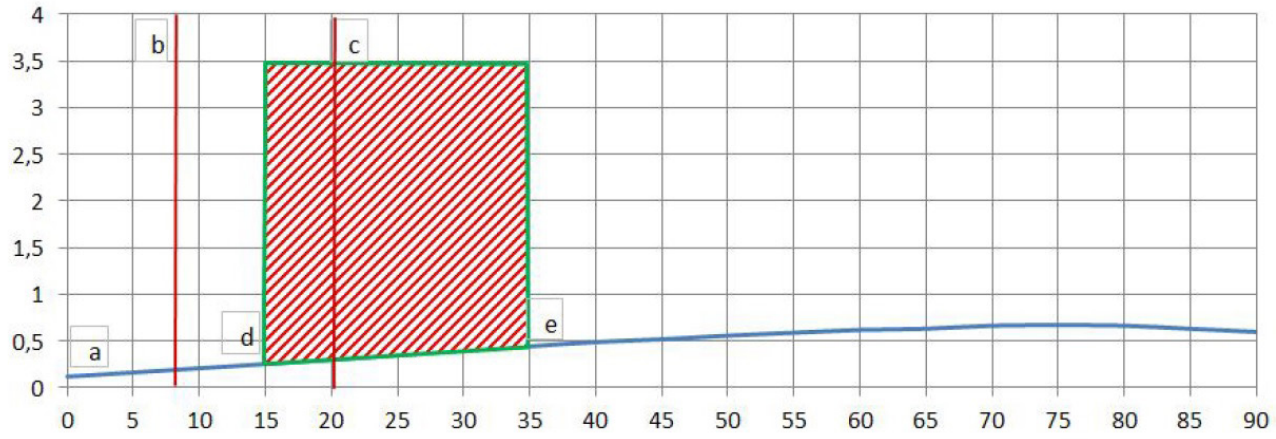


Figure 124

ISM25_Shell interlocking shaft torque

The interlocking process might be divided into next steps:

- "a-b" – backlash;
- "b-c" – electrical interlock zone;
- "d-e" – mechanical trip zone

The allowed deviations are indicated by hatching.

Torque on the Interlocking Shaft for ISM Manual Trip

The torque on the interlocking shaft for ISM manual trip shall be:

- for ISM15_LD_8, MD_1, MD_3 and ISM15_HD_1 - no more than 3.5 N*m;
- for ISM15_Shell_2 - no more than 4 N*m.

Load Capacity of ISM15_LD_8, MD_1, MD_3, Shell_2, HD_1, ISM25_Shell_2 Interlocking Shaft

- The angle of the interlocking shaft rotation shall not exceed 90 °.

Exceeding any of the above limitations can lead to damage of the interlocking mechanism.

Connection of CBkit_Interlock_8 to ISM15_Shell_2 Interlocking Shaft

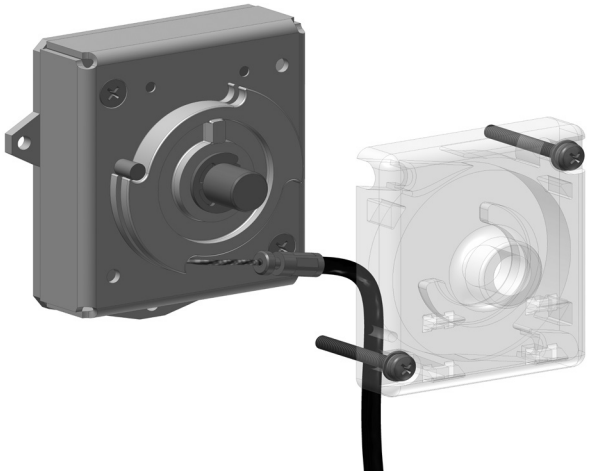
CBkit_Interlock_8 can be used with the ISM15_Shell_2 as an accessory for next manual trip / interlock connection to the ISM.

The installation of the CBkit_Interlock_8 is shown below (Figure 125). The ISM15_Shell_2 shall be in unlatched position.

Notes:

- It is recommended to install ISM in the Switchgear and connect its auxiliary circuits prior interlock connection to simplify the connection and adjustment process;
- If the flexible release cable passes through the switchgear segregations according to the design solution it is recommended to pass it through these segregations prior interlock connection;
- As CBkit_Interlock_8 is used for the next connection of manual trip unit or interlock the connection of cable CBcomp_RelCable_3 is shown as well.

a)



b)

c)

a) Unscrew the screws that fix plastic cover of the CBunit_Interlock_3;

b) Install the flexible release cable;

c) Install the cover back and fix it by screws. The cover should fix the flexible release cable cover.

Figure 125

Flexible release cable connection to CBunit_Interlock_3

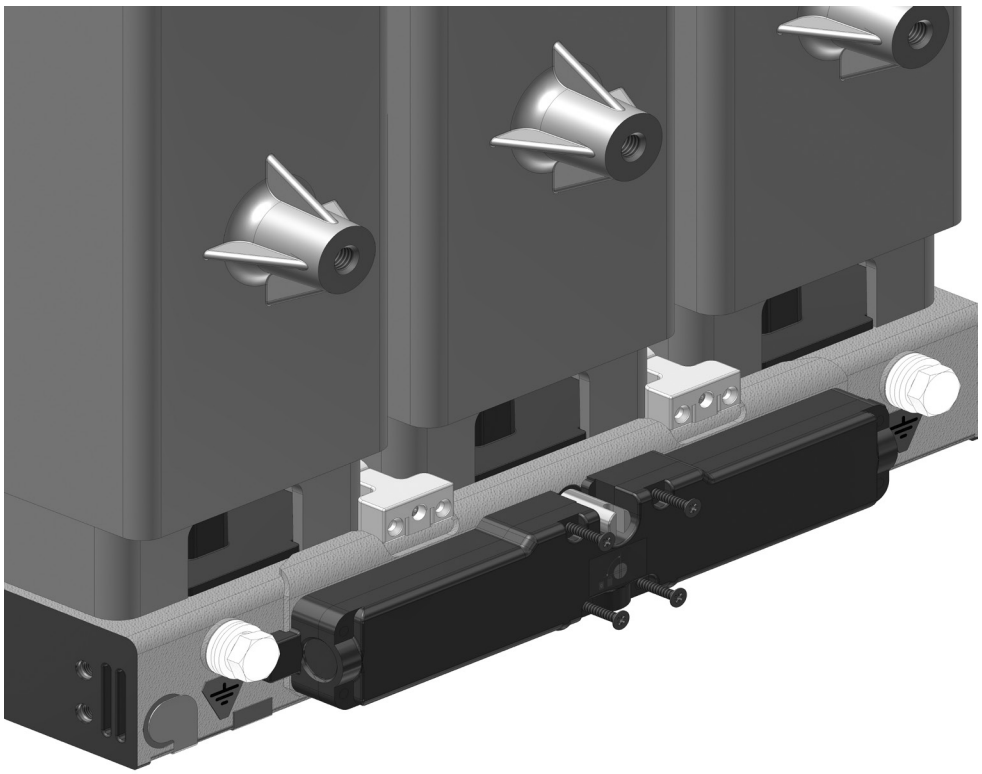


Figure 126

Remove the four screws that fix the central part of plastic cover of ISM

The removed screws shall not be used later for CBkit_Interlock_2 connection to the ISM.

Install CBdet_Holder_14 on the ISM with help of StandDet_Screw_DIN7982(4.2_25_Fe-Zn) from the delivery kit of CBkit_Interlock_2; (see Figure 127).

Install CBunit_Interlock_3 on the CBdet_Holder_14 with help of StandDet_Screw_DIN7985-Ph(M4_8_Fe48-Zn) and StandDet_Washer_DIN127-A(4_Fe-Zn) from the delivery kit of CBkit_Interlock_2 (see Figure 127).

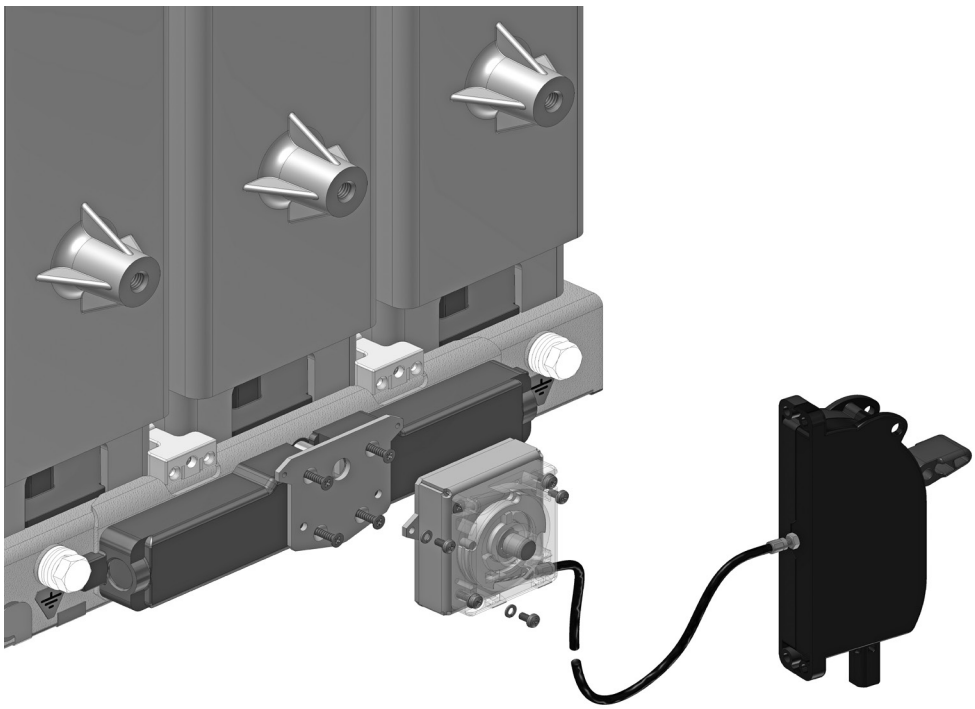


Figure 127

Installation of CBunit_Interlock_3 with connected flexible release cable on the ISM.
Connection of CBkit_Interlock_3 to CBkit_Interlock_8 is shown for instance.

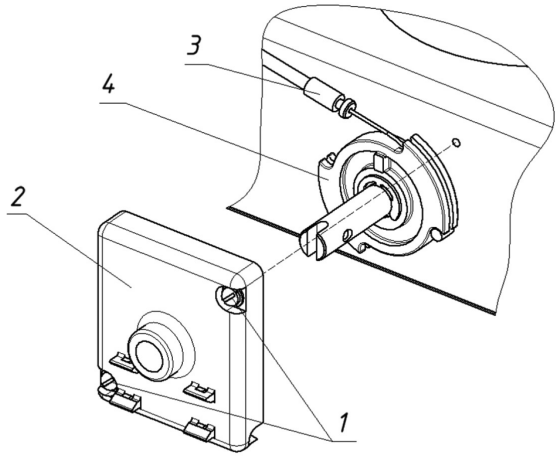
Connection of CBkit_Interlock_3 to ISM15_LD_8, MD_1, MD_3, Shell_2, HD_1, ISM25_Shell_2 Interlocking Shaft

CBkit_Interlock_3 can be used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 as an accessory for manual trip / lockout of the ISM by key switch. CBkit_Interlock_3 can be used also with the ISM15_Shell_2 via CBkit_Interlock_8

The connection of the CBkit_Interlock_3 to the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3 and , ISM15_HD_1 and ISM25_Shell_2 interlocking shaft is shown below. (Figure 128 – Figure 129). The ISM shall be in Unlatched position.

Notes:

- the bending radius of the flexible release cable shall be not less than 100 mm;
- it is recommended to install ISM in the Switchgear and connect its auxiliary circuits prior interlock connection to simplify the connection and adjustment process;
- if the flexible release cable passes through the Switchgear segregations according to the design solution it is recommended to pass it through these segregations prior interlock connection.



1. Unscrew two captive screws 1;
2. Take off the plastic cover 2;
3. Install release cable 3 in cam 4;
4. Put the plastic cover back and tighten two screws 1.

Figure 128

Connection of release cable to the ISM interlocking shaft

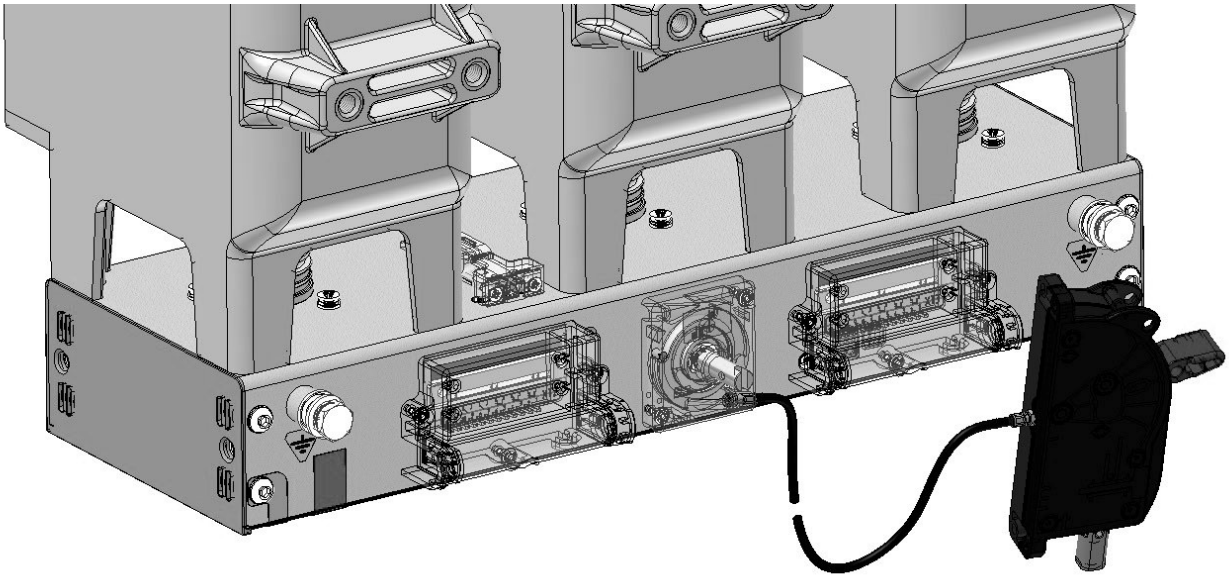
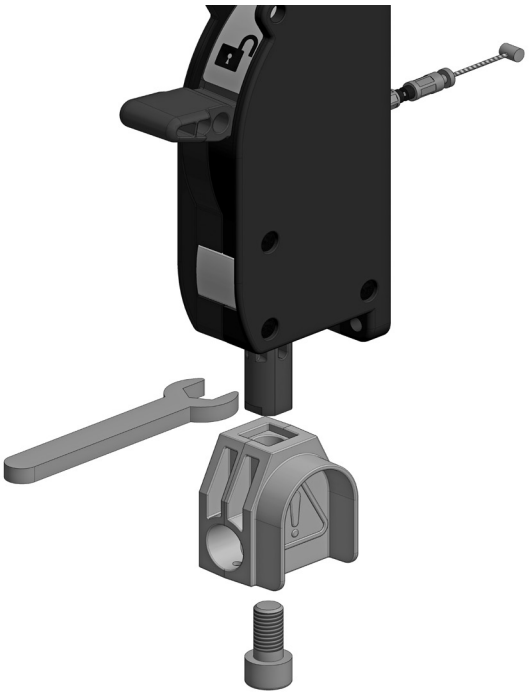


Figure 129

Connection of CBkit_Interlock_3 to the ISM interlocking shaft

Installation and adjustment of CBkit_Interlock_3 in the Switchgear is shown in the Figure 130– Figure 137.



Install CBdet_Stopper_2 on the CBunit_Interlock_1(1) with help of StandDet_Screw_DIN912(M10_20_Fe88-Zn) from the delivery kit of CBkit_Interlock_3. The orientation of CBdet_Stopper_2 depends on the way of next installation of CBunit_Interlock_1(1).

During fixation of StandDet_Screw_DIN912(M10_20_Fe88-Zn) the rod of CBunit_Interlock_1(1) shall not be loaded by torque, the wrench shall be used for rod unloading.

Figure 130

Installation of CBdet_Stopper_2 on the CBunit_Interlock_1(1)

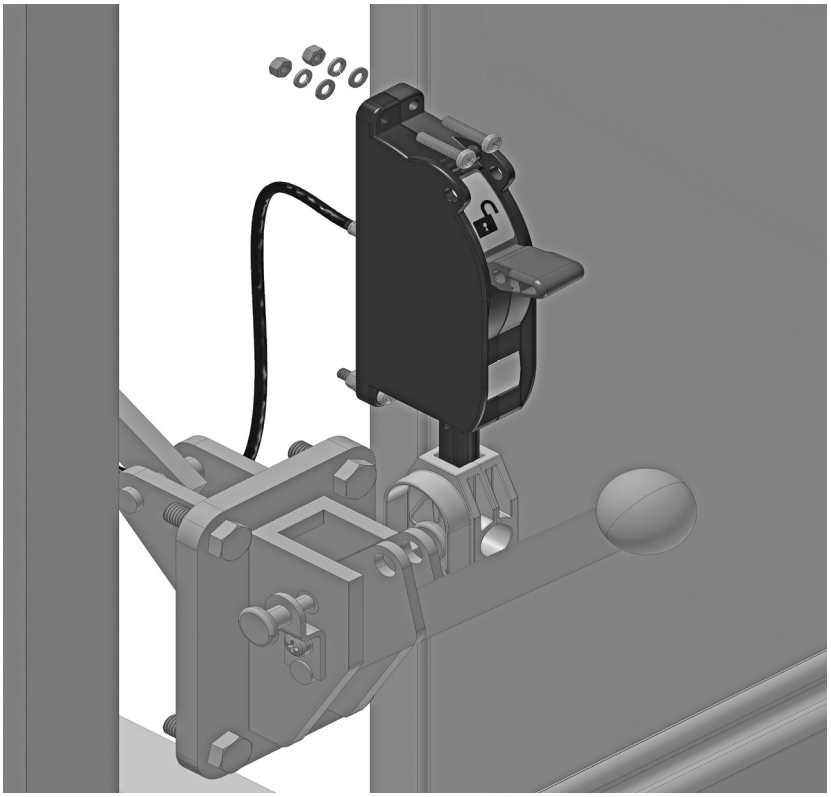


Figure 131

Installation of CBunit_Interlock_1(1) for variant with one or with two straddling disconnectors

The state of the disconnector - unlocked, the state of the ISM - locked.

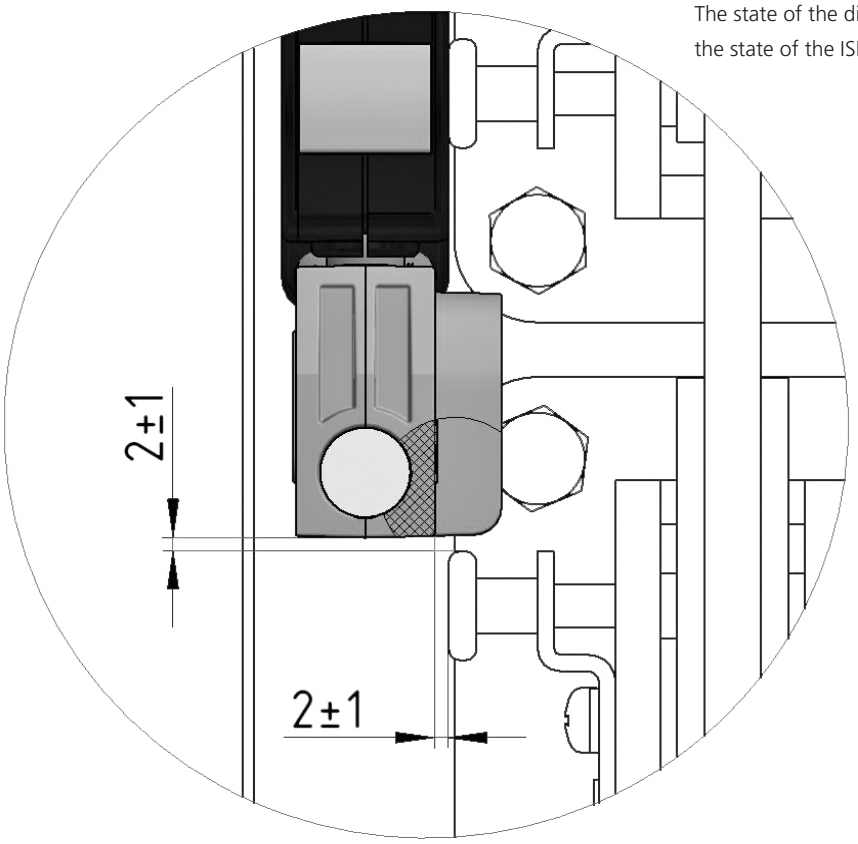


Figure 132

Adjustment of CBunit_Interlock_1(1) installation for variant with one or with two straddling disconnectors

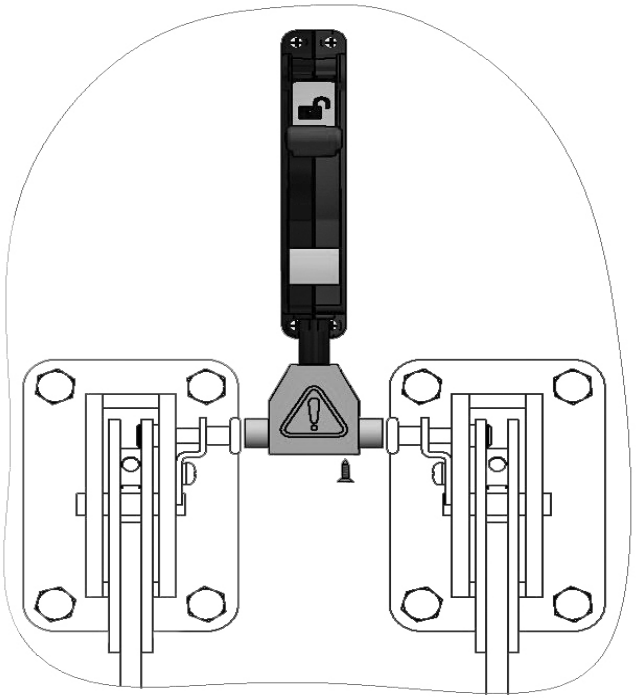


Figure 133

Installation of CBunit_Interlock_1(1) for variant with two disconnectors

The state of the disconnector - unlocked,
the state of the ISM - locked.

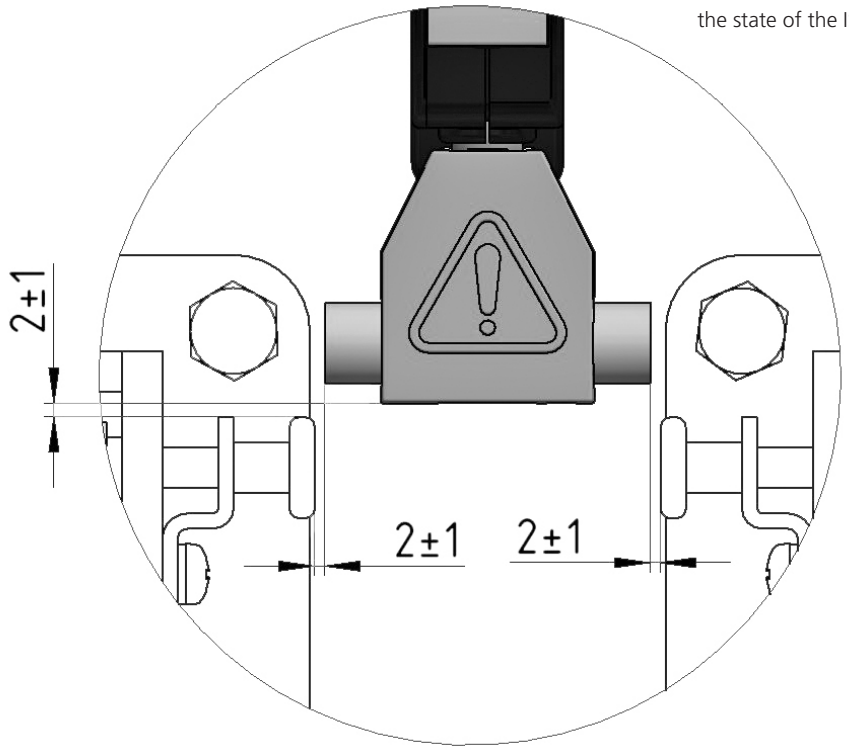


Figure 134

Adjustment of CBunit_Interlock_1(1) installation for variant with two disconnectors

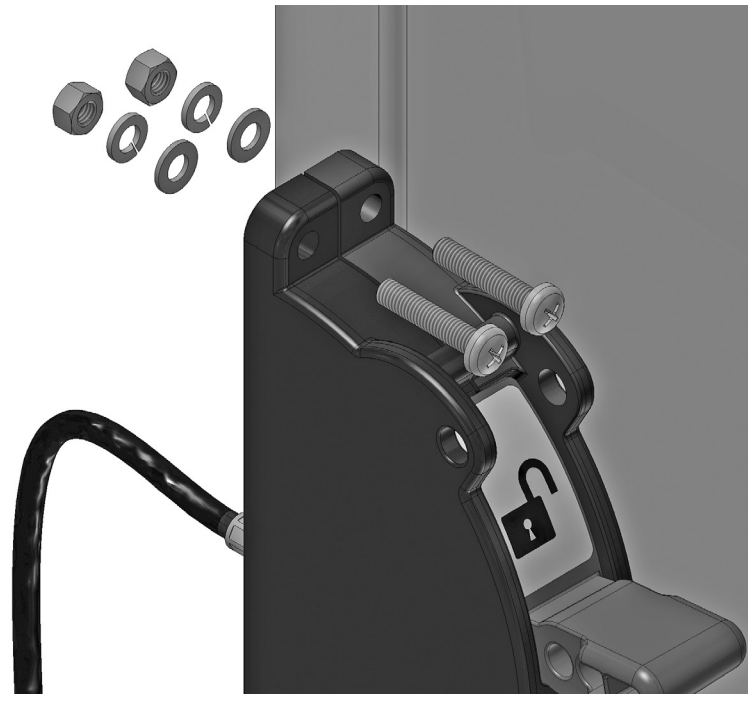


Figure 135

Fixation of CBunit_Interlock_1(1)

CBunit_Interlock_1(1) shall be fixed with help of:

- StandDet_Screw_DIN7985-Ph(M5_25_Fe48-Zn);
- StandDet_Washer_DIN125-1A(5.3_Fe-Zn);
- StandDet_Washer_DIN127-A(5_Fe-Zn);
- StandDet_Nut_DIN555(M5_Fe-Zn)

from the delivery kit of CBkit_Interlock_3. Alternatively StandDet_Screw_DIN7504-K(4.8_19_Fe-Zn) from the delivery kit of CBkit_Interlock_3 can be used.

The flexible release cable shall be fixed in the Switchgear with help of StandDet_CableTie_LS(4.6_150_40) from the delivery kit of CBkit_Interlock_3. If necessary the stroke of flexible release cable can be adjusted as shown in the Figure 136.

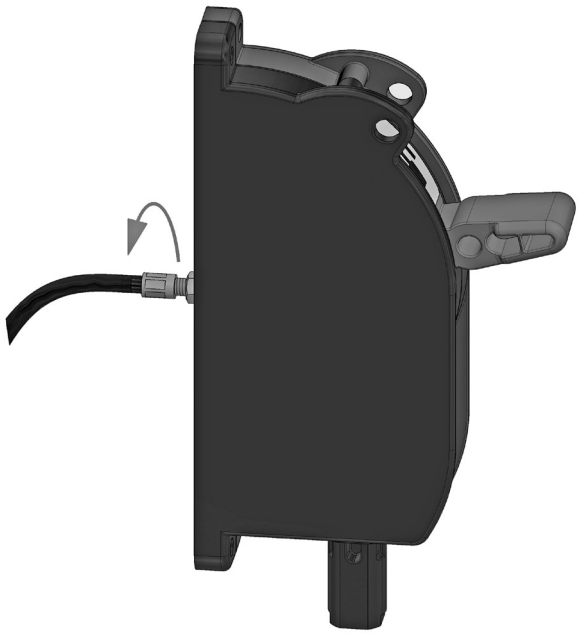
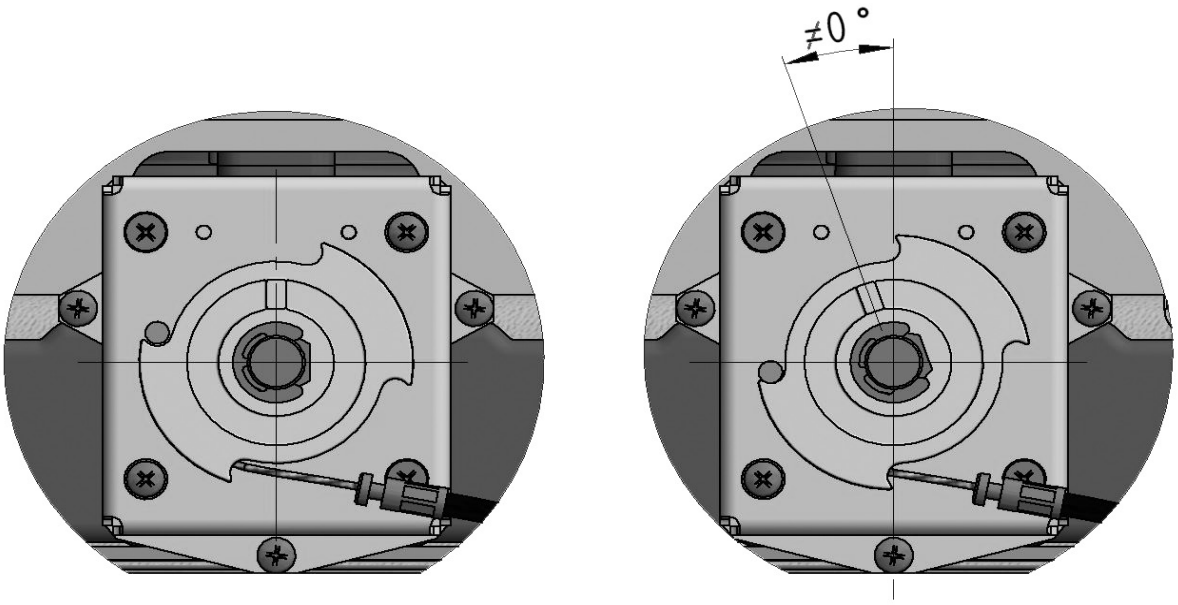


Figure 136

Adjustment of stroke of flexible release cable



Correct

Wrong

Figure 137

Position of interlocking shaft of the ISM with connected CBkit_Interlock_3

Connection of CBkit_Interlock_4 to ISM15_LD_8, MD_1, MD_3, Shell_2, HD_1, ISM25_Shell_2 interlocking shaft

CBkit_Interlock_4 can be used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 as an accessory for manual trip / lockout of the ISM by rotary switch. CBkit_Interlock_4 can be used with the ISM15_Shell_2 via CBkit_Interlock_8.

The connection of the CBkit_Interlock_4 to the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 interlocking shaft is shown in the Figure 138 and Figure 139. The ISM shall be in Unlatched position.

Notes:

- the bending radius of the flexible release cable shall be not less than 100 mm;
- it is recommended to install ISM in the Switchgear and connect its auxiliary circuits prior interlock connection to simplify the connection and adjustment process;
- if the flexible release cable passes through the Switchgear segregations according to the design solution it is recommended to pass it through these segregations prior interlock connection.

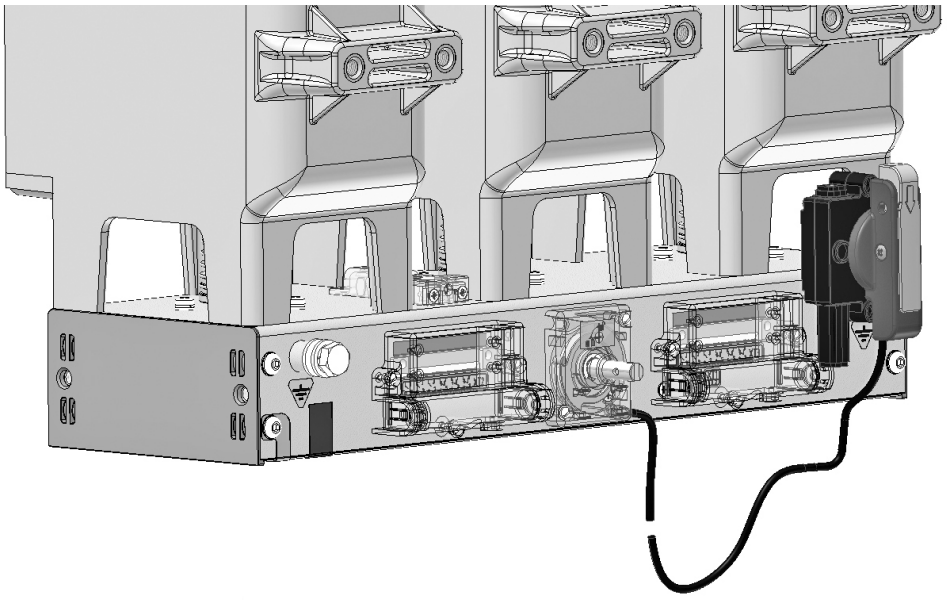


Figure 138

Connection of CBkit_Interlock_4 to the ISM interlocking shaft

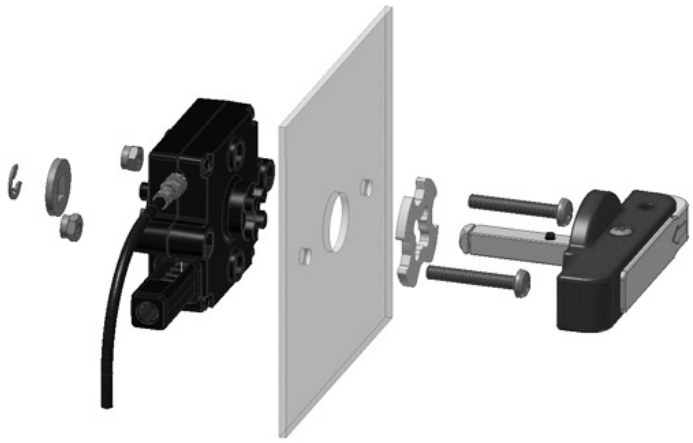


Figure 139

CBkit_Interlock_4 mounting on the Switchgear door

Adjustment of CBkit_Interlock_3 in the Switchgear is shown in the Figure 136.

Connection of CBkit_Interlock_5 to ISM15_LD_8, MD_1, MD_3, Shell_2, HD_1, ISM25_Shell_2 interlocking shaft

CBkit_Interlock_5 can be used with the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 as an accessory for manual trip of the ISM as a manual trip button. CBkit_Interlock_5 can be used with the ISM15_Shell_2 via CBkit_Interlock_8.

The connection of the CBkit_Interlock_5 to the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 interlocking shaft is shown in the Figure 136 and Figure 140. The ISM shall be in Unlatched position.

Notes:

- the bending radius of the flexible release cable shall be not less than 100 mm;
- it is recommended to install ISM in the Switchgear and connect its auxiliary circuits prior interlock connection to simplify the connection and adjustment process;
- if the flexible release cable passes through the Switchgear segregations according to the design solution it is recommended to pass it through these segregations prior interlock connection.

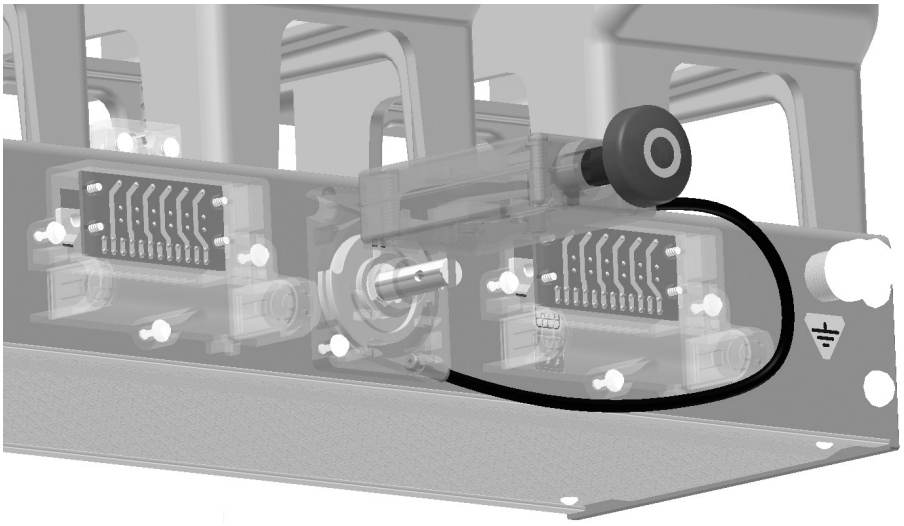


Figure 140

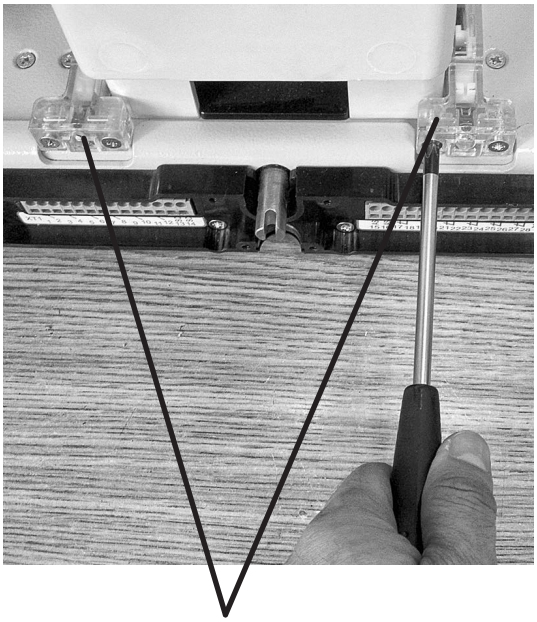
Unscrew the self-tapping screws of the transparent cover and remove it

4.1.7 Installation of ISM15_LD_8, MD_1, MD_3, Shell_2, HD_1, ISM25_Shell_2 Main Contacts Position Indicator

The installation of the main contacts position indicator is shown below. (Figure 141 - Figure 146). The ISM shall be in the Closed position.

Notes:

- the bending radius of the flexible indication cable shall be not less than 40 mm.



There are two possibilities (left, right) to connect the flexible indication cable

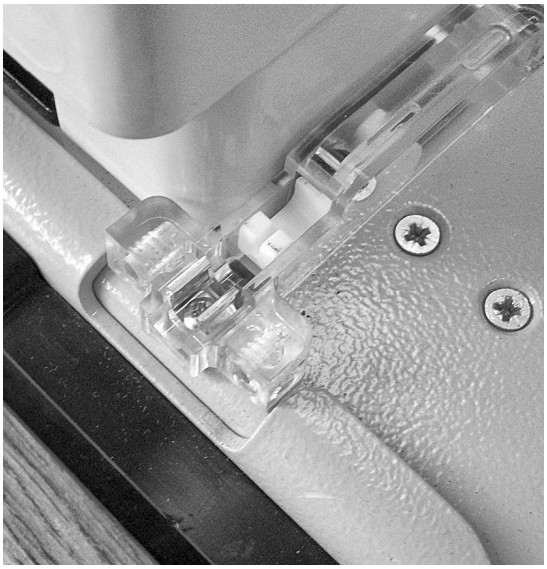


Figure 141

Connection of CBkit_PosInd_1(1000) to the ISM

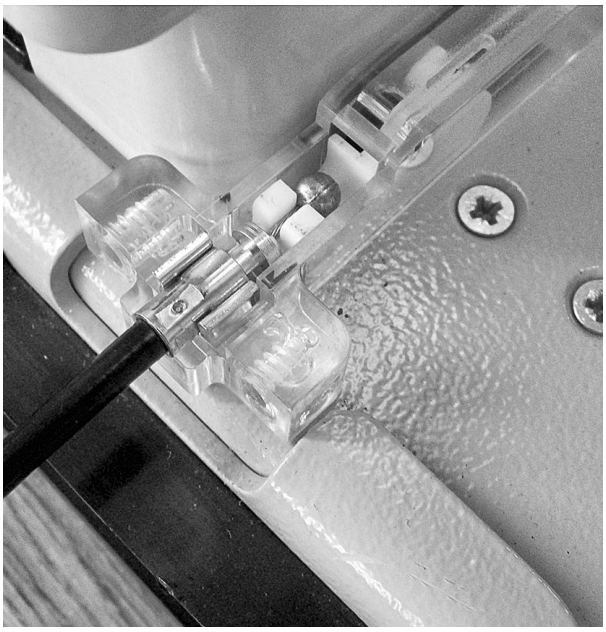


Figure 142

Drop the boss of the wire horizontally into the slot. Insert the end of the sheath into the V-shape spring contact

Figure 143

Return the cover and fasten it to the ISM

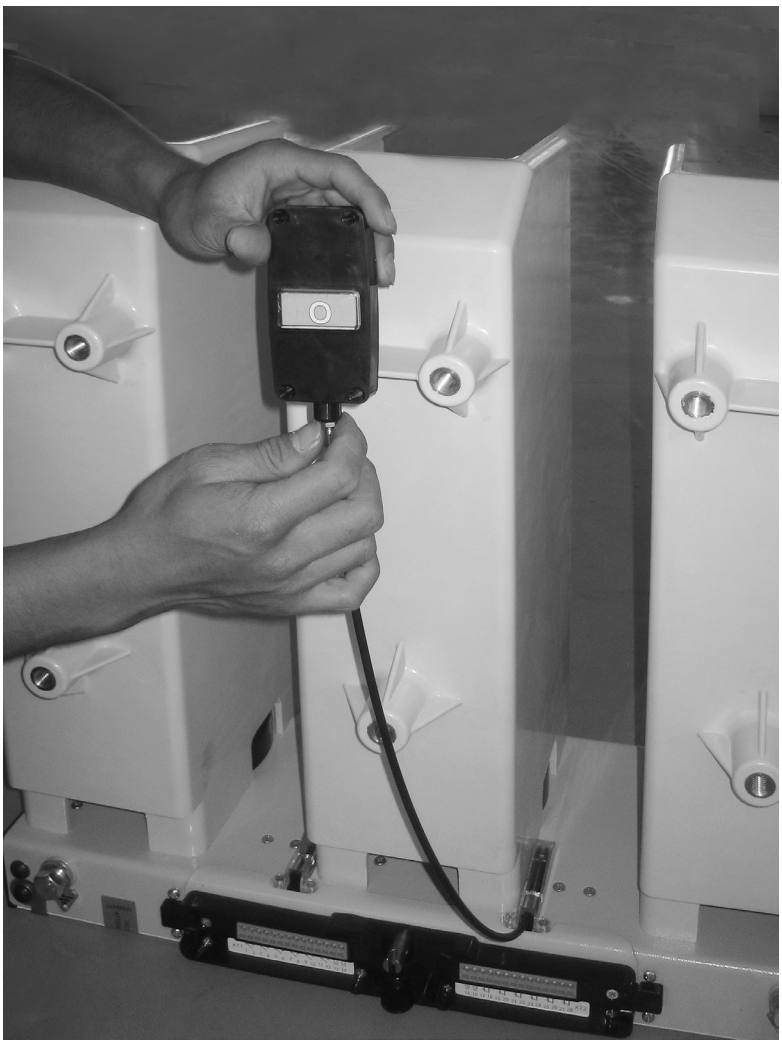


Figure 144

Adjust the indicator for both closed and opened states of the switching module

Figure 145

Position indicator shows that main contacts are open

Figure 146

Position indicator shows that main contacts are closed

4.1.8 Installation of Insulation kit CBkit_Ins_4

CBkit_Ins_4 can be used with the ISM15_MD as an accessory to comply with the rated impulse withstand voltage of 95 kV according to IEC 62271-1. The installation of the CBkit_Ins_4 is shown in the Figure 147 and Figure 148.

a) put insulator CBdet_ RubberIns_2 on the busbar

b) connect busbar to the ISM terminal

c) screw the bolt M12 with torque 50±2 H*m

d) cover the ISM terminal tightly by put insulator CBdet_RubberIns_2

e) insulation of double bars 40x10 mm connection is the same, insulator CBdet_RubberIns_2 shall be cut to fit with double bars

Figure 147

Installation of CBkit_Ins_4(1) in case of busbars 40x10 mm usage

a) cover the bar by shrinkable tube in case it is required

b) put insulator CBdet_RubberIns_3 on the busbar

c) screw the bolt M12 with torque 50±2 H*m and cover the ISM terminal tightly by put insulator CBdet_RubberIns_3

Figure 148

Installation of CBkit_Ins_4(2) in case of busbars 80x10 mm usage

4.1.9 Protective Earthing

For personnel protection the metal housing of the ISM must be connected according to the applicable regulations, such as IEC 62271-1, IEC 62271-100, IEC 62271-200 via the marked earth screw of the ISM to the earthing arrangement of the particular panel. The earthing connection can be carried out with a cable or a fat copper bar. The area around the earth screw shall be cleaned before providing the earth connection. After the occurrence of a short circuit, the proper condition of the protective earthing must be checked.

Table 9 - Reference Values for Cross Sections of Earth Connections (copper)

Fault current (1 s)	Maximum temperature	Cross section of earth connection
16 kA	300 °C	55 - 95 mm²
20 kA	300 °C	70 - 120 mm²
25 kA	300 °C	95 - 140 mm²
31.5 kA	300 °C	120 - 190 mm²

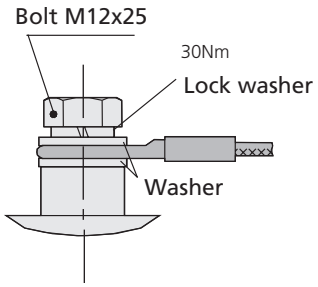


Figure 149
ISM protective earthing connection

The method of ISM15_LD_1, LD_6, and ISM25_LD_1, LD_2, earthing is shown in the Figure 151, method of ISM15_LD_8 earthing is shown in the Figure 150.

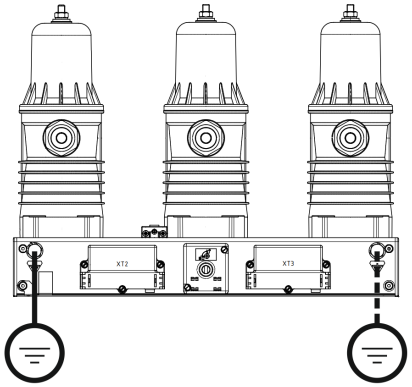


Figure 150
ISM15_LD_8 earthing

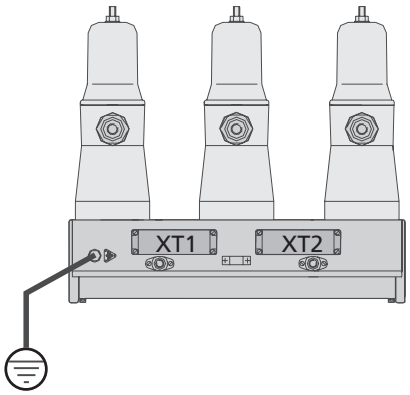


Figure 151
ISM15_LD1, LD_6, ISM25_LD_1, LD_2 earthing

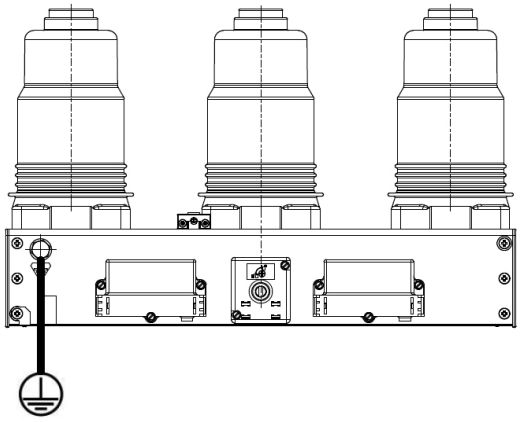


Figure 152
ISM15_MD_1 earthing

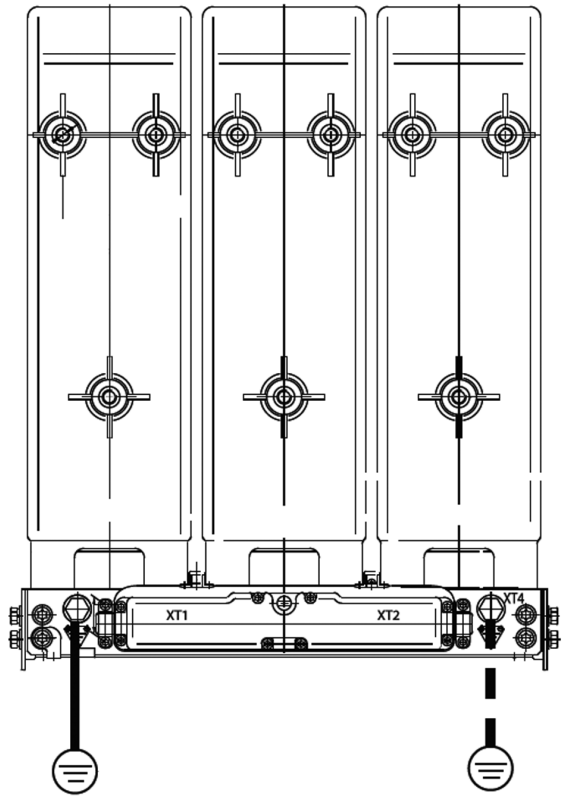


Figure 153
ISM15_Shell_2 and ISM25_Shell_2 earthing

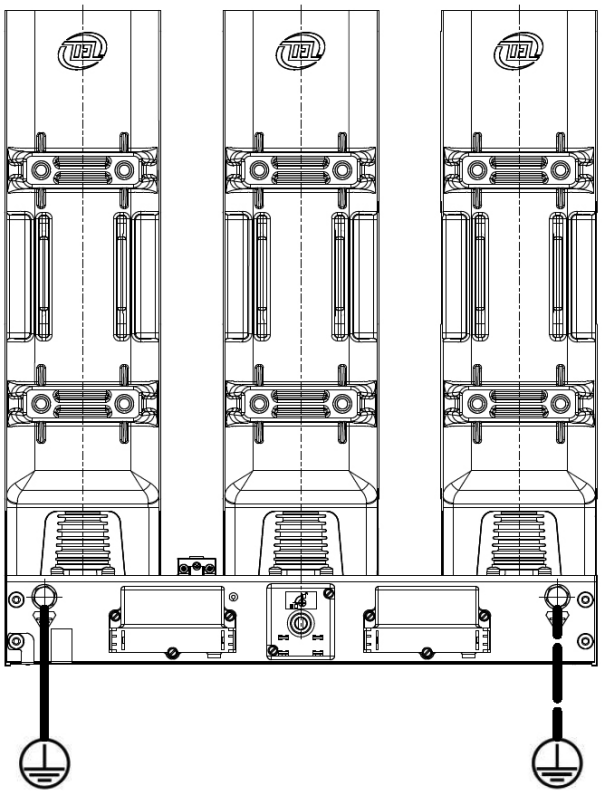


Figure 154
ISM15_HD_1 earthing

An example of one side copper bar earthing is represented in Figure 155.

Figure 155
Example of earthing the ISM15_Shell_2 by copper busbar

4.2 Secondary Part

4.2.1 Three-Phase ISM Secondary Connections

All three-phase ISM15_LD_1, ISM15_LD_6, ISM15_Shell_2, ISM25_LD_1 and ISM25_LD_2 have secondary connectors as shown below.

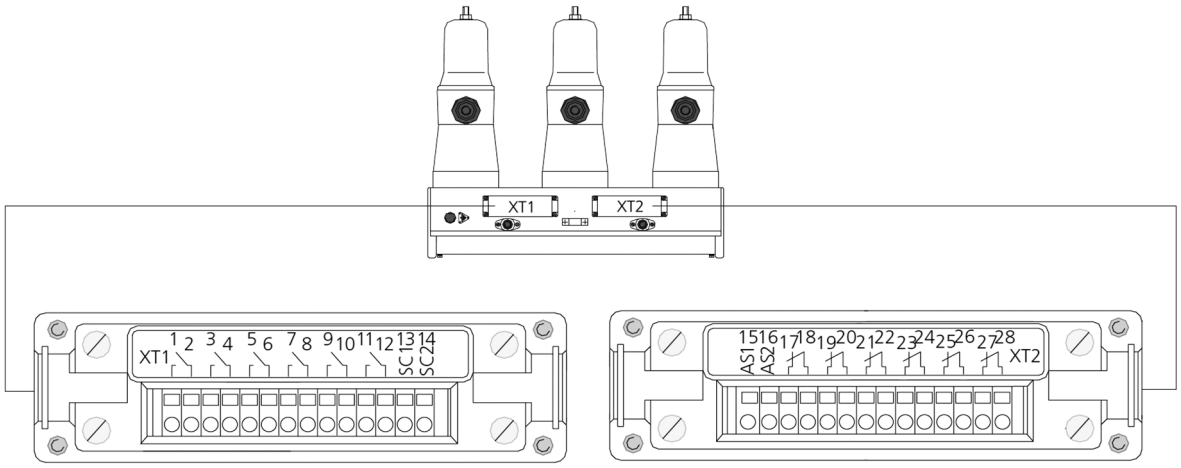


Figure 156

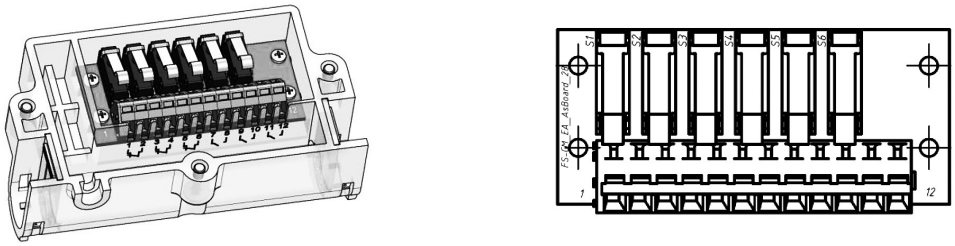
Terminal arrangement of the three-phase ISM15_LD_1, ISM15_LD_6, ISM15_Shell_2, ISM25_LD_1 and ISM25_LD_2

Table 10 - Three-Phase ISM15_LD, ISM15_Shell and ISM25_LD Terminal Arrangement

XT1		XT2	
Terminal No.	Connection	Terminal No.	Connection
1	Auxiliary switch S 1 (1)	15	Auxiliary switch S 13 (AS1)
2	Auxiliary switch S 1 (4)	16	Auxiliary switch S 13 (AS2)
3	Auxiliary switch S 2 (1)	17	Auxiliary switch S 7 (1)
4	Auxiliary switch S 2 (4)	18	Auxiliary switch S 7(2)
5	Auxiliary switch S 3 (1)	19	Auxiliary switch S 8 (1)
6	Auxiliary switch S 3 (4)	20	Auxiliary switch S 8 (2)
7	Auxiliary switch S 4 (1)	21	Auxiliary switch S 9 (1)
8	Auxiliary switch S 4 (4)	22	Auxiliary switch S 9 (2)
9	Auxiliary switch S 5 (1)	23	Auxiliary switch S 10 (1)
10	Auxiliary switch S 5 (4)	24	Auxiliary switch S 10 (2)
11	Auxiliary switch S 6 (1)	25	Auxiliary switch S 11 (1)
12	Auxiliary switch S 6 (4)	26	Auxiliary switch S 11 (2)
13	Actuator coil (SC1)	27	Auxiliary switch S 12 (1)
14	Actuator coil (SC2)	28	Auxiliary switch S 12 (2)

ISM15_LD_8, ISM15_MD_1, ISM15_HD_1 and ISM25_Shell_2 have secondary connectors as shown below.

a) ISM actuator coil terminal



b) Auxiliary switches board EA_Asboard_28 (XT2, XT3)

Figure 157

Terminal arrangement of the ISM15_LD_8, ISM15_MD_1, ISM15_HD_1 and ISM25_Shell_2

Each of the ISM15_MD_1, ISM15_HD_1 and ISM25_Shell_2 has two auxiliary switches boards EA_Asboard_28.

Note: Depending on the order ISM15_LD_8 can be supplied with or without auxiliary switches board (auxiliary switches boards can be ordered separately). Following auxiliary switches boards are available: auxiliary board with 3NO + 3NC, 4NO + 4NC, 6NO + 6NC contacts.

Table 11 - ISM15_LD_8, MD_1 and ISM15_HD_1 Terminal Arrangement

XT1		**XT2, XT3 (Auxiliary switches board EA_Asboard_28)**	
Terminal No.	Connection	Terminal No.	Connection
1	Actuator coil (SC1)	1	NC auxiliary switch S 1(1)
2	Actuator coil (SC2)	2	NC auxiliary switch S 1(1)
		3	NC auxiliary switch S 2(1)
		4	NC auxiliary switch S 2(1)
		5	NC auxiliary switch S 3(1)
		6	NC auxiliary switch S 3(1)
		7	NO auxiliary switch S 4(1)
		8	NO auxiliary switch S 4(1)
		9	NO auxiliary switch S 5(1)
		10	NO auxiliary switch S 5(1)
		11	NO auxiliary switch S 6(1)
		12	NO auxiliary switch S 6(1)

4.2.2 Single-Phase ISM Secondary Connections

Single-phase ISM15_LD_3 and ISM25_LD_3 have secondary connectors as shown below.

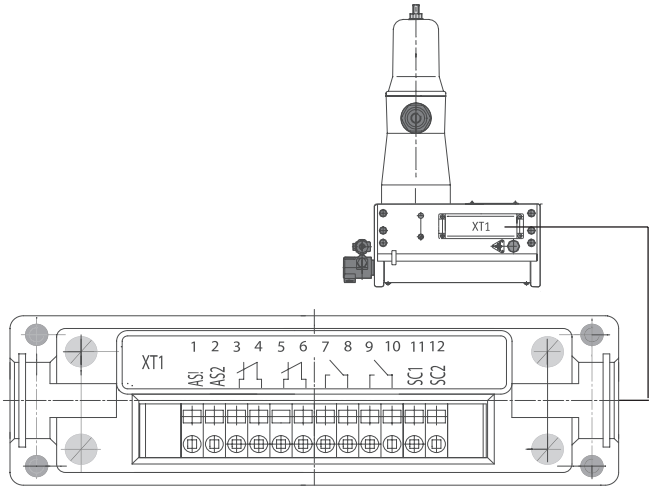


Figure 158

Terminal arrangement of the single-phase ISM15_LD_3 and ISM25_LD_3

Table 12 - Single-Phase ISM15_LD_3 and ISM25_LD_3 Terminal Arrangement

XT1	
Terminal No.	**Connection**
1	Auxiliary switch SF1 (AS1)
2	Auxiliary switch SF1 (AS2)
3	Auxiliary switch SF2
4	Auxiliary switch SF2
5	Auxiliary switch SF3
6	Auxiliary switch SF3
7	Auxiliary switch SF4
8	Auxiliary switch SF4
9	Auxiliary switch SF5
10	Auxiliary switch SF5
11	Actuator coil (SC1)
12	Actuator coil (SC2)

Single-phase ISM15_MD_3 has secondary connectors as shown below.

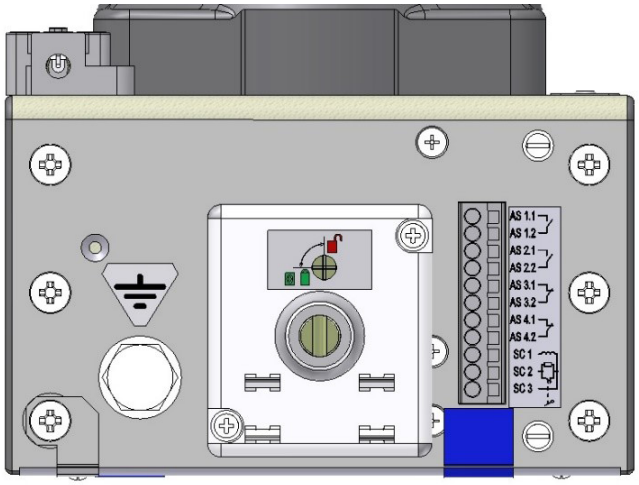


Figure 159

Terminal arrangement of the single-phase ISM15_MD 3

Table 13 - Single-Phase ISM15_MD_3 Terminal Arrangement

XT1	
Terminal No.	**Connection**
1	Auxiliary switch AS1 (AS1.1)
2	Auxiliary switch AS1 (AS1.2)
3	Auxiliary switch AS2 (AS2.1)
4	Auxiliary switch AS2 (AS2.2)
5	Auxiliary switch AS3 (AS3.1)
6	Auxiliary switch AS3 (AS3.2)
7	Auxiliary switch AS4 (AS4.1)
8	Auxiliary switch AS4 (AS4.2)
9	Actuator coil (SC1)
10	Actuator coil (SC2) with internal interlock
11	Actuator coil (SC3) without interlock

Note: Actuator coil input CS3 is intended for case when internal interlock is not required. For instance, when three single-phase ISM15_MD_3 are connected in parallel to one control module. In such case the interlock of one of these ISMs can be used. Please contact the nearest Tavrida Electric sales representative for case when three single-phase ISM15_MD_3 are connected in parallel to one control module for more information.

4.2.3 CM Secondary Connections

CM_16_1 has secondary connectors as shown below.

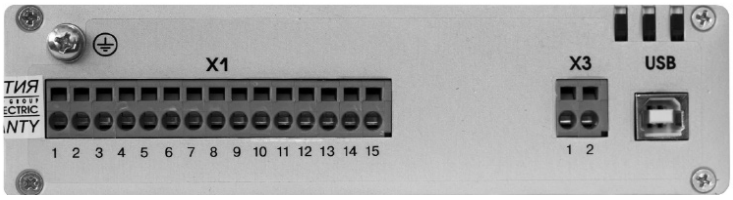


Figure 160

Terminal arrangement of the CM

Table 14 - CM Terminal Arrangement

XT1		XT2	
Terminal No.	Connection	Terminal No.	Connection
1	Power supply input (+)	1	Actuator coil output
2	Power supply input (-)	2	Actuator coil output
3	Relay output 1 NO		
4	Relay output 1 Com		
5	Relay output 1 NC		
6	Relay output 2 NO		
7	Relay output 2 Com		
8	Relay output 2 NC		
9	Relay output 3 NO		
10	Relay output 3 Com		
11	Relay output 3 NC		
12	Close dry input		
13	Close dry input		
14	Trip dry input		
15	Trip dry input		

CM relay functionality:

- Relay 1 - “ISM main contact position” relay;
- Relay 2 - “Ready” relay;
- Relay 3 - “Malfunction or Loss of auxiliary supply” relay.

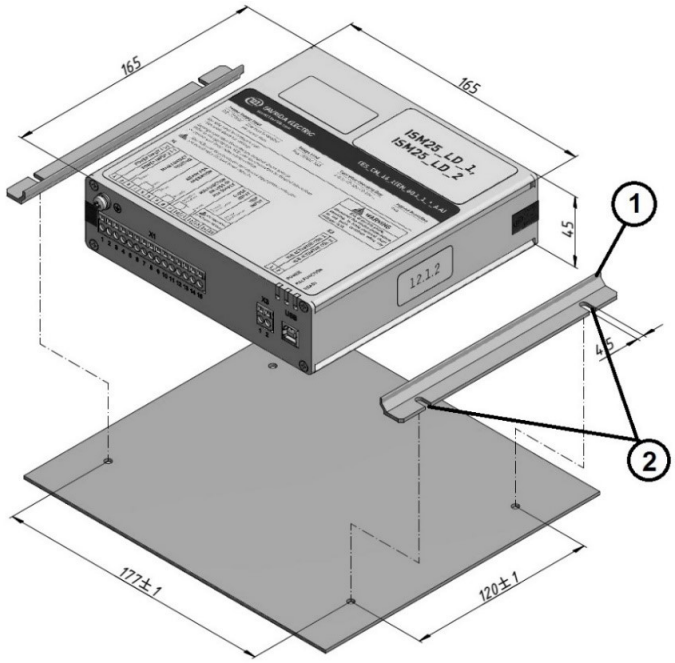
Relay “ISM main contact position“ keeps its state (1 NO and 1 NC contacts with common point) after CM power supply disconnection.

USB port of CM is not used under service conditions (only for CM programming during production).

Relays functionality and number of relays with same functionality can be changed on request. Please contact the nearest Tavrida Electric sales representative for more information.

4.2.4 Installation of the CM

The installation of the CM is carried out according to the panel design either on the draw out unit or in the low voltage compartment of the switchboard. It must be separated from the high voltage compartment.



1. CM holders
2. Slots for CM mounting (by M4 screws)

Figure 161

Provisions for CM_16 installation

With help of the CBmount_CM_1 the CM can be mounted on a DIN rail in the low voltage compartment of a Switchgear. There are two variants of the CM installation available.

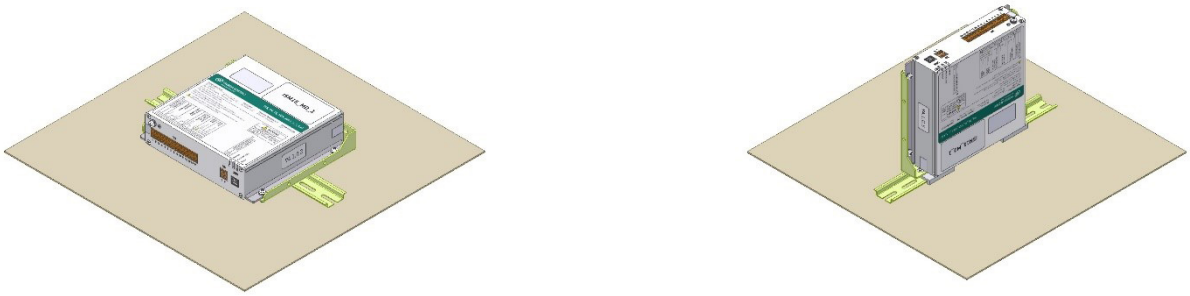


Figure 162

Variants of the CM installation on the DIN rail

The CM can operate in any mounting position. Care must be taken for good access and visibility of the terminals, LEDs.

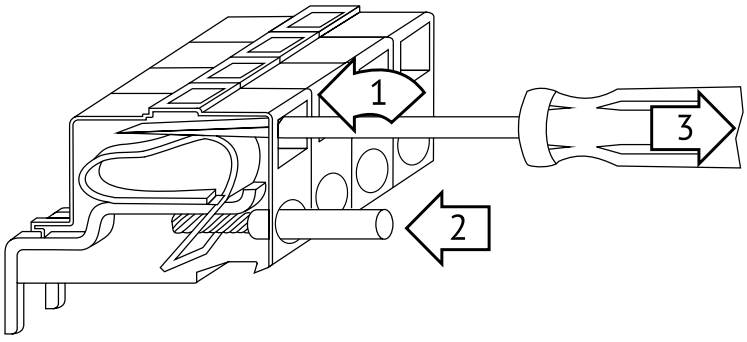


Figure 163

Installation to CM terminals

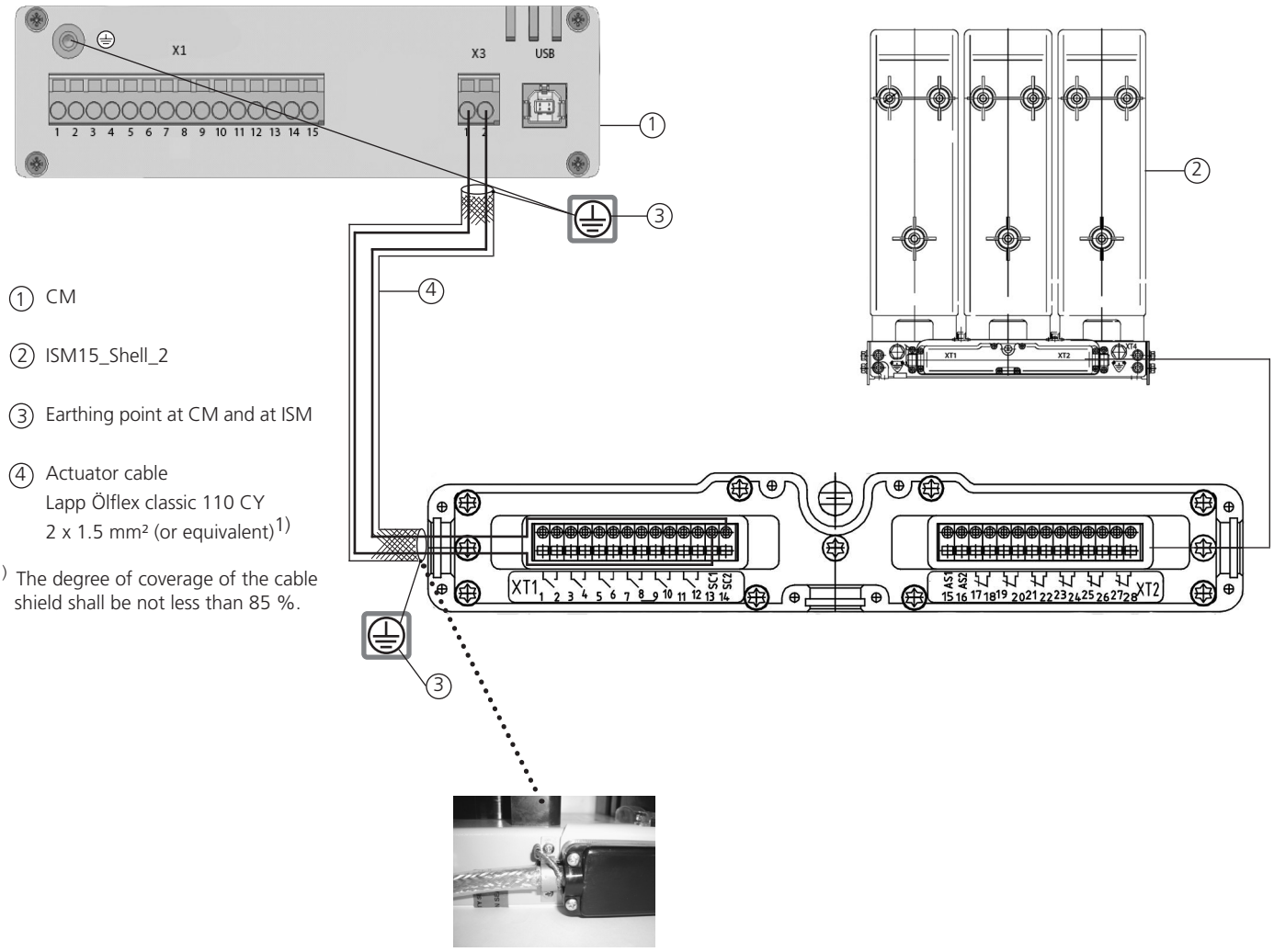
Wires are connected to the CM terminals by using a screwdriver (Figure 22). The terminals can accept solid and stranded wire within the range 0.5-2.5 mm. The insulation stripping length shall be 6-10 mm. Insulated auxiliary circuits shall provide 2 kV power frequency dielectric strength.

4.2.5 Installation of Secondary Cables Between ISM and CM

Before connection CM to ISM the compliance between ISM type (shown on ISM serial number plate – Figure 2) and CM (applicability of CM for particular type of ISM are shown on CM designation label – Figure 4 and CM packing label - Figure 21) shall be confirmed.

Warning! If the CM label does not show the correct ISM type connection shall not be established. It can lead to damage of the ISM. Contact your nearest Tavrida Electric partner for replacement.

Secondary cables between ISM and CM shall be installed according to the following instructions (Figure 164 – Figure 167). To achieve best possible protection against electromagnetic influences. The earthing point 3 ⏚ shall be as close as possible to the CM. Unshielded parts of wires shall be not longer than 10 cm. Connections between the end of cable shields and ISM earthing points shall be not longer than 5 cm.



① CM

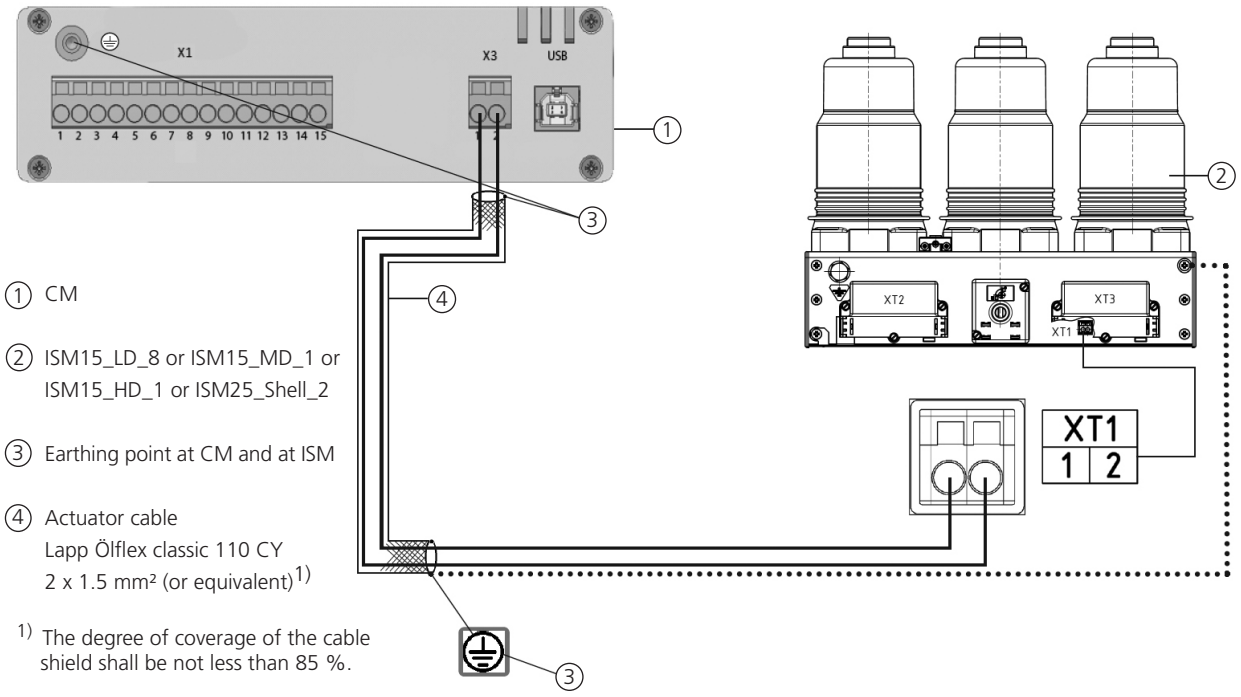
② ISM15_Shell_2

③ Earthing point at CM and at ISM

④ Actuator cable
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[1)]

[1)] The degree of coverage of the cable shield shall be not less than 85 %.

Figure 164
Secondary cables between ISM15_Shell_2 and CM



① CM

② ISM15_LD_8 or ISM15_MD_1 or ISM15_HD_1 or ISM25_Shell_2

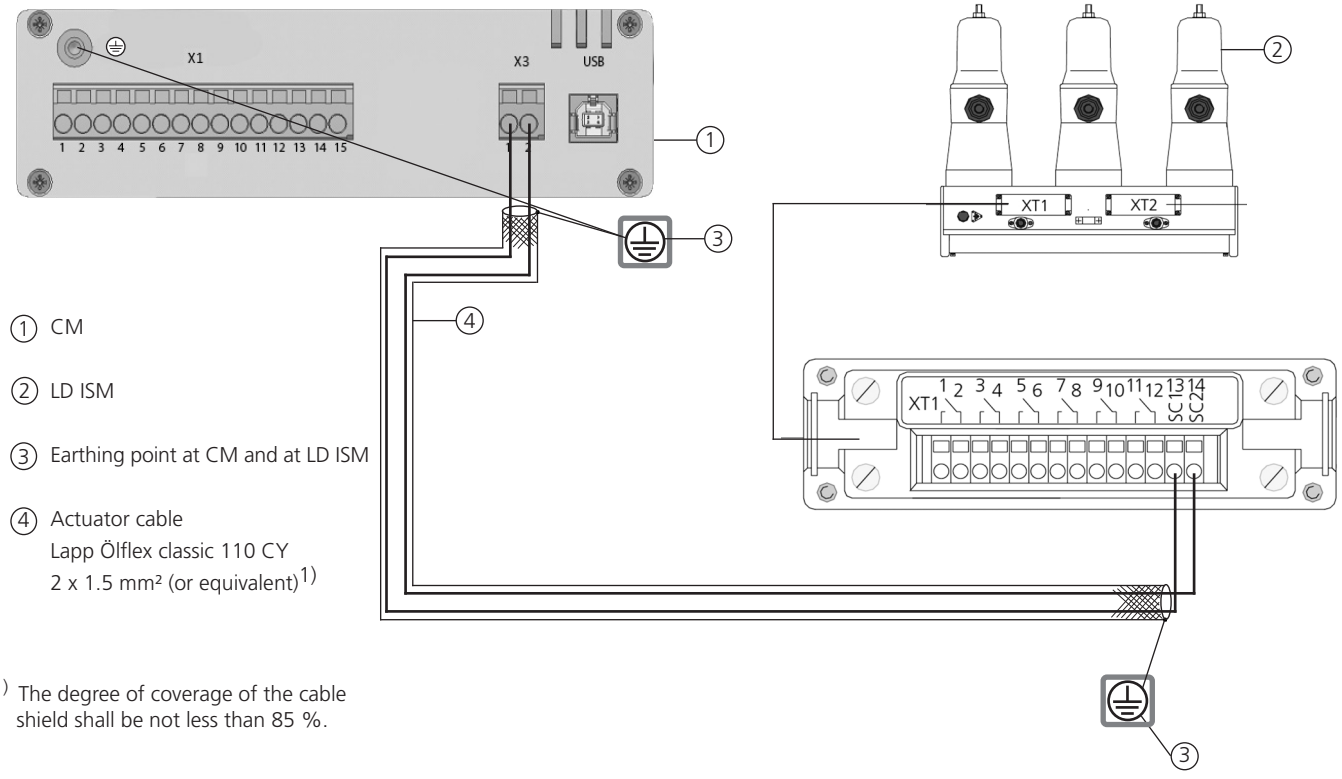
③ Earthing point at CM and at ISM

④ Actuator cable
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[1)]

[1)] The degree of coverage of the cable shield shall be not less than 85 %.

Figure 165

Secondary cables between ISM15_LD_8 or ISM15_MD_1 or ISM15_HD_1 or ISM25_Shell_2 and CM



① CM

② LD ISM

③ Earthing point at CM and at LD ISM

④ Actuator cable
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[1)]

[1)] The degree of coverage of the cable shield shall be not less than 85 %.

Figure 166

Secondary cables between three phases ISM15_LD_1, LD_6 or ISM25_LD_1, ISM25_LD_2 and CM

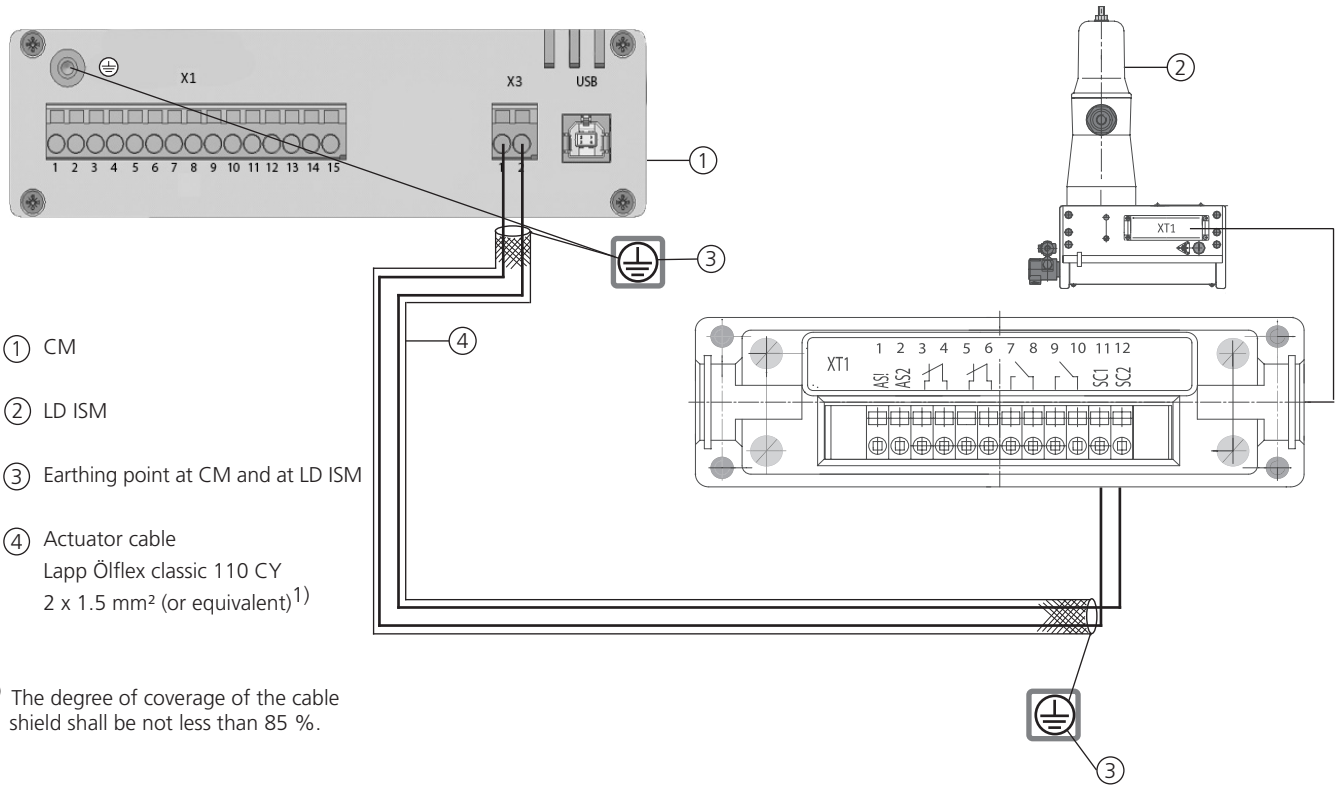


Figure 167

Secondary cables between single phase ISM15_LD_3 or ISM25_LD_3 ISM and CM

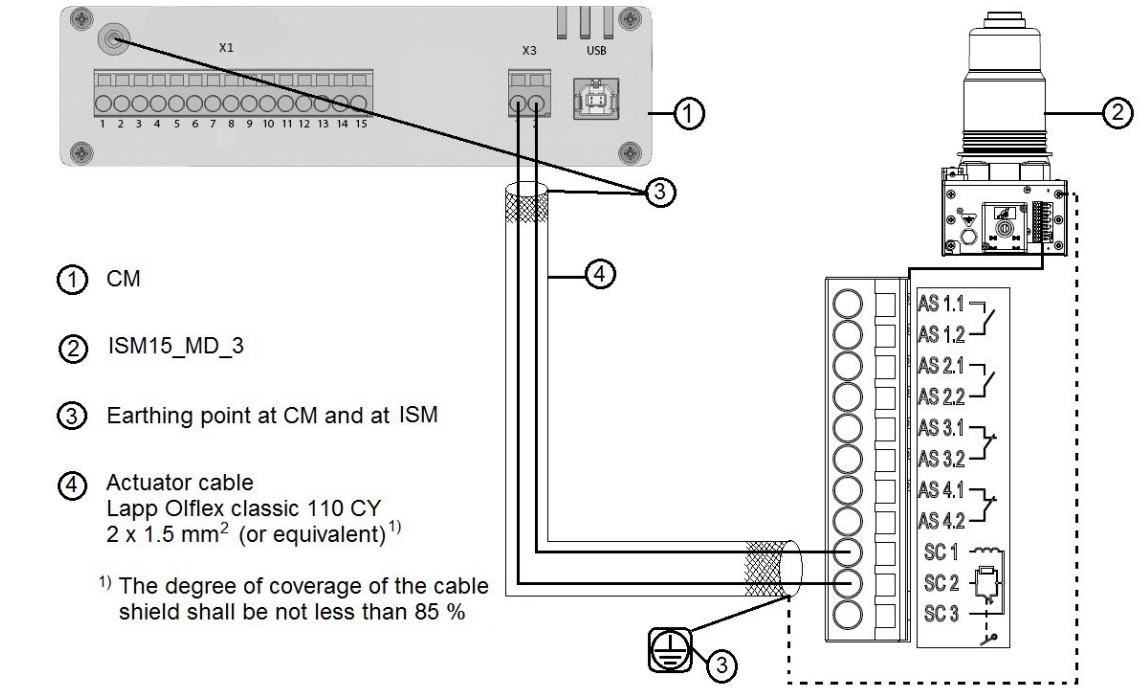
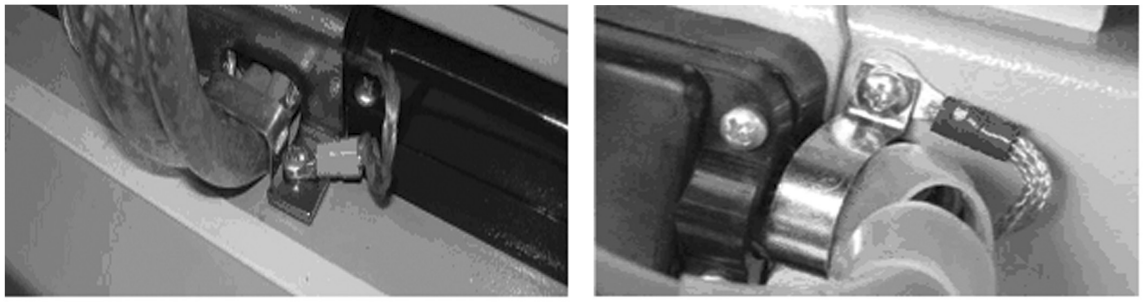


Figure 168

Secondary cables between ISM15_MD_3 and CM

Even after the CM is disconnected from all the power supplies there still may be hazardous voltage on the CM connectors. Achievement of safe voltage level is indicated by the extinction of all LEDs on the CM front panel. This may take up to 15 minutes after the CM is deenergized.

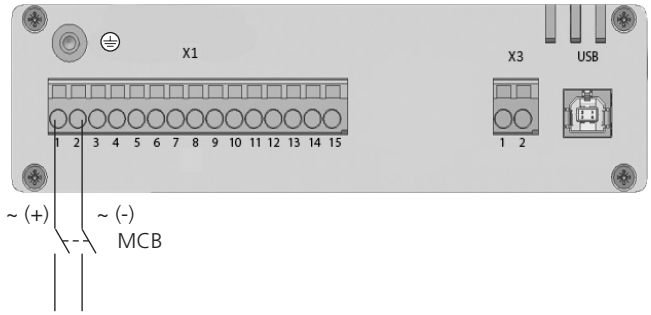


a) LD ISM b) ISM15_Shell_2

Figure 169
Sample of earthed cable shielding on ISM side

4.2.6 Auxiliary Supply

Connection of CM_16_1 to power supply is shown below.



Power supply inputs

Figure 170
CM_16 power supply connection

Type of MCB shall be selected according to CM consumption data given in Table 1.

If the CM is connected to DC voltage, pay special attention to the correct polarity for CM_16_1(Par1_60.1_Par2_Par3_Par4_Par5).

If Manual generators CBunit_ManGen are used for charging the CM, DC voltage outputs shall be connected to power supply inputs of CM_16_1.

Arrangement of output wires of Manual generators CBunit_ManGen_1 and CBunit_ManGen_2:

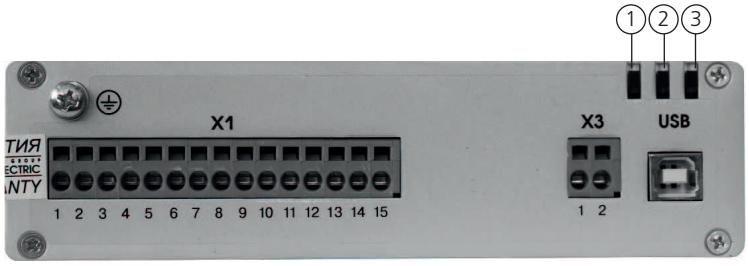
- red colour wire - positive polarity output wire;
- black colour wire - negative polarity output wire;
- yellow-green colour wire - manual generator earthing wire.

4.2.7 CM Indication

The CM has the following LED indication functionality:

- CM "Power" indication;
- CM "Ready" state indication;
- CM "Malfunction" state indication.

The placement of LED indicators are shown in Figure 161. The LED indicators are visible from two directions.



1. "Power" LED indicator
2. "Malfunction" LED indicator
3. "Ready" LED indicator

Figure 171
CM_16 LED indicators

The self-diagnostic system inside the CM detects possible malfunctions and reports them via the Malfunction LED blink signals and Malfunction or Loss of auxiliary supply Relay state. The explanation of the LED blink codes is given in Table 15.

Table 15 - CM Self-Diagnostic Indication

CM State	Type of Indication	Indication		
		LED Power	LED Ready	LED Malfunction
Power supply voltage is absent more than 3 minutes	Warning and Loss of auxiliary supply	off	off	off
"Close" operation is preparing	Normal	continuous	off	off
CM is ready and operable	Normal	continuous	continuous	off
Power supply voltage is absent for more than 1.5 seconds	Warning and Loss of auxiliary supply	off	continuous	1 blink
Excessive trip or close time	Malfunction	continuous	off	2 blinks
Actuator coil isolated	Malfunction	continuous	off	3 blinks
Short circuit of Actuator coil	Malfunction	continuous	off	4 blinks
Manual Trip and Lock	Warning	continuous	off	5 blinks
Out of temperature range	Warning	continuous	off	6 blinks
ISM state is open without command from the CM	Malfunction	continuous	off	7 blinks
Internal fault of the CM	Malfunction	continuous	off	continuous

Notes.

1. Number of blinks in series followed by 1.5 s intervals, continuous light or off state are shown for LED indicators.
2. Period of checking Actuator Coil state (short circuit / isolated) – 10 s.

Priority of the fault indication starting from the lowest one:

1. CM is out of temperature range;

2. ISM state is open without command from the CM;
3. Excessive trip or close time;
4. Manual Trip and Lock;
5. Actuator coil isolated;
6. Short circuit of Actuator coil;
7. Power supply voltage is absent more than 1.5 seconds.

4.2.8 CM Relay Contacts Operation

Relay contacts of CM_16_1 change their state as described below.

Table 16 - CM Relay "Ready" Contacts Operation

CM State	Relay "Ready" contacts state	
	NC (terminals 7-8 by default)	NO (terminals 6-7 by default)
CM is ready for close or open operation	Open	Closed
CM is not ready for close or open operation	Closed	Open

Table 17 - CM Relay "ISM Main Contact Position" Contacts Operation

ISM State	Relay "ISM main contact position" contacts state	
	NC (terminals 4-5 by default)	NO (terminals 3-4 by default)
ISM is closed	Open	Closed
ISM is open	Closed	Open

CM performs the checkup of ISM main contacts position and updates the "'ISM main contacts position" relay status in the following cases:

- In case Close command was applied from the CM. In this case the update is performed not later than in 150 ms after ISM main contacts closing;
- In case Trip command was applied from the CM. In this case the update is performed not later than in 70 ms after ISM main contacts opening;
- Periodically every 10 s in case no Close or Open command was applied from the CM.

In case application project requires to define main contacts position faster than the timing mentioned above it is recommended to use auxiliary switches installed at the ISM. Position indication of ISM provided by CM can be incorrect, in case CM is not operable due to absence of auxiliary supply.

Table 18 - CM Relay “Malfunction or Loss of Auxiliary Supply“ Contacts Operation

CM State	Relay “Malfunction or Loss of Auxiliary Supply“ Contacts State	
	NC	NO
Power supply voltage is absent for more than 1.5 seconds (1 blink of LED Malfunction)	Open	Closed
Excessive trip or close time (2 blinks of LED Malfunction)	Open	Closed
Actuator coil isolated (3 blinks of LED Malfunction)	Open	Closed
Short circuit of Actuator coil (4 blinks of LED Malfunction)	Open	Closed
Manual Trip and Lock (5 blinks of LED Malfunction)	Closed	Open
Out of temperature range (6 blinks of LED Malfunction)	Closed	Open
ISM state is open without command from the CM (7 blinks of LED Malfunction)	Open	Closed
Internal fault of CM (continuous light of LED Malfunction)	Open	Closed

5. Commissioning

The list of commissioning operations and checks is shown in Table 19 below. Initial state of VCB components before checks: ISM - open, CM - deenergized. Main circuits of ISM shall be disconnected/isolated from the main circuits of substation to avoid high voltage being applied to the ISM before the commissioning procedure completion. Commissioning and maintenance is only permitted for qualified and trained personnel.

Table 19 - List of Commissioning Operations and Check-Ups

Operation description	Required tool	Approximate timing
Tests at the end of installation		
Check for damage, remove any dirt, contamination or moisture	Visual check, no tool is required	2 minutes
Unsupported busbar length shall be according to Table 3 for LD ISM and Table 6 for HD ISM	Ruler, tape measure or calliper - depends on distance value and place of measurement execution	2 minutes
Fixing points shall be according to Figure 65 - Figure 74	Visual check, no tool is required	1 minute
Bolts and torques shall be according to Figure 65 - Figure 74	Torque wrench according to torque value	2 minutes
Clearances shall be according to subchapters 4.1.3 and 4.1.4	Ruler, tape measure or calliper - depends on distance value and place of measurement execution	2 minutes
Protective earthing shall be according to subchapter 4.1.9	Visual check, no tool is required	1 minute
Check that free air circulation at ISM is possible	Visual check, no tool is required	1 minute
Installation of CM shall be according to subchapter 4.2.4	Visual check, no tool is required	1 minute
Availability of the CM auxiliary power supply. It is recommended to use the same auxiliary power supply as for protection and control devices. Type of voltage and voltage level according to selected CM type	Voltmeter with measurement range according to expected power supply voltage value	2 minutes
Polarity of auxiliary power supply and selection of MCB shall be according to subchapter 4.2.6. Check of compliance between ISM type on ISM serial number plate and on CM designation label	DC voltmeter with measurement range according to expected power supply voltage value - for voltage polarity check. Visual check, no tool is required – for MCB check	2 minutes
Connection between CM and ISM shall be according to subchapter 4.2.5	Multimeter - for validation of correct wiring connections (utilizing the continuity function of the meter)	5 minutes
Checking that all secondary connections have been secured adequately	Visual and mechanical check of connections, no tool is required	2 minutes
Checking whether the CM, ISM are connected according to project/ product documentation and according to circuit diagrams in „Appendix 3.Secondary schemes“.	Multimeter - for validation of correct wiring connections (utilizing the continuity function of the meter)	5 minutes

Table 19 - List of Commissioning Operations and Check-Ups

Operation description	Required tool	Approximate timing
Operation check		
Turn on the CM auxiliary power supply then check the following: • The "Power" LED must light up immediately; • The "Ready" LED must light up continuously within 15 s after switching on; • The "Malfunction" LED must not light up; • The "Ready" relay contact must close within 15 s.; • The "Malfunction or Loss of auxiliary supply" relay contact must change its state1); • The "ISM main contact position" relay contact must not change its state; • ISM main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute
Apply close command to the CM then check the following: • The "Power" LED must light continuously; • The "Ready" LED must light continuously; • The "Malfunction" LED must not light up; • The "Ready" relay contact must not change its state; • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state; • The "ISM main contact position" relay contact must change its state; • ISM main contacts must change their state (ISM shall be closed).	Visual check, no tool is required	1 minute
Apply trip command to the CM then check the following: • The "Power" LED must light continuously; • The "Ready" LED must light continuously; • The "Malfunction" LED must not light up; • The "Ready" relay contact must not change its state; • The "Malfunction of Loss of auxiliary supply" relay contact must not change its state; • The "ISM main contact position" relay • contact must change its state; • ISM main contacts must change their state (ISM shall be open).	Visual check, no tool is required	1 minute

1) „As earlier, after CM power supply disconnection this relay indicated the CM state: "Power supply voltage is absent for more than 1.5 seconds"

Table 19 - List of Commissioning Operations and Check-Ups

Operation description	Required tool	Approximate timing
Do not remove trip command and apply close command to the CM then check the following: • The "Power" LED must light continuously; • The "Ready" LED must light continuously; • The "Malfunction" LED must not light up; • The "Ready" relay contact must not change its state; • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state; • The "ISM main contact position" relay contact must not change its state; • ISM main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute
Remove close and trip commands to the CM then check the following: • The "Power" LED must light continuously; • The "Ready" LED must light continuously; • The "Malfunction" LED must not light up; • The "Ready" relay contact must not change its state; • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state; • The "ISM main contact position" relay must not change its state; • ISM main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute
Apply and keep close command and then apply trip command to the CM then check the following: • The "Power" LED must light continuously; • The "Ready" LED must go out after the trip of the ISM and then light up continuously within 10 s.; • The "Malfunction" LED must not light up; • The "Ready" relay contact must change its state after the trip of the ISM and then change its state again within 10 s.; • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state; • The "ISM main contact position" relay contact must change its state each time when ISM is closed and open; • ISM main contacts must change their state each time when ISM is closed and open.	Visual check, no tool is required	1 minute

Table 19 - List of Commissioning Operations and Check-Ups

Operation description	Required tool	Approximate timing
Primary circuits insulation check [1)]		
Observe safety precautions listed in the danger and warning advisories. Construct proper barriers and warning light systems	Equipment to provide safety in the test area	10 minutes
Ground each pole of ISM that is not under test [2)]	Wires	2 minutes
Apply slowly rising 100% [3)] of test voltage [4)] (50 or 60 Hz) across each pole for one minute [5)]. (ISM is open)	Power frequency withstand voltage test set	2 minutes
If the pole sustains the test voltage for that period, its vacuum integrity has been verifed [6)]	Power frequency withstand voltage test set	-
Repeat actions above to check each pole of ISM	Power frequency withstand voltage test set, wires	8 minutes
Close the ISM. Ground each pole of ISM that is not under test [2)]	Wires	1 minute
Apply slowly rising 100% [3)] of test voltage [3)] (50 or 60 Hz) between a primary conductor of the pole and ground for one minute, repeat test for each pole of ISM	Power frequency withstand voltage test set	12 minutes
If no disruptive discharge occurs, the insulation system is satisfactory	Power frequency withstand voltage test set	-
After the test, ground all main circuit terminals to dissipate any static charge	Wires	2 minutes
Auxiliary circuits insulation check		
Connect all points of the secondary circuits with a shorting wire. ISM coil connection wires must be disconnected from connector X3 of CM before the test	Wires	5 minutes
Connect the shorting wire to the high potential lead of the high voltage tester and ground the circuit breaker housing. Starting with zero volts, gradually increase the test voltage to 1500 V RMS, 50 or 60 Hz. Maintain test voltage for one minute	Power frequency withstand voltage test set	3 minutes
If no disruptive discharge occurs, the secondary circuits insulation level is satisfactory	Power frequency withstand voltage test set	-
Disconnect the shorting wire and re-attach the wires to connector X3 of CM	Visual check, no tool is required	5 minutes

1) This test includes not only the vacuum interrupter test, but also the other insulation components tested in parallel with the interrupter. These include the standoff insulators and the insulated drive links, as well as the insulating (tension) struts between the upper and lower vacuum interrupter supports. If these insulation components are contaminated or defective, the test voltage will not be sustained. If so, clean or replace the affected components, and retest.
2) Three phase ISM should be tested phase by phase only. Therefore poles not under the test should be grounded.
3) For test of separate VCB - 100% level of test voltage, for test of Switchgear with installed VCB - 80% level of test voltage according to IEC 62271-200.
4) Rated test voltage levels (Ud) are given in Table 1.
5) To apply test voltage single-core short cables should be used. Application of high voltage coaxial cables is strictly prohibited. To coordinate the surge impedance between the test set and ISM extra resistor as shown in the Figure 172 shall be used.
6) During testing of vacuum interrupter, self-fading restrikes may appear. In case of restrikes, reduce the voltage slightly until the restrikes disappear (for 10-15 seconds) and then increase again.

Table 19 - List of Commissioning Operations and Check-Ups

Operation description	Required tool	Approximate timing
Primary circuits contact resistance check		
ISM shall be closed before the test, there should not be any external circuits connected to ISM main terminals that provide parallel circuit with the ISM main circuits otherwise tests will be invalid.	Visual check, no tool is required	1 minute
Test equipment shall be connected to ISM main circuits terminals according to Figure 163 in order exclude any additional contact resistance and to decrease measurement error. Main contact resistance shall be measured by appropriate equipment at test current not less than 50 A.	Resistance measurement test equipment with test current not less than 50 A	10 minutes
Measured values for VCB15_LD, VCB25_LD and VCB15_MD must not exceed limits specified in Table 1. Measured values for VCB15_Shell and VCB15_HD must not exceed limits specified in Table 1 increased on 2 μOhm. These 2 μOhm are added by contact resistance between ISM terminals and additional burs attached to them (see in the Figure 173)	Visual check, no tool is required	-

After above listed tests were performed successfully the VCB can be put into operation.

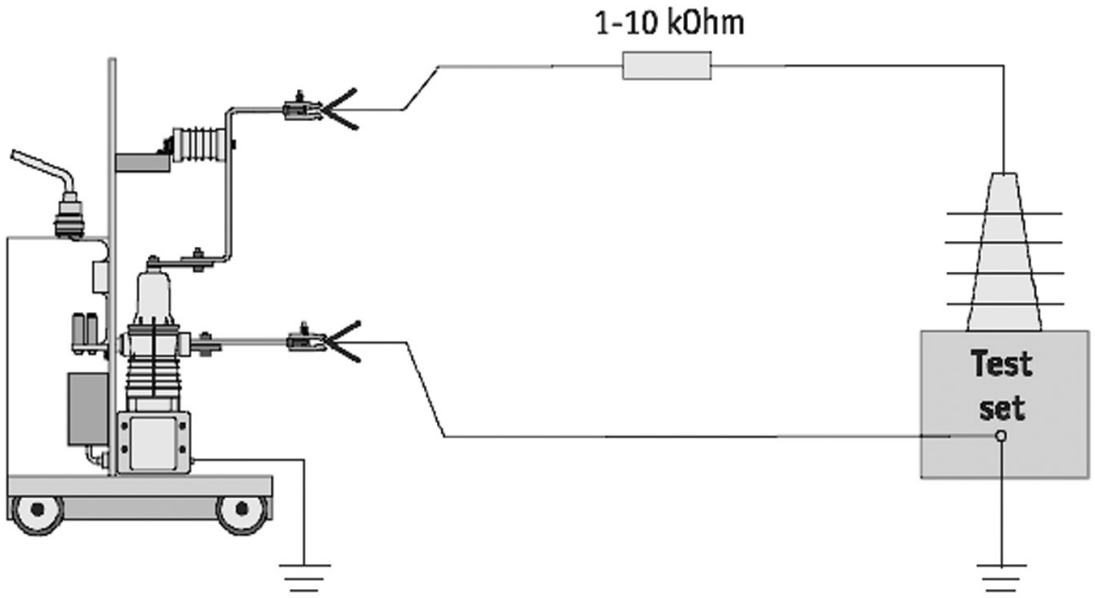


Figure 172

The Vacuum integrity and solid insulation test installation

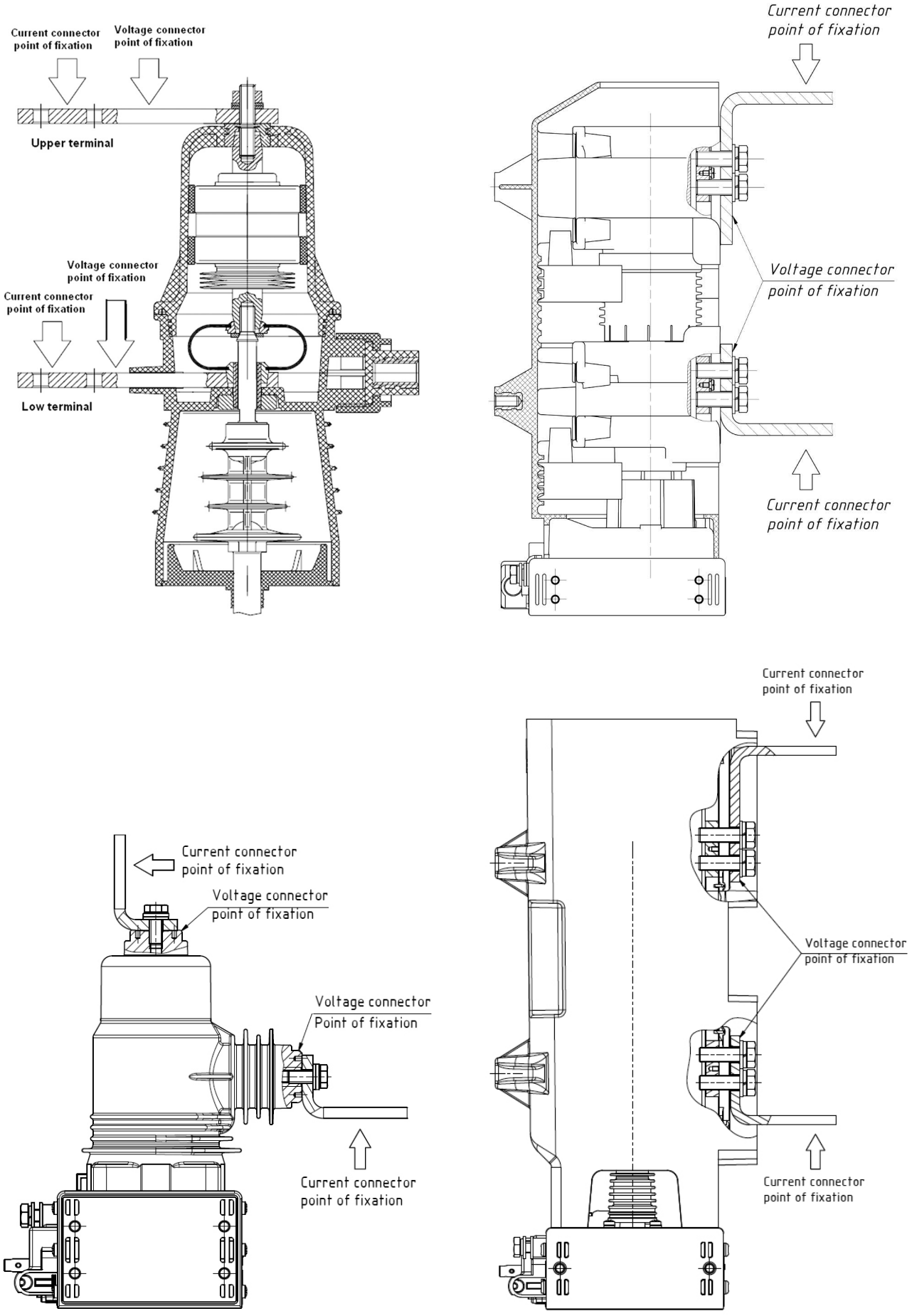


Figure 173

The connection points of the contact resistance meter

6. Operation

6.1 Switching

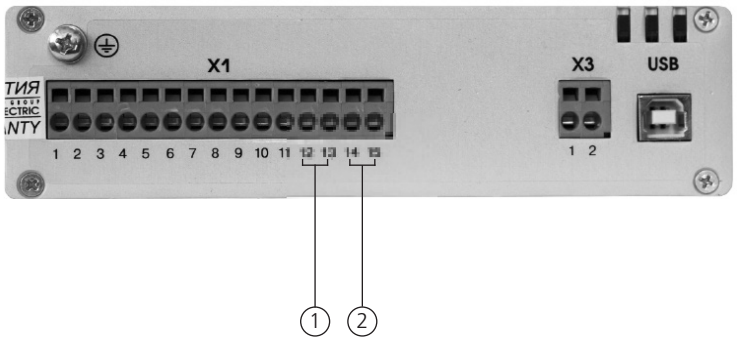
6.1.1 Closing

To close the ISM main contacts the CM close command shall be applied. It is a "dry contact" input so no external voltage should be applied.

The Close command will be accepted if:

- CM state is "Ready" (Ready LED flashes green);
- no Trip command is applied;
- optional electrical interlock is unlocked;
- mechanical and electrical interlock is unlocked (in case of ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2 and ISM15_HD_1 only).

If Close command is applied and held before the CM is in a "Ready" state the Close command will not be accepted. If auxiliary power is not available, the manual generator CBunit_ManGen shall be used to charge the CM capacitors and to close the ISM. Mechanical closing is not possible.



1. Close command input
2. Trip command input

Figure 174
CM_16 close and trip inputs

If Manual generators CBunit_ManGen are used to charge the CM, the Manual generator handle shall be rotated until the Ready LED of the CM flashes green (approximately 30 seconds). Then the ISM close command can be applied to the CM. One possible variant is the connection of NO and Common contacts of relay Ready to the Close command input of the CM. Be aware that in this case the ISM will be closed automatically once the CM reaches the Ready state.

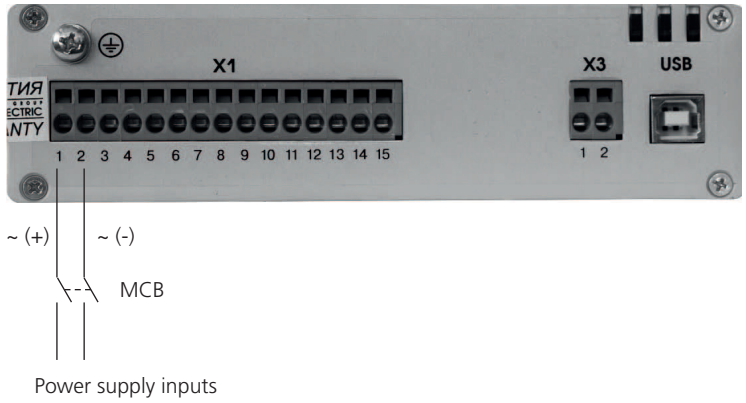


Figure 175
CM_16 power supply connection

If Manual generators CBunit_ManGen are used for charging the CM, DC voltage outputs of the Manual generator shall be connected to the power supply inputs (Figure 175) of CM_16_1. Pay special attention to the correct polarity for CM_16_1(Par1_60.1_Par2_Par3_Par4_Par5).

6.1.2 Opening

To open the ISM main circuits, a trip command should be applied to the CM trip command input. It is a "dry contact" input so no external voltage should be applied. The trip command will be accepted if:

- CM state is "Ready" (Ready LED flashes green) or within 60 seconds after the removal of the auxiliary power supply;
- optional electrical interlock is unlocked;
- mechanical and electrical interlock is unlocked (in case of ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2 and ISM15_HD_1 only) If the trip command is applied and kept before the CM is in a "Ready" state, the trip command will not be accepted.

6.1.3 Emergency Opening

The ISM can also be opened manually. When the synchronizing shaft is rotated, a force exceeding the magnetic attraction forces of the ring magnet is applied to the armature, which subsequently starts to move. As the air gap increases, the opening springs and the contact pressure springs overcome the magnetic holding force, and the vacuum interrupter opens.

To open the ISM15_LD_1, LD_3, LD_6 and ISM25_LD1, LD_2, LD_3 manually, the force shall be applied to the interlocking pins or torque shall be applied to the stub shaft evenly during their movement - see Figure 176. Force shall be applied along the pin's movement axis and directed to the ISM frame. The torque shall be applied in the direction of shaft rotation during ISM opening. The force or torque influence shall not be applied at the end of pin's stroke or shaft rotati¬on and shall not be applied to the pin or shaft before ISM closing.

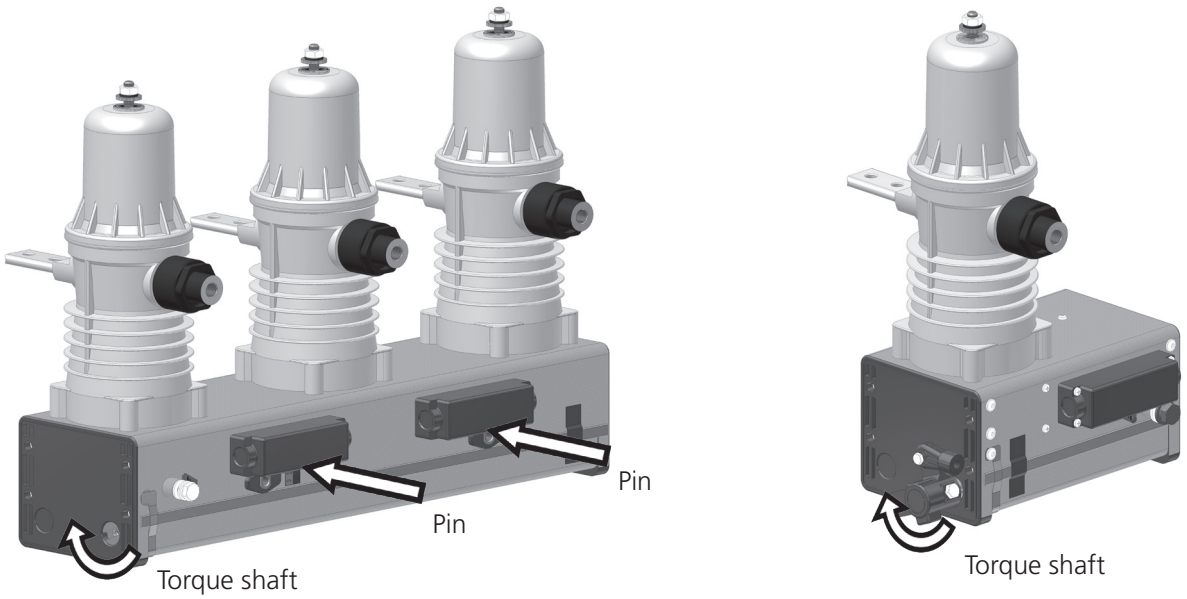


Figure 176

ISM15_LD_1, LD_3, LD_6 and ISM25_LD1, LD_2, LD_3 manual trip execution. Force or torque can be applied to any of the points shown above

To open the ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2 and ISM15_HD_1 manually, the torque shall be applied to the interlocking shaft evenly during its movement - see Figure 177. The torque shall be applied counterclockwise of shaft rotation (90 degrees angle). The torque shall not be applied at the end of shaft rotation. ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_Shell_2 and ISM15_HD_1 have a built in electrical interlock that interrupts the ISM coil circuit after the interlocking shaft is rotated counterclockwise. After manual trip, the shaft should be rotated clockwise to unlock the ISM.

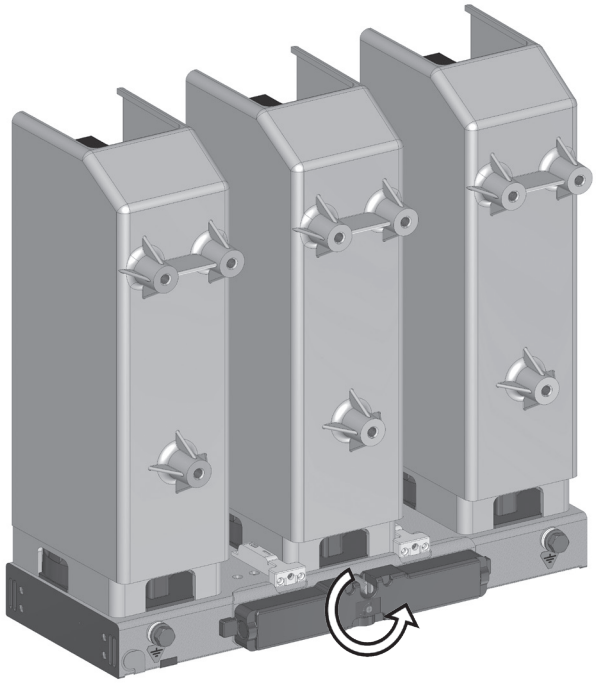


Figure 177

ISM15_Shell_2 manual trip execution (ISM15_LD_8, ISM15_MD_1, ISM15_MD_3, ISM15_HD_1 and ISM25_Shell_2 have same manual trip execution)

7. Maintenance and troubleshooting

7.1 Primary Circuits

Under normal operating conditions (see Table 1) the ISM is maintenance free for a period of at least 30 years or until it has reached the permissible number of operating cycles.

However when maintenance is carried out on the switchgear then the commissioning tests should be repeated. Check that the ISM is disconnected from all voltage sources before inspecting its insulating parts. Test results should be treated as given in Table 20.

Table 20 - List of Tests and Check-Ups of ISM During Maintenance

Operation description	Required tool	Approximate timing
Check for damage, remove any dirt, contamination or moisture	Dry napless cloth or a napless cloth soaked in alcohol to clean the insulation	5 minutes
Bolts and torques shall be according to Figure 65 - Figure 74	Torque wrench according to torque value	2 minutes
Protective earthing shall be according to subchapter 4.1.9	Wrench if required	1 minute
ISM operation check		
Perform close and open operation of the ISM. Modules shall be operable. Otherwise, check the control circuit. If necessary, change the failed module	Visual check, no tool is required	1 minute
Primary circuits insulation check [1]		
Observe safety precautions listed in the danger and warning advisories. Construct the proper barrier and warning light system	Equipment to provide safety in test area	10 minutes
Ground each pole not under test	Wires	2 minutes
Apply slowly rising 100% [2] of test voltage [3] (50 or 60 Hz) across each pole for one minute [4]. (ISM is open)	Power frequency withstand voltage test set	2 minutes
If the pole sustains the test voltage for that period, its vacuum integrity has been verifed [5]	Power frequency withstand voltage test set	-
Repeat actions above to check each pole of the ISM	Power frequency withstand voltage test set, wires	8 minutes
Close the ISM. Ground each pole not under test	Wires	1 minute
Apply slowly rising 80% of test voltage [2] (50 or 60 Hz) between a primary conductor of the pole and ground for one minute, repeat test for each pole of ISM	Power frequency withstand voltage test set	12 minutes
If no disruptive discharge occurs, the insulation system is satisfactory	Power frequency withstand voltage test set	-
After the test, ground all main circuit terminals to dissipate any static charge	Wires	2 minutes

1) This test includes not only the vacuum interrupter test, but also the other insulation components tested in parallel with the interrupter. These include the support insulators and the insulated drive links, as well as the insulating (tension) struts between the upper and lower vacuum interrupter supports. If these insulation components are contaminated or defective, the test voltage will not be sustained. If so, clean or replace the affected components, and retest.

2) For test of separate VCB - 100% level of test voltage, for test of Switchgear with installed VCB - 80% level of test voltage according to IEC 62271-200.

3) Rated test voltage levels (Ud) are given in Table 1 above.

4) To apply test voltage the single-core short cables should be used. Application of high voltage coaxial cables is strictly prohibited. To coordinate the surge impedance between the test set and ISM extra resistor as shown in Figure 172 shall be used.

5) During testing of vacuum interrupter, self-fading restrikes may appear. In case of restrikes, reduce the voltage slightly until the restrikes disappear (for 10-15 seconds) and then increase again.

Table 20 - List of Tests and Check-Ups of ISM During Maintenance

Operation description	Required tool	Approximate timing
Primary circuits contact resistance check [1)]		
ISM shall be closed before the test, there should not be any external circuits connected to ISM main terminals that provide parallel circuit with the ISM main circuits otherwise tests will be invalid.	Visual check, no tool is required	1 minute
Test equipment shall be connected to ISM main circuits terminals according to Figure 173 in order exclude any additional contact resistance and to decrease measurement error. Main contact resistance shall be measured by appropriate equipment at test cur¬rent not less than 50 A.	Resistance measurement test equipment with test current not less than 50 A	10 minutes
Measured values for VCB15_LD, VCB25_LD and VCB15_MD must not exceed limits specified in Table 11) Measured values for VCB15_Shell and VCB15_HD must not exceed limits specified in Table 1 increased on 2 μOhm. These 2 μOhm are added by contact resistance between ISM terminals and additional burs attached to them (see in the Figure 173)	Visual check, no tool is required	-

1) If the Module has contact resistance which exceeds the specified limit but is less than twice this limit, continuation of use is possible, if actual continuous current does not exceed the following value:

$$Ia < Ir\sqrt{\frac{Rr}{Ra}}$$

where:

Ia, Ra — actual current and corresponding contact resistance,

Ir, Rr — rated values (Table 1).

If the contact resistance is at least twice as high as the specified limit, the ISM must be replaced.

Additionally switchboards can be subjected to extra tests that are specified in corresponding documentation for the switchboards.

7.2 Secondary Circuits

The CM is inherently maintenance free. However when maintenance is carried out on the switchgear then commissioning tests should be repeated. It is also recommended to conduct regular visual checks of the module housing and insulation of the wires connected to the CM. Test results should be treated as given in the Table 21.

Table 21 - List of Tests and Check-Ups of CM During Maintenance

Operation description	Required tool	Approximate timing
Auxiliary circuits insulation check		
Connect all points of the secondary circuits with a shorting wire. ISM coil connection wires must be disconnected from connector X3 of the CM before the test	Wires	5 minutes
Connect the shorting wire to the high potential lead of the high voltage tester and ground the circuit breaker housing. Start with zero volts, gradually increase the test voltage to 1500 V RMS, 50 or 60 Hz. Maintain test voltage for one minute	Power frequency withstand voltage test set	3 minutes
If no disruptive discharge occurs, the secondary circuits insulation level is satisfactory	Power frequency withstand voltage test set	-
Disconnect the shorting wire and reattach the wires to connector X3 of the CM	Visual check, no tool is required	5 minutes

7.3 Troubleshooting

If during installation, commissioning, operation or maintenance any non-conformity occurs, contact your nearest Tavrida Electric sales representative. The contact data and web site links are listed at the end of this document. In case of a non-conformity any repairs are strictly prohibited without permission from the sales representative. To be sure that a non-conformity occurred, please perform the checks as mentioned in Table 22 prior to contacting our regional representative.

Table 22 - Typical Fault Symptoms and Methods of Their Elimination

Failure description	Possible reason	Method of elimination
Appearance failure	Mechanical or arc damage, breach of service conditions	Replacement of failed component
Excessive contact resistance of ISM	ISM reached the permissible number of operating cycles or decreasing of insulation level in ISM vacuum interrupters	Replacement of ISM
ISM cannot pass power frequency voltage withstand test at 80 % of rated voltage	ISM vacuum interrupters or insulation damage	Replacement of ISM
ISM cannot perform close/trip operation	ISM is interlocked	Check ISM interlock state and its actuator coil connection with connector X3 of CM
	CM failure	Check CM LED states
	Mechanical damage of ISM	Replacement of ISM
1 blink of CM "Malfunction" LED	Absence of CM power supply	Check presence of CM power supply, its polarity and voltage level
2 blinks of CM "Malfunction" LED	ISM cannot be closed / tripped	Check the circuit of ISM actuator coil connection with connector X3 of CM, check state of ISM electrical interlocks
3 blinks of CM "Malfunction" LED	ISM actuator coil circuit is interrupted	Check the circuit of ISM actuator coil connection with connector X3 of CM, check state of ISM electrical interlocks
4 blinks of CM "Malfunction" LED	Short circuit of ISM actuator coil circuit	Check the circuit of ISM actuator coil connection with connector X3 of CM, check state of ISM electrical interlocks
5 blinks of CM "Malfunction" LED	Manual trip of ISM and ISM is electrically interlocked	Check the ISM and its interlock state
6 blinks of CM "Malfunction" LED	CM is out of the temperature range	Stop performing CO operations until the blinks stop if temperature is above the temperature range or move CM into environment with higher temperature if temperature is below the temperature range.
7 blinks of CM "Malfunction" LED	ISM state is open without command from the CM	Check the ISM and its interlock state
CM "Malfunction" LED lights continuously	Internal fault of CM	Replacement of CM
None of CM LEDs lights	Absence of CM power supply	Check presence of CM power supply, its polarity and voltage level
	Internal fault of CM	Replacement of CM

The ISM or CM removal and the installation of the new one should be performed according to chapter 4. The checks and tests after substitution are described in chapter 5.

8. Disposal

All Tavrida Electric Vacuum Circuit Breakers and their components are manufactured from environmentally friendly materials, therefore no special waste disposal is required.

Appendix 1. VCB Package Dimensions and Weights

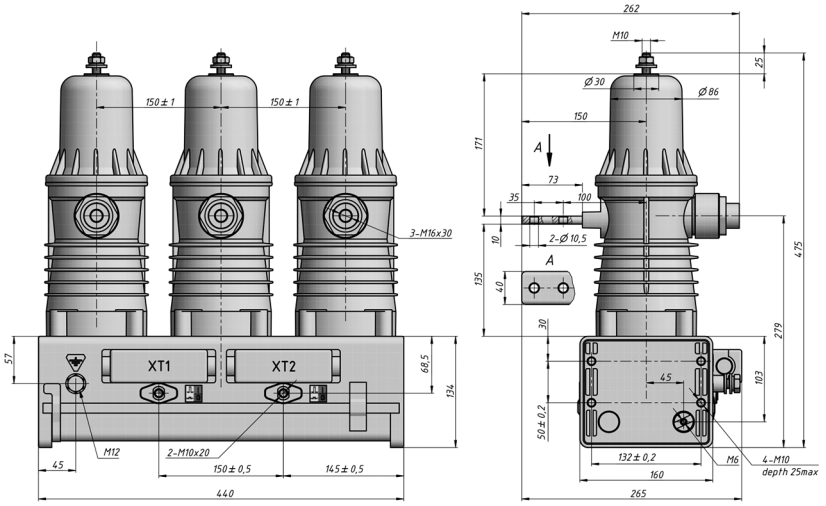
VCB package dimensions and weights

VCB	Package Dimensions, not more than (LxWxH), mm	Gross Weight, not more than, kg
VCB15_LD1_16.F	645x330x550	39.1
VCB15_LD3_16.F	645x290x550	17.1
VCB15_LD6_16.RD	470x410x700	62.3
VCB15_LD8_16.F	790x290x550	31,3
VCB15_MD1_16.F	760x315x490	41.5
VCB15_MD3_16.F	300x315x190	16.1
VCB15_Shell2_16.F	790x275x800	68.4
VCB15_HD1_16.F	830x330x680	79.5
VCB25_LD1_16.F	775x290x550	41.7
VCB25_LD2_16.F	645x330x550	40.1
VCB25_LD3_16.F	645x290x550	18.3
VCB25_Shell2_16.F	825x328x874	73 kg

Appendix 2.
Overall Drawings

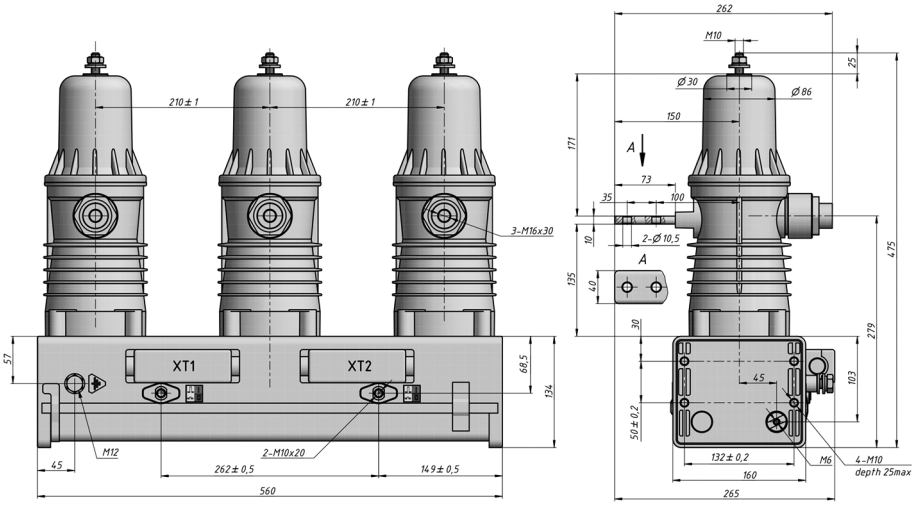
Dimensions of Indoor Switching Modules

ISM15_LD



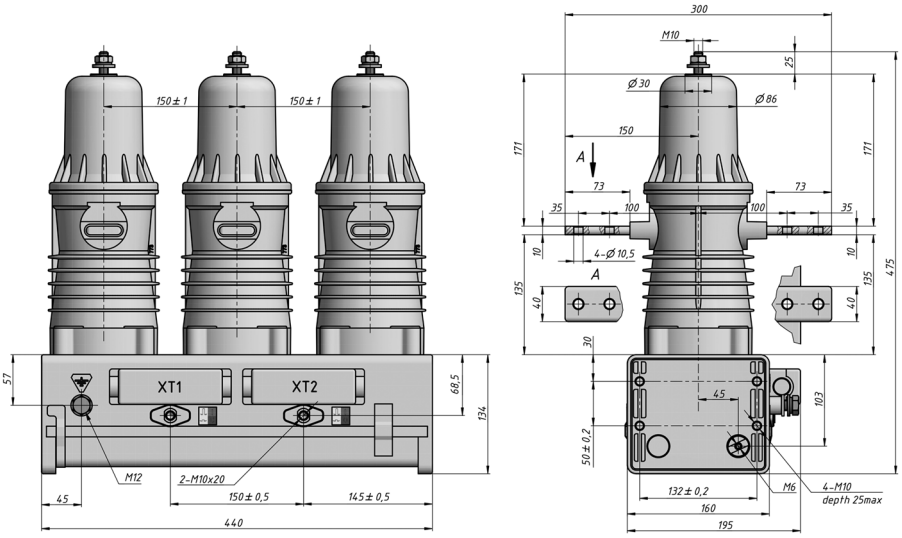
ISM15_LD_1(67),
PCD 150 mm
Weight: 34 kg

L_{max} = 265 mm
W_{max} = 440 mm
H_{max} = 475 mm



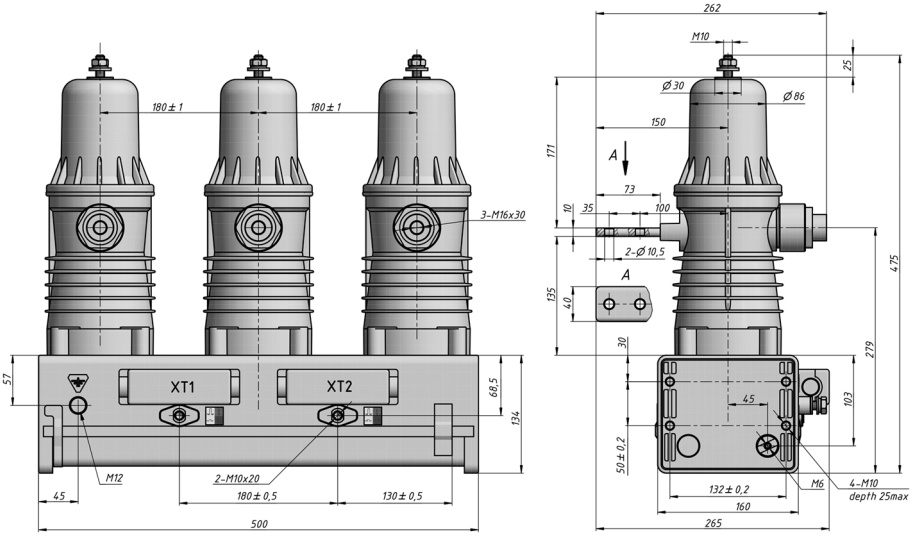
ISM15_LD_1(55),
PCD 210 mm
Weight: 36 kg

L_{max} = 265 mm
W_{max} = 560 mm
H_{max} = 475 mm



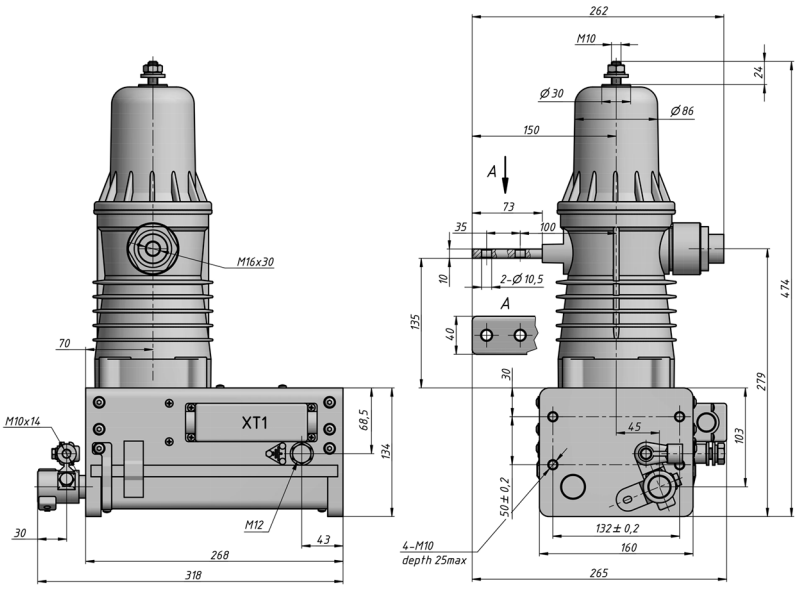
ISM15_LD_1(80), two lower terminals (continuous busbar),
PCD 150 mm
Weight: 36 kg

L_{max} = 300 mm
W_{max} = 440 mm
H_{max} = 475 mm



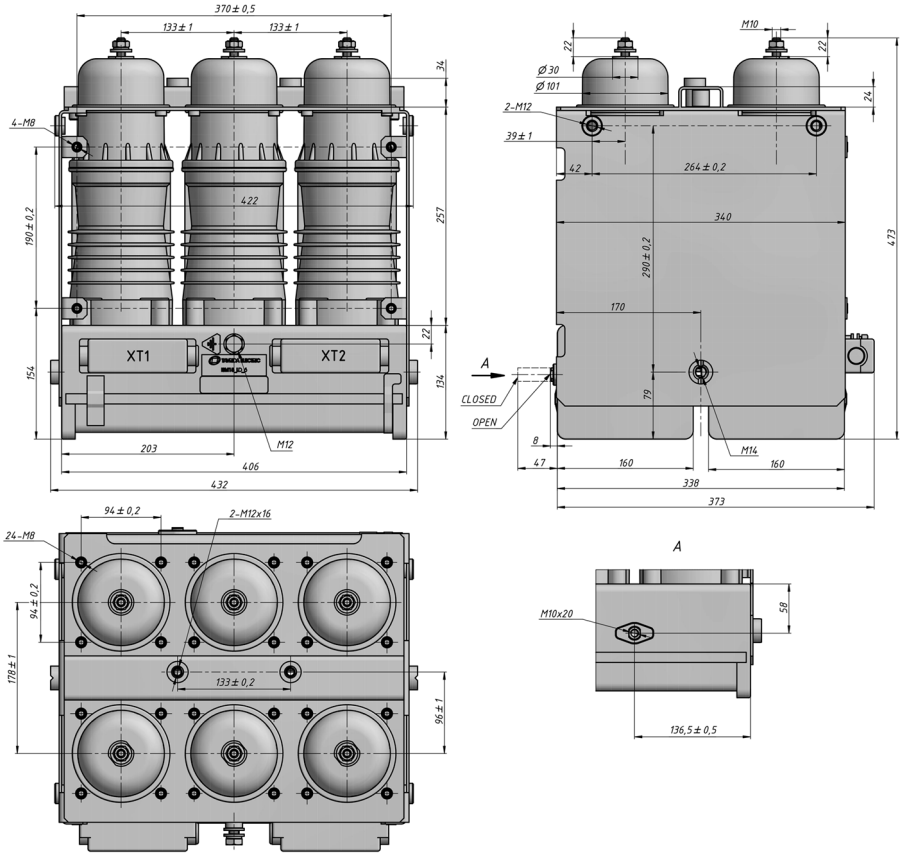
ISM15_LD_1(90),
PCD 180 mm
Weight: 36 kg

L_{max} = 265 mm
W_{max} = 500 mm
H_{max} = 475 mm



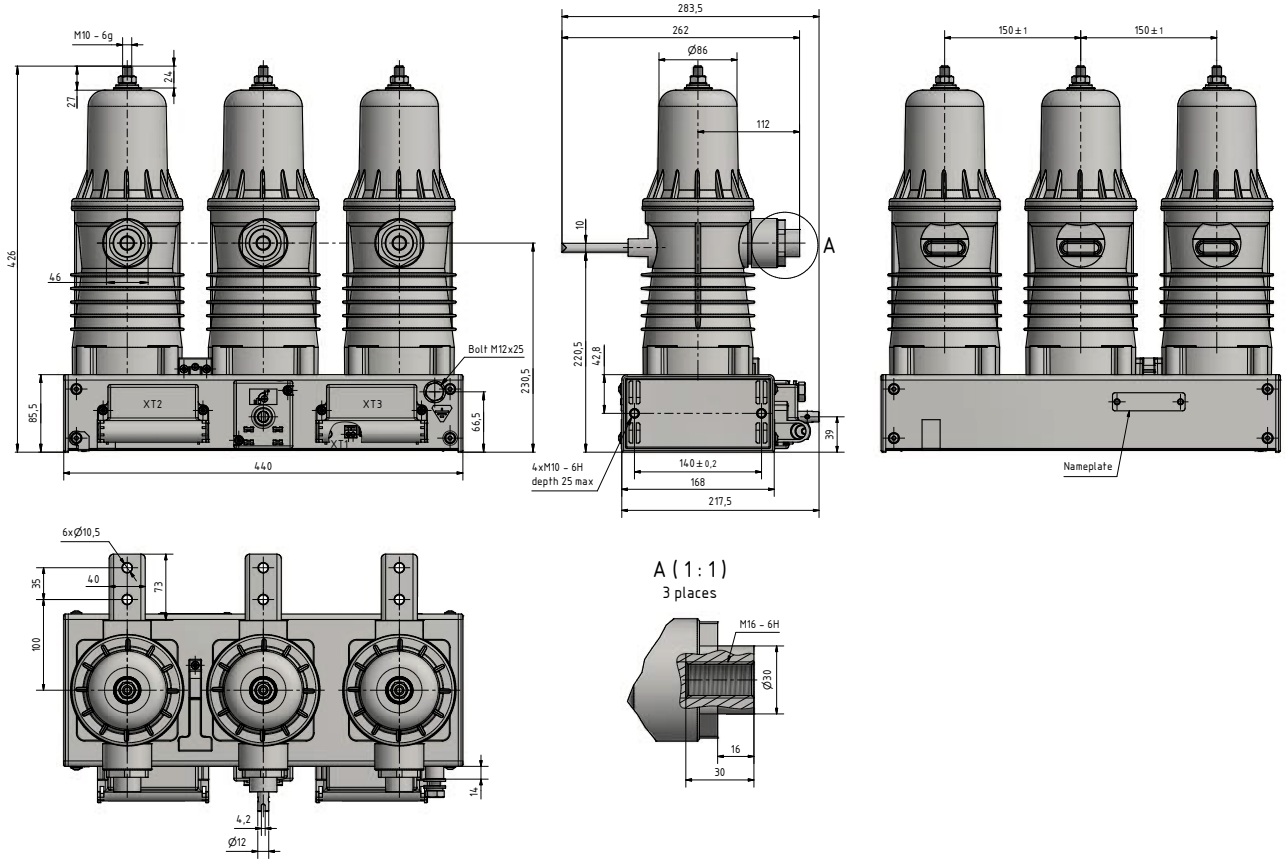
ISM15_LD_3,
Weight: 13 kg

L_{max} = 265 mm
W_{max} = 318 mm
H_{max} = 474 mm



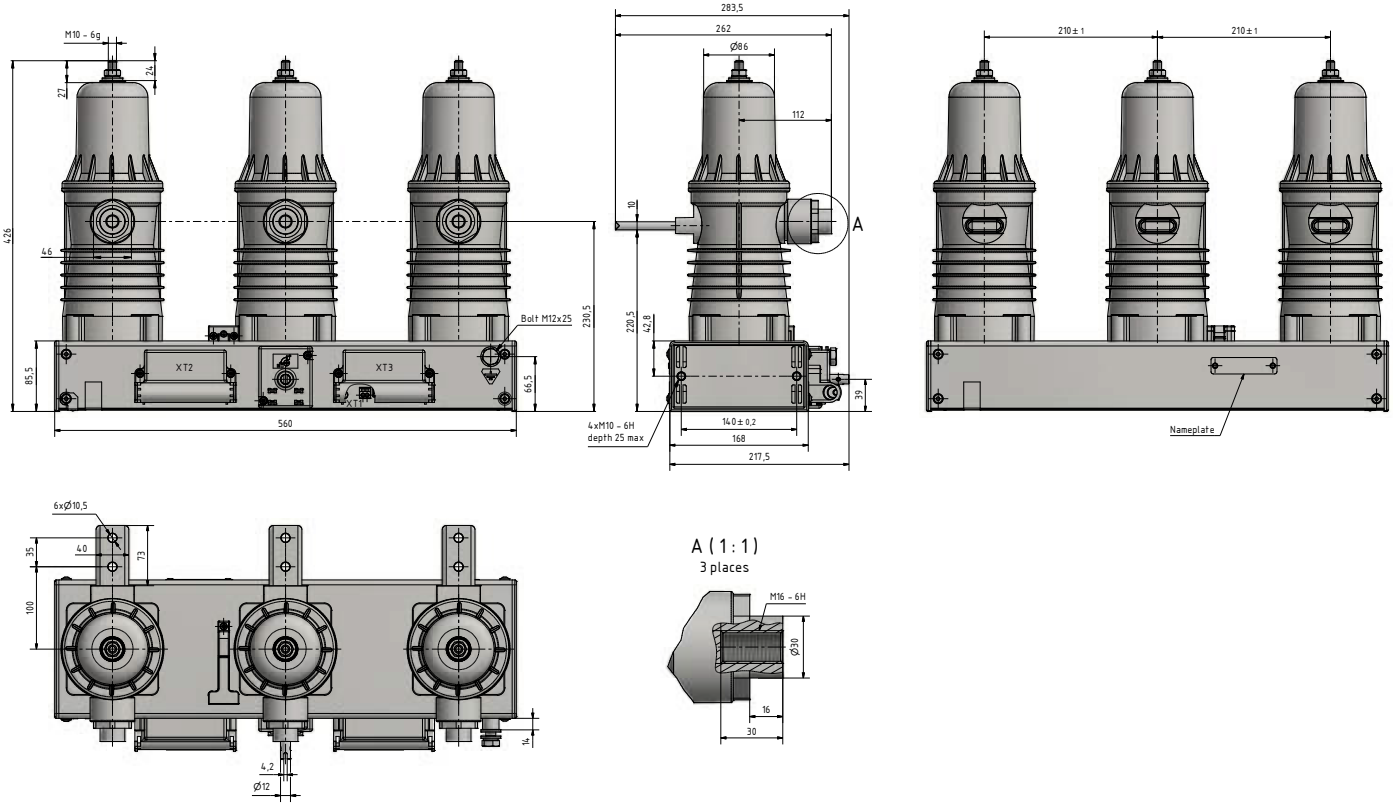
ISM15_LD_6,
PCD 133 mm
Weight: 55 kg

L_{max} = 381 mm
W_{max} = 432 mm
H_{max} = 473 mm



ISM15_LD_8(150_1),
PCD 150 mm
Weight: 25 kg

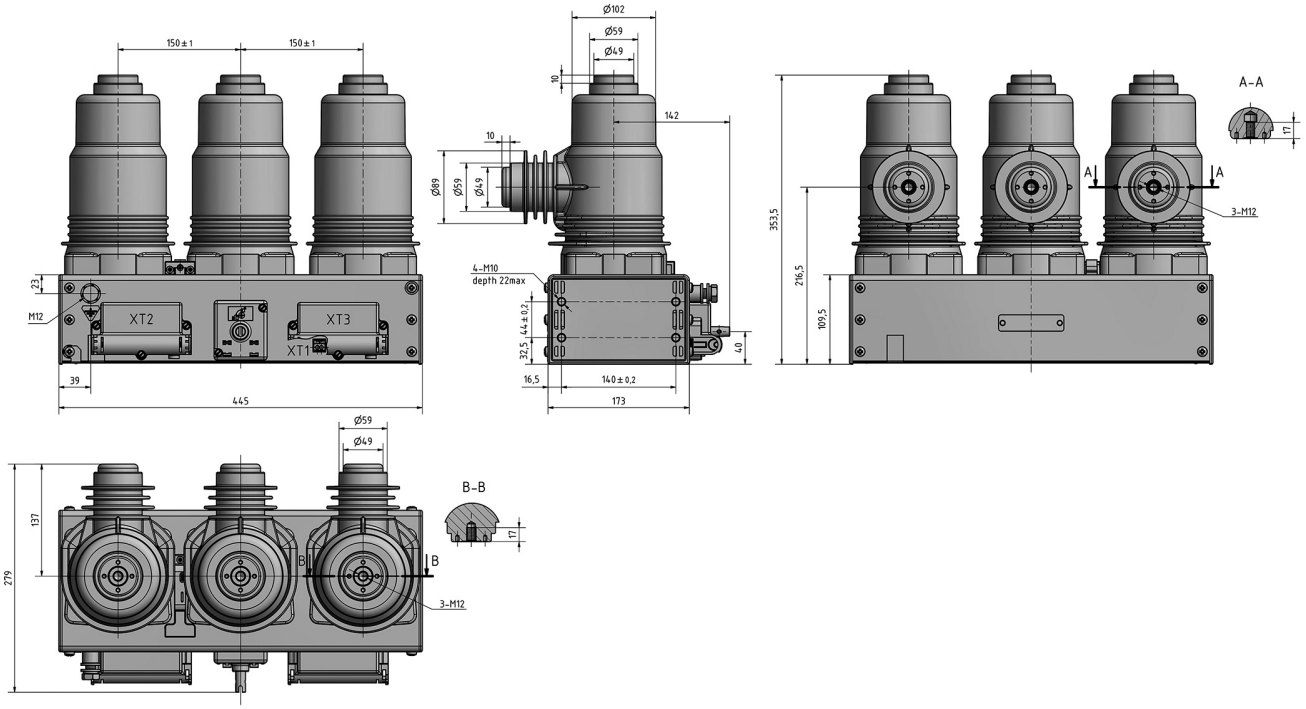
L_{max} = 283.5 mm
W_{max} = 440 mm
H_{max} = 426 mm



ISM15_LD_8(210_1C),
PCD 210 mm
Weight: 26 kg

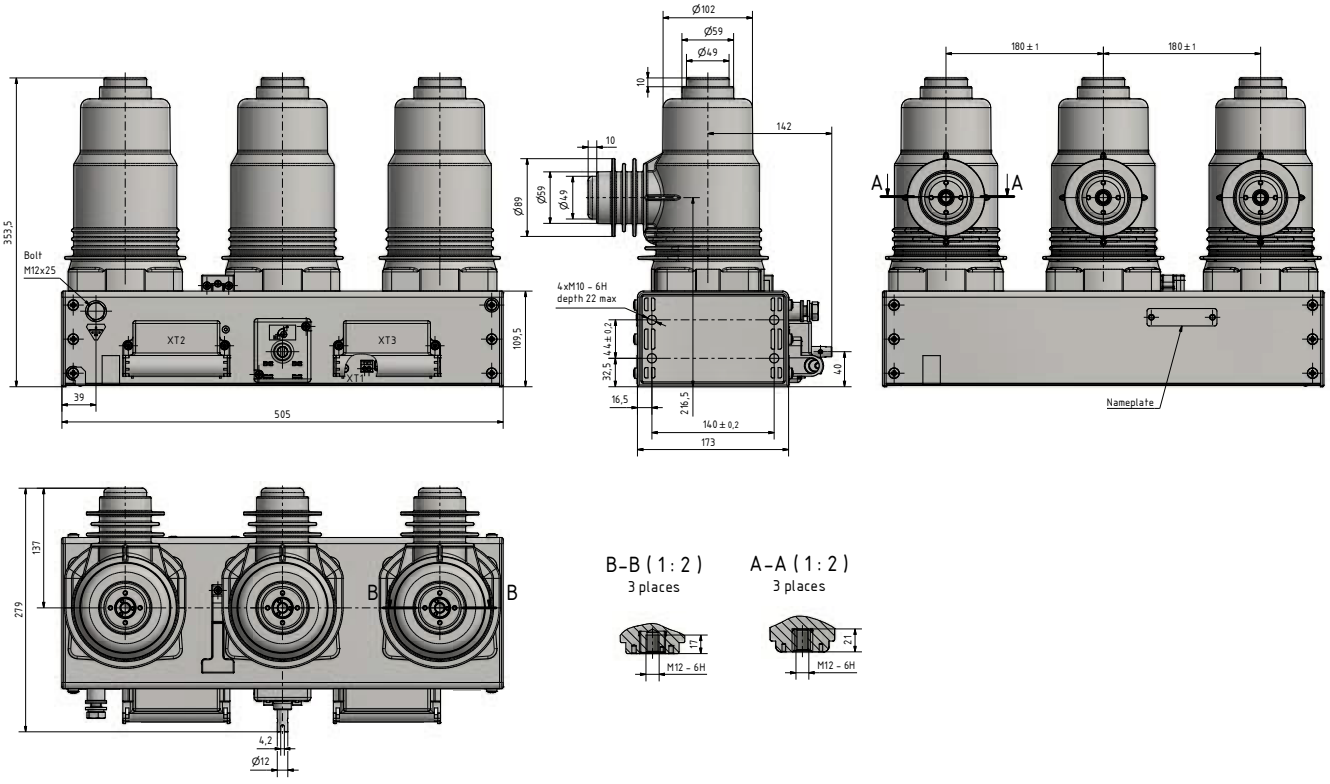
L_{max} = 283.5 mm
W_{max} = 560 mm
H_{max} = 426 mm

ISM15_MD



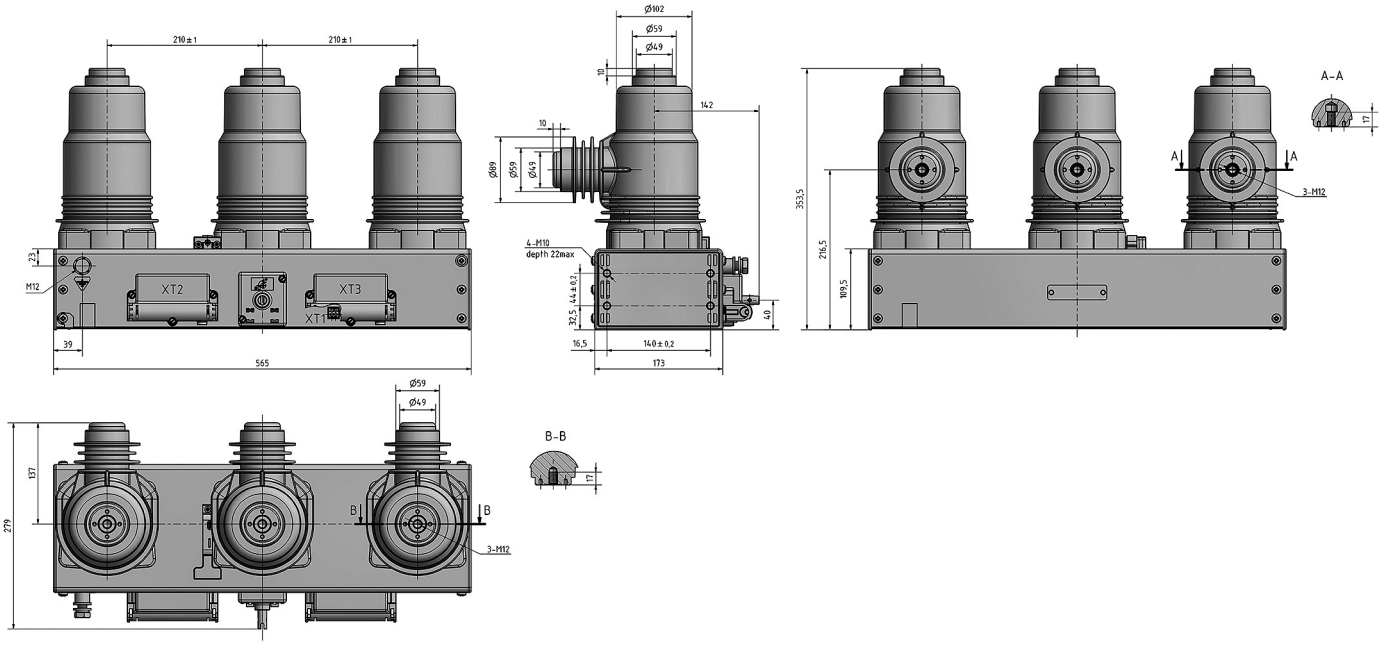
ISM15_MD_1(150_L),
PCD 150 mm,
Weight: 33 kg

L_{max} = 279 mm
W_{max} = 445 mm
H_{max} = 353.5 mm



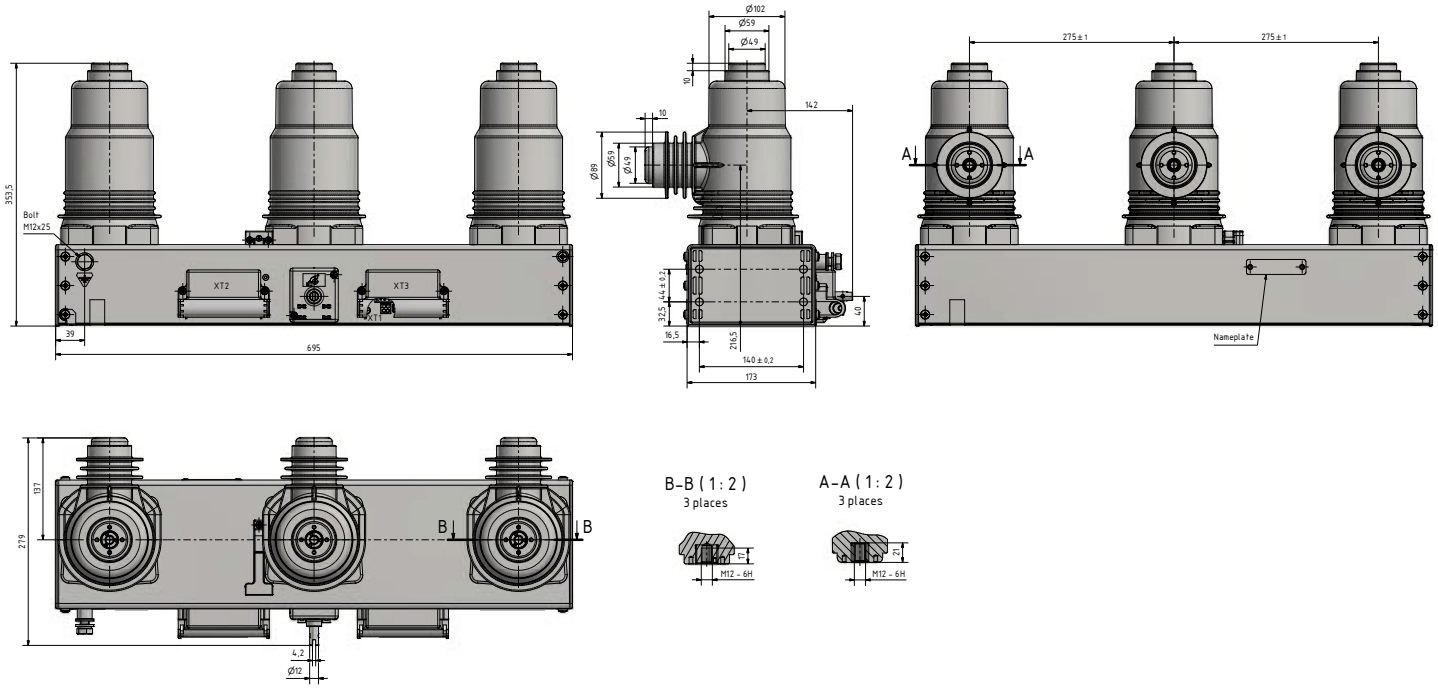
ISM15_MD_1(180_L),
PCD 180 mm,
Weight: 34 kg

L_{max} = 279 mm
W_{max} = 505 mm
H_{max} = 353.5 mm



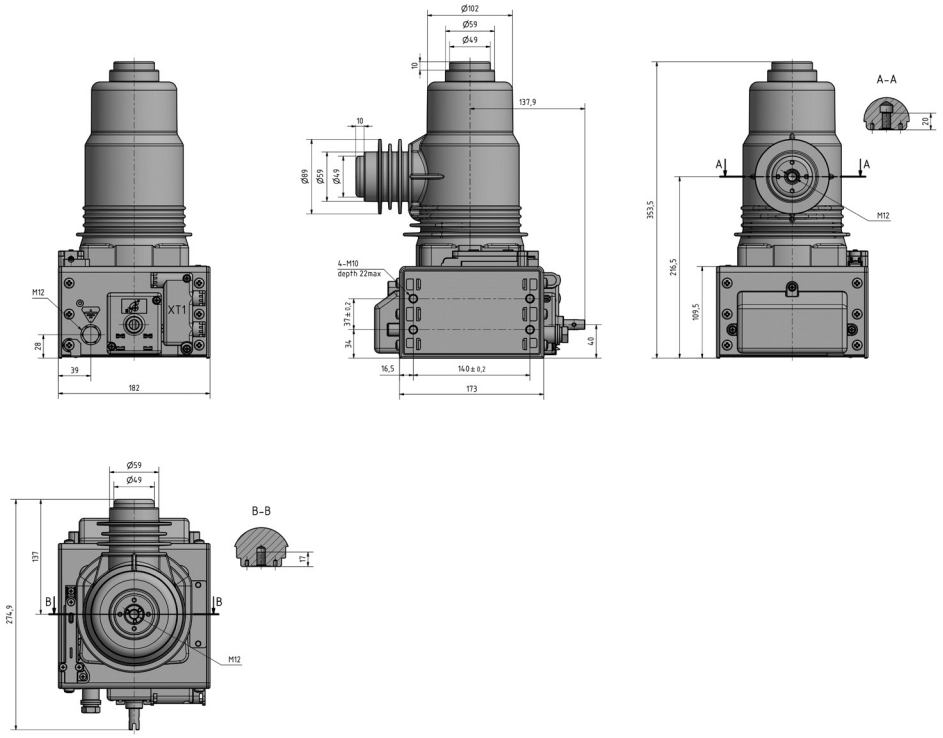
ISM15_MD_1(210_L),
PCD 210 mm,
Weight: 35 kg

L_{max} = 279 mm
W_{max} = 565 mm
H_{max} = 353.5 mm



ISM15_MD_1(275_L),
PCD 275 mm,
Weight: 37 kg

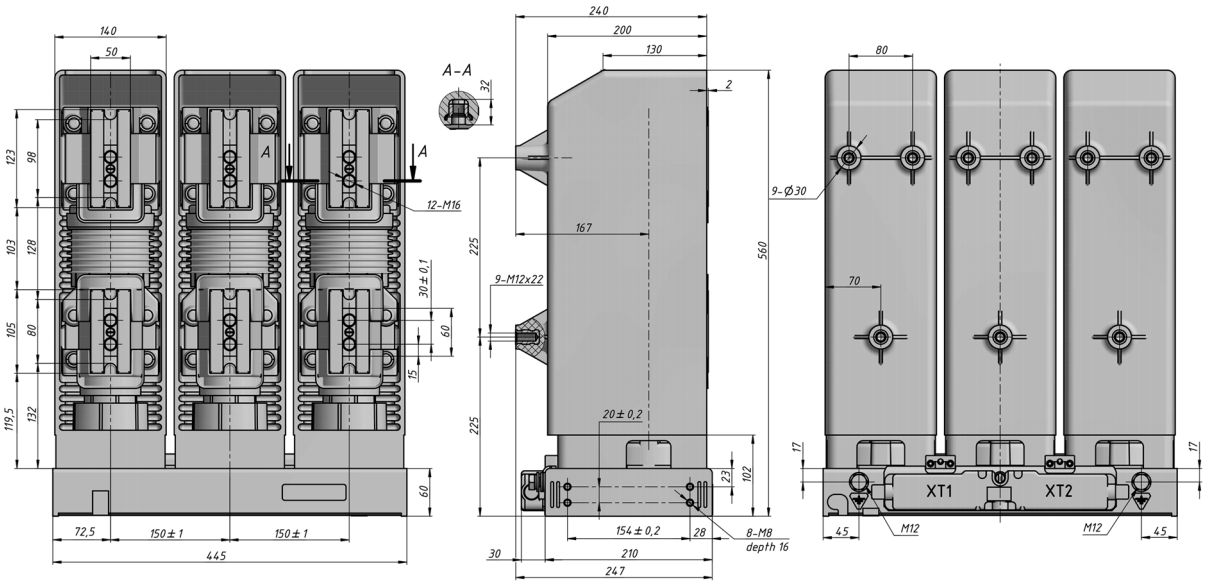
L_{max} = 279 mm
W_{max} = 695 mm
H_{max} = 353.5 mm



ISM15_MD_3,
Weight: 13 kg

L_{max} ***= 274.9 mm***
W_{max} ***= 182 mm***
H_{max} ***= 353.5 mm***

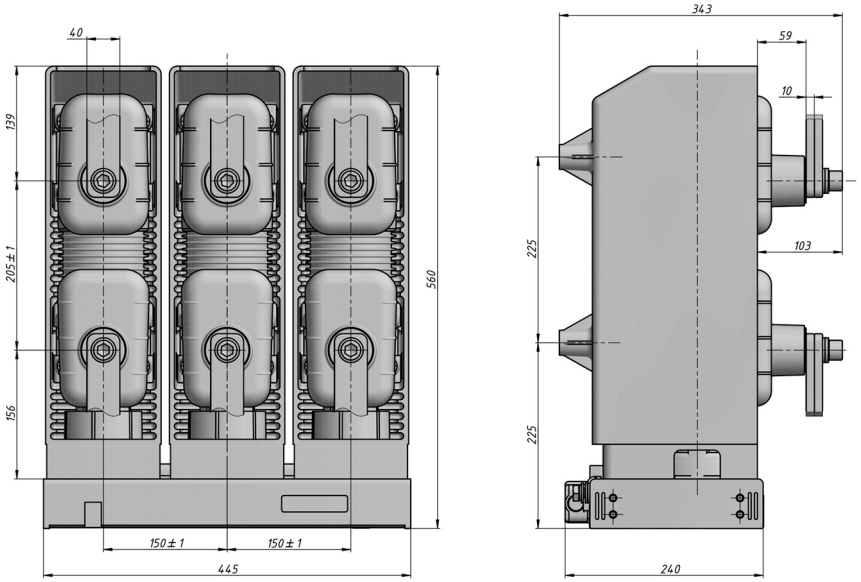
ISM15_Shell



ISM15_Shell_2(150_L), ***L_{max} = 247 mm***

PCD 150 mm, ***W_{max} = 445 mm***

Weight: 51 kg ***H_{max} = 560 mm***

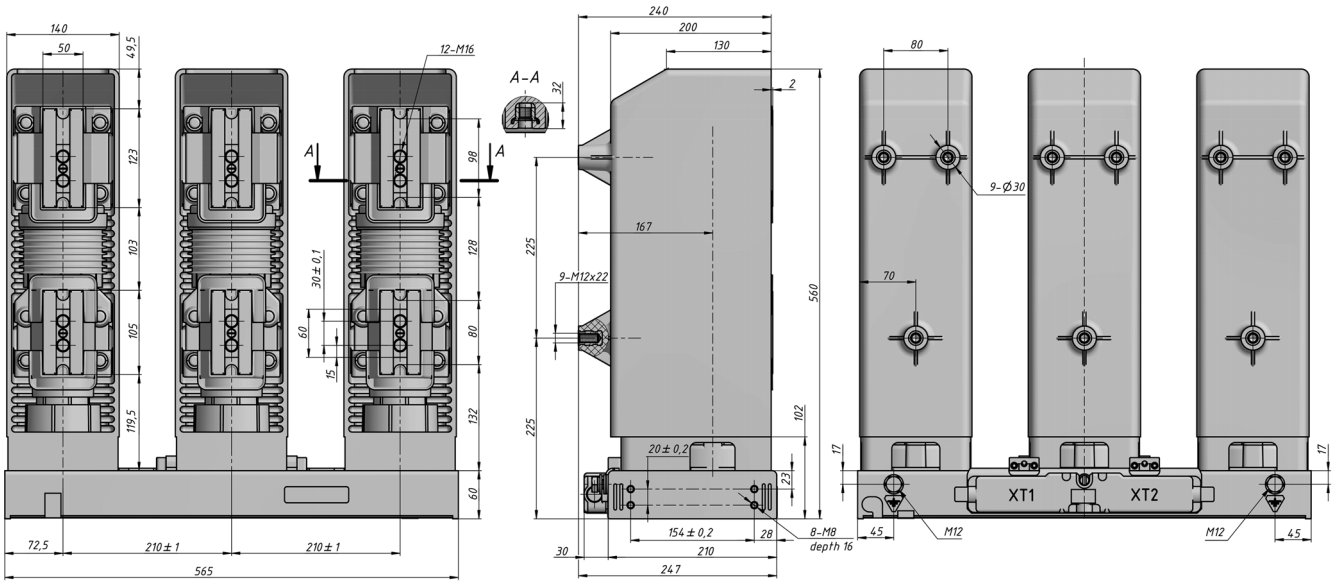


ISM15_Shell_2(150_L) with CBkit_Shell15_1(205) installed*, ***L_{max} = 343 mm***

PCD 150 mm, ***W_{max} = 445 mm***

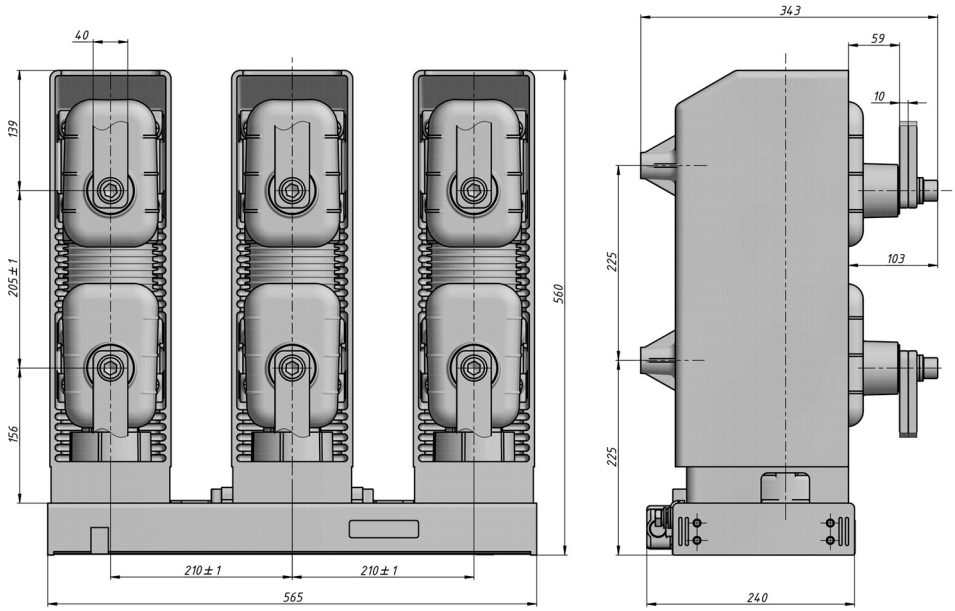
Weight: 59,5 kg ***H_{max} = 560 mm***

****- busbars shown for reference and are not supplied.***



ISM15_Shell_2(210_L),
PCD 210 mm,
Weight: 52 kg

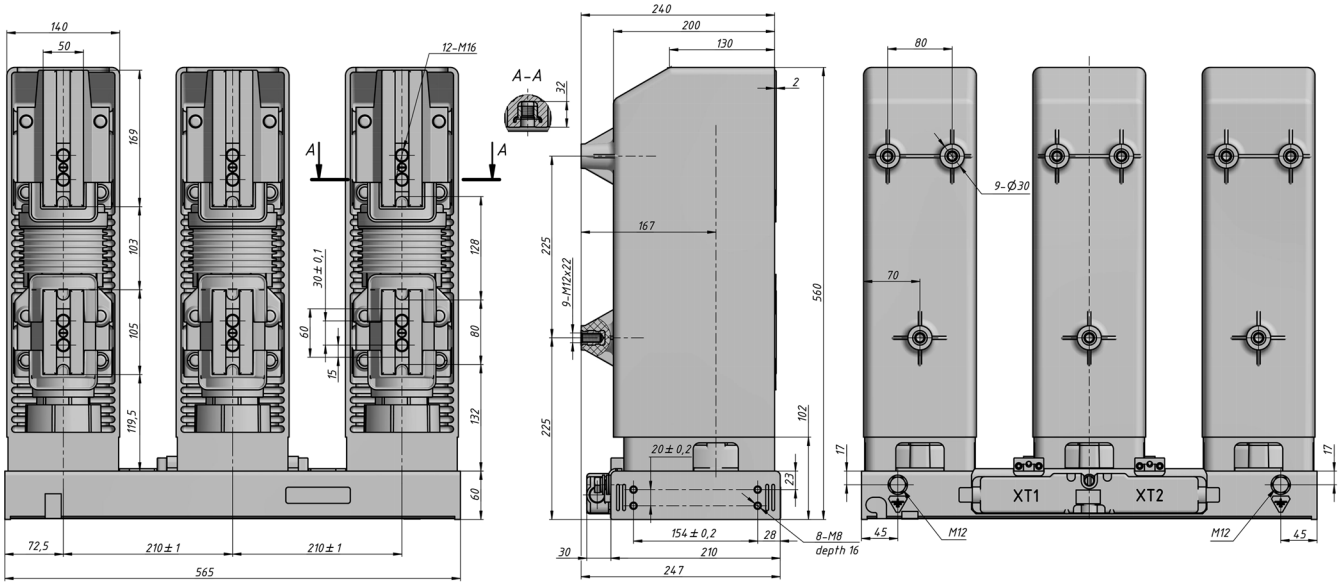
L_{max} ***= 247 mm***
W_{max} ***= 565 mm***
H_{max} ***= 560 mm***



ISM15_Shell_2(210_L) with CBkit_Shell15_1(205) installed*,
PCD 210 mm,
Weight: 60,5 kg

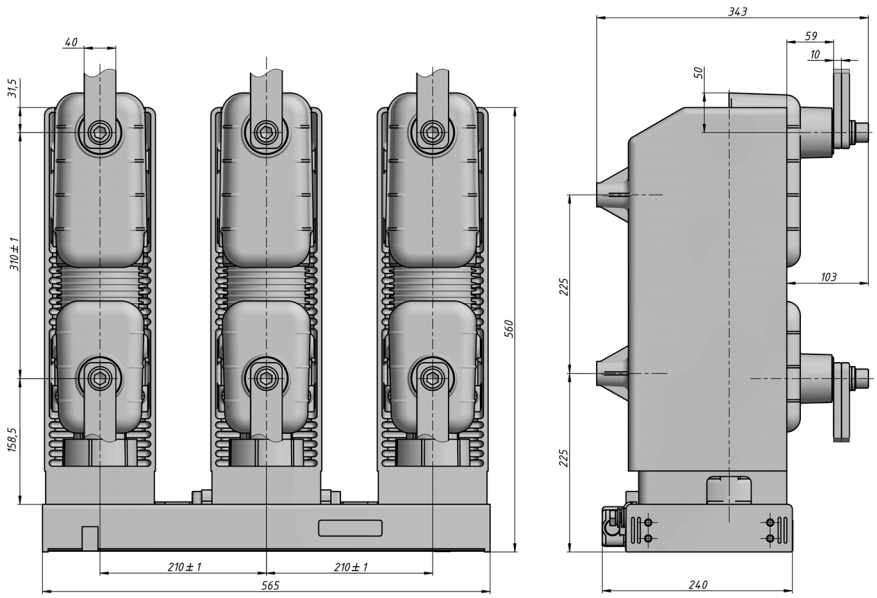
L_{max} ***= 343 mm***
W_{max} ***= 565 mm***
H_{max} ***= 560 mm***

****- busbars shown for reference and are not supplied.***



ISM15_Shell_2(210_H),
PCD 210 mm,
Weight: 53 kg

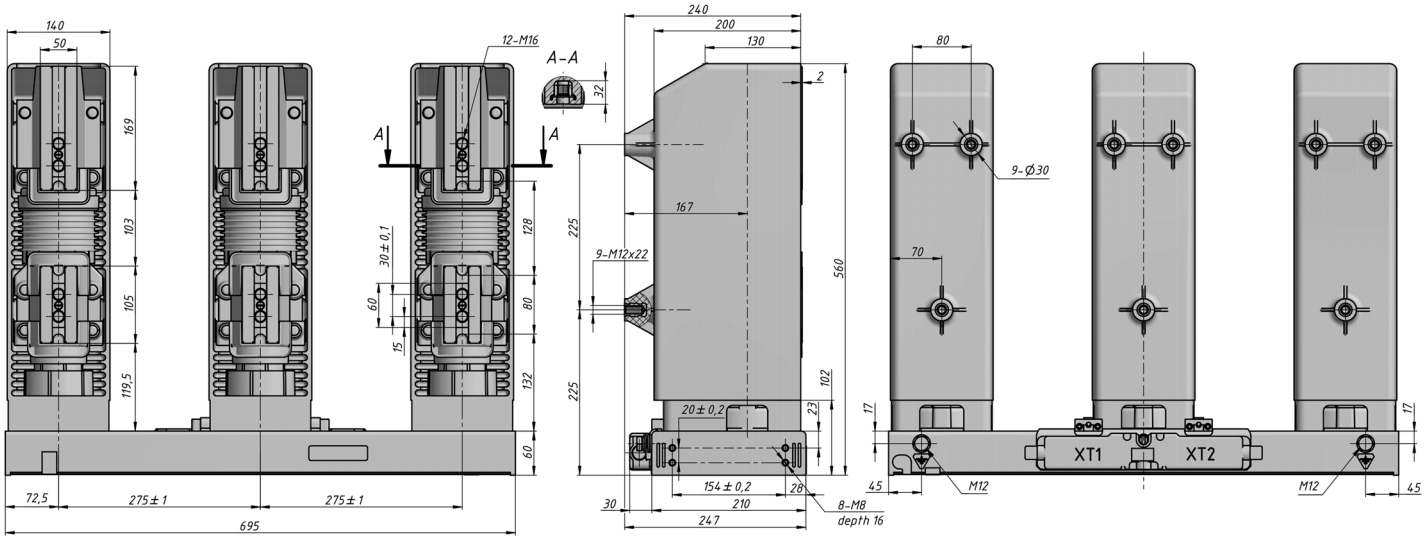
L_{max} = 247 mm
W_{max} = 565 mm
H_{max} = 560 mm



ISM15_Shell_2(210_H) with CBkit_Shell15_1(310) installed,*
PCD 210 mm,
Weight: 61,5 kg

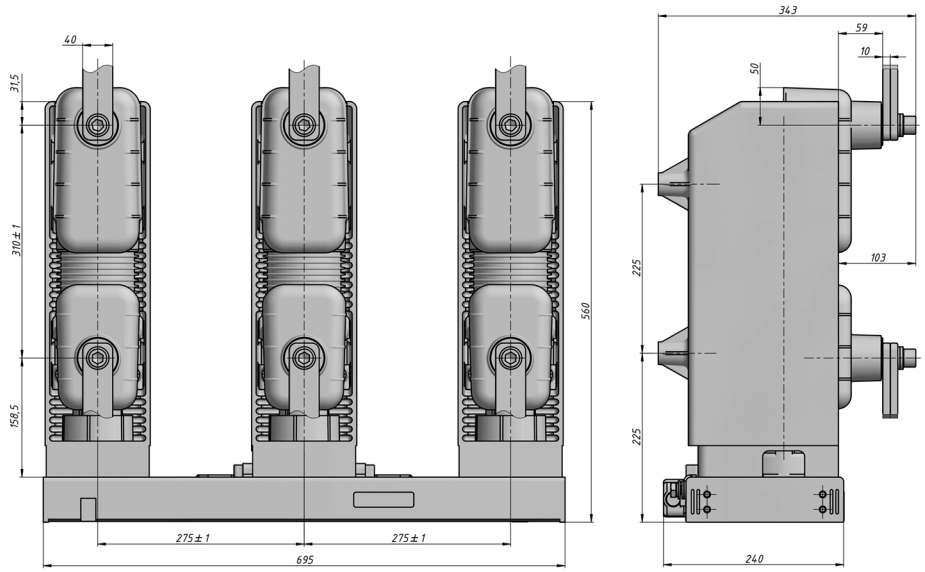
L_{max} = 343 mm
W_{max} = 565 mm
H_{max} = 560 mm

**- busbars shown for reference and are not supplied.*



ISM15_Shell_2(275_H),
PCD 275 mm,
Weight: 55 kg

L_{max} ***= 247 mm***
W_{max} ***= 695 mm***
H_{max} ***= 560 mm***

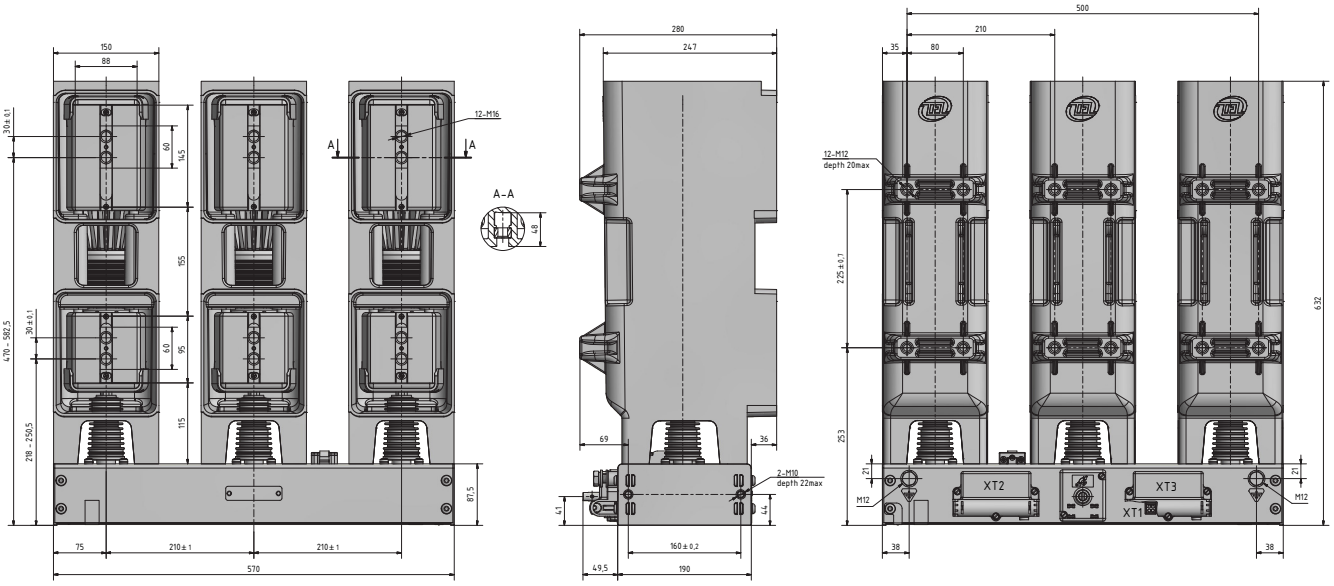


ISM15_Shell_2(275_H) with CBkit_Shell15_1(310) installed*,
PCD 275 mm,
Weight: 63,5 kg

L_{max} ***= 343 mm***
W_{max} ***= 695 mm***
H_{max} ***= 560 mm***

****- busbars shown for reference and are not supplied.***

ISM15_HD



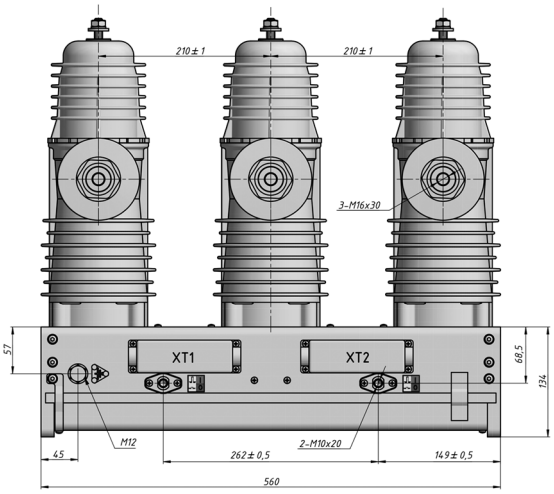
ISM15_HD_1(210),
PCD 210 mm,
Weight: 70 kg

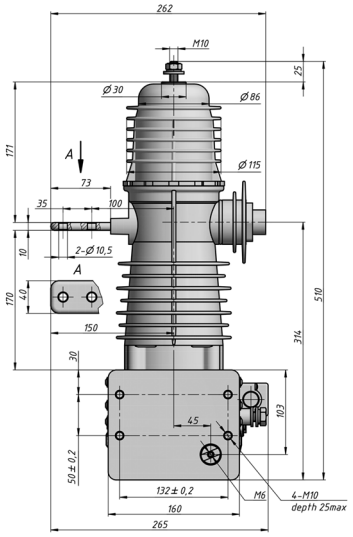
L_{max} = 280 mm
W_{max} = 570 mm
H_{max} = 632 mm

ISM15_HD_1(275),
PCD 275 mm,
Weight: 72 kg

L_{max} = 280 mm
W_{max} = 700 mm
H_{max} = 632 mm

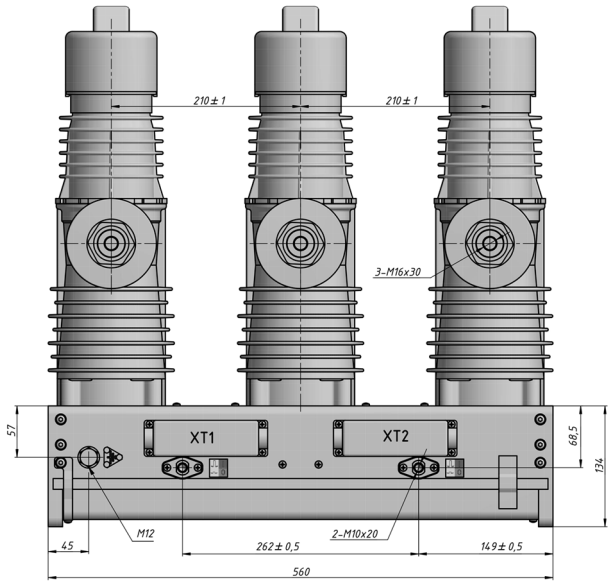
ISM25_LD

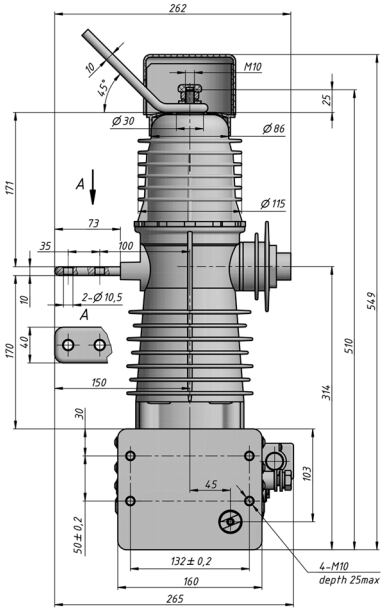




ISM25_LD_1(210_Par2),
PCD 210 mm
Weight: 36 kg

L_{max} = 265 mm
W_{max} = 560 mm
H_{max} = 510 mm

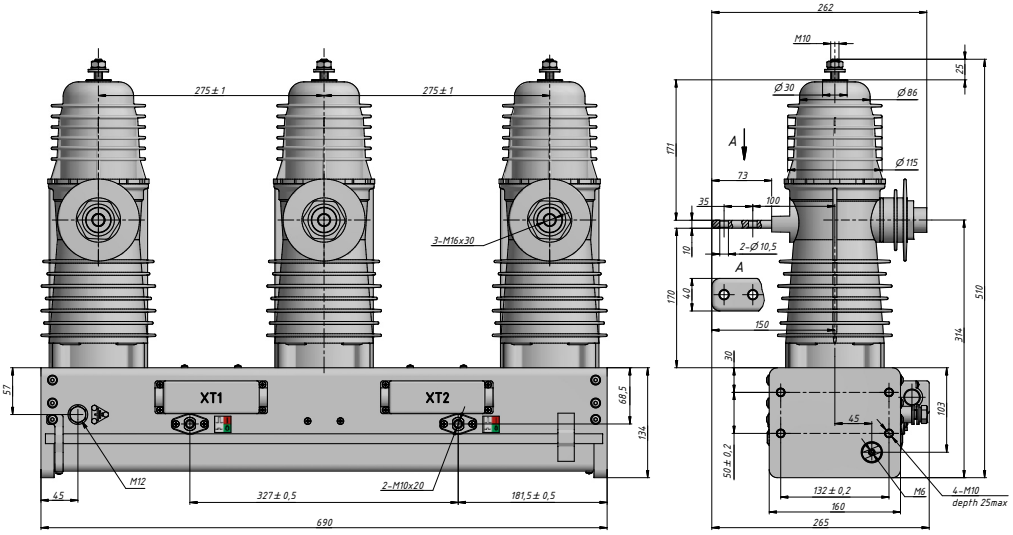




ISM25_LD_1(210_Par2) with CBkit_Ins_3 installed*,
PCD 210 mm,
Weight: 36,5 kg

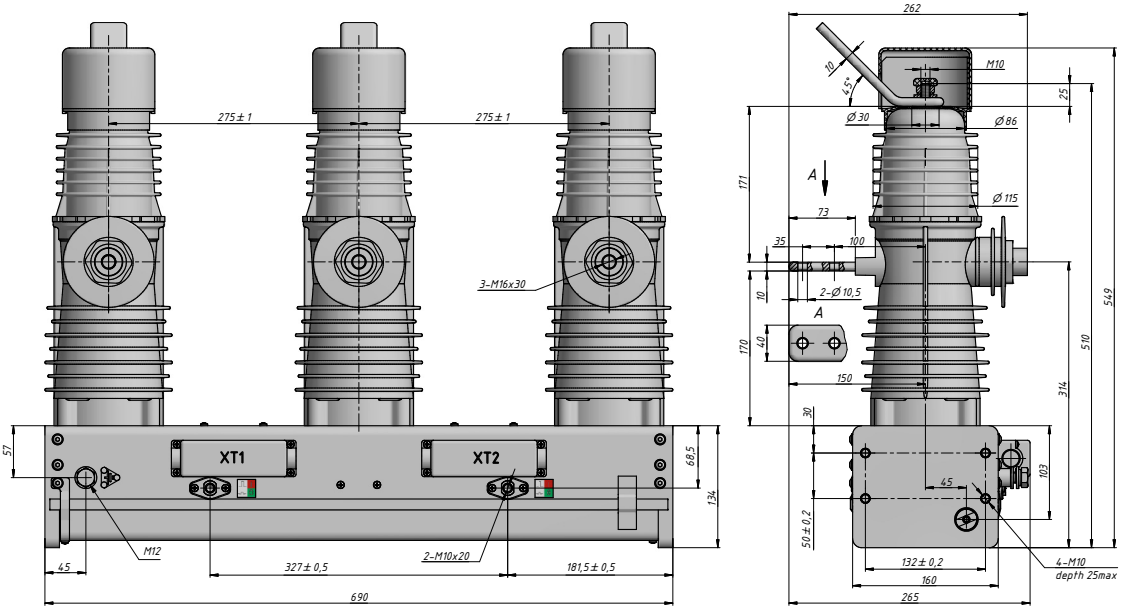
L_{max} = 265 mm
W_{max} = 560 mm
H_{max} = 549 mm

****- upper busbars shown for reference and are not supplied.***



ISM25_LD_1(275_S),
PCD 275 mm
Weight: 38 kg

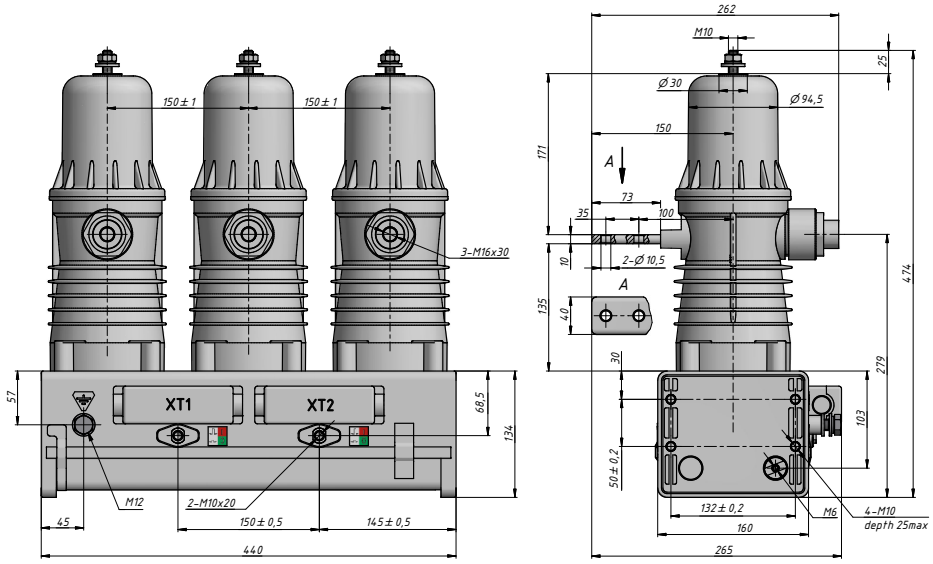
L_{max} = 265 mm
W_{max} = 690 mm
H_{max} = 510 mm



ISM25_LD_1(275_S) with CBkit_Ins_3 installed*,
PCD 275 mm,
Weight: 38,5 kg

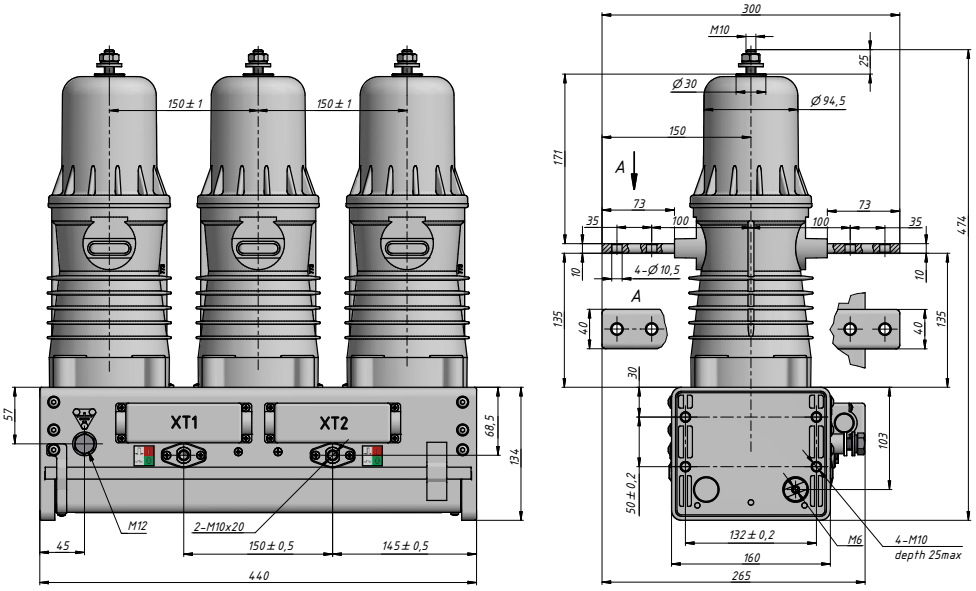
L_{max} = 265 mm
W_{max} = 690 mm
H_{max} = 549 mm

****- upper busbars shown for reference and are not supplied.***



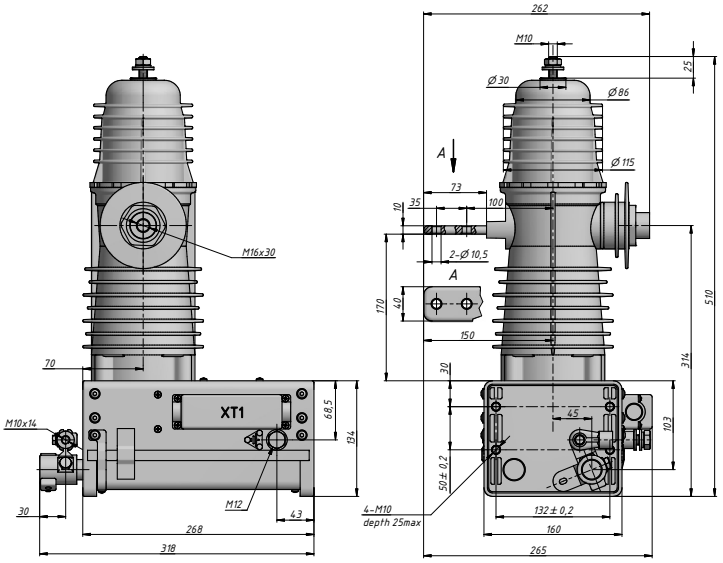
ISM25_LD_2(1),
PCD 150 mm
Weight: 35 kg

L_{max} = 265 mm
W_{max} = 440 mm
H_{max} = 474 mm



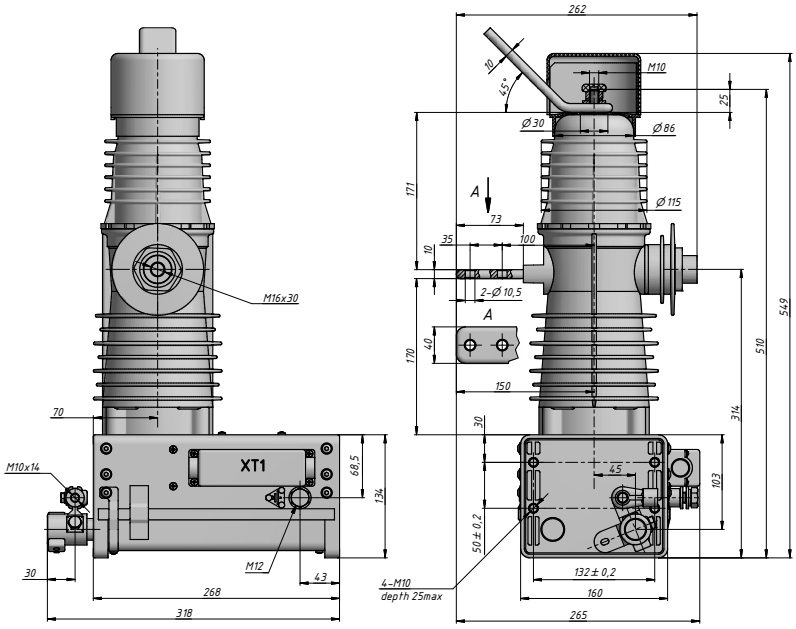
ISM25_LD_2(2),
PCD 150 mm
Weight: 37 kg

L_{max} = 300 mm
W_{max} = 440 mm
H_{max} = 474 mm



ISM25_LD_3,
Weight: 14 kg

L_{max} = 265 mm
W_{max} = 318 mm
H_{max} = 510 mm

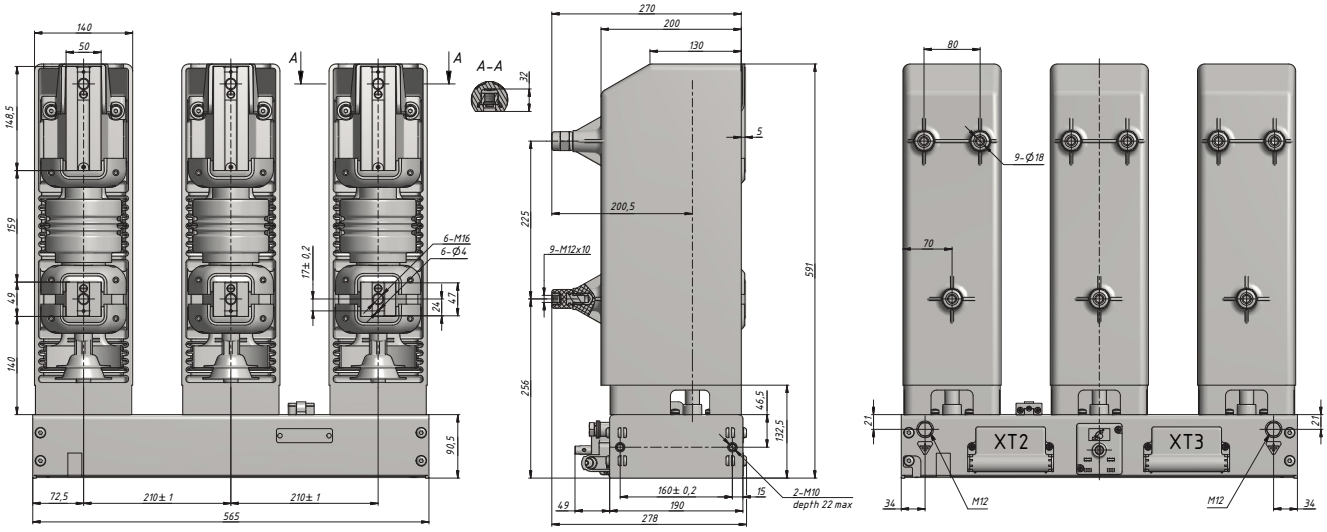


ISM25_LD_3 with CBkit_Ins_3 installed*,
Weight: 14,5 kg

L_{max} = 265 mm
W_{max} = 318 mm
H_{max} = 549 mm

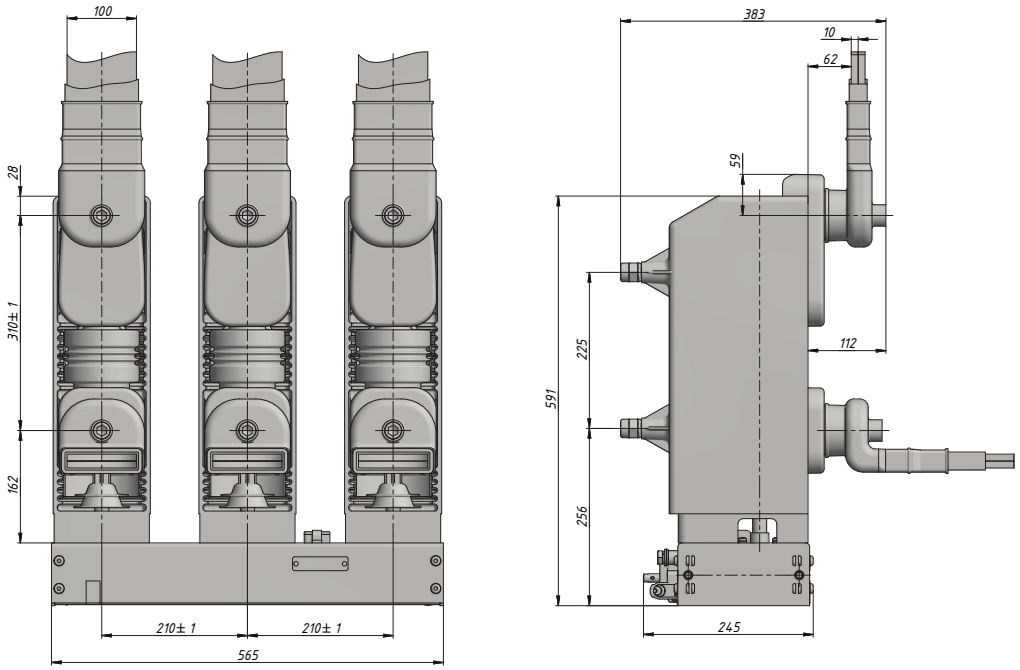
****- upper busbar shown for reference and is not supplied.***

ISM25_Shell



ISM25_Shell_2(210),
PCD 210 mm,
Weight: 53 kg

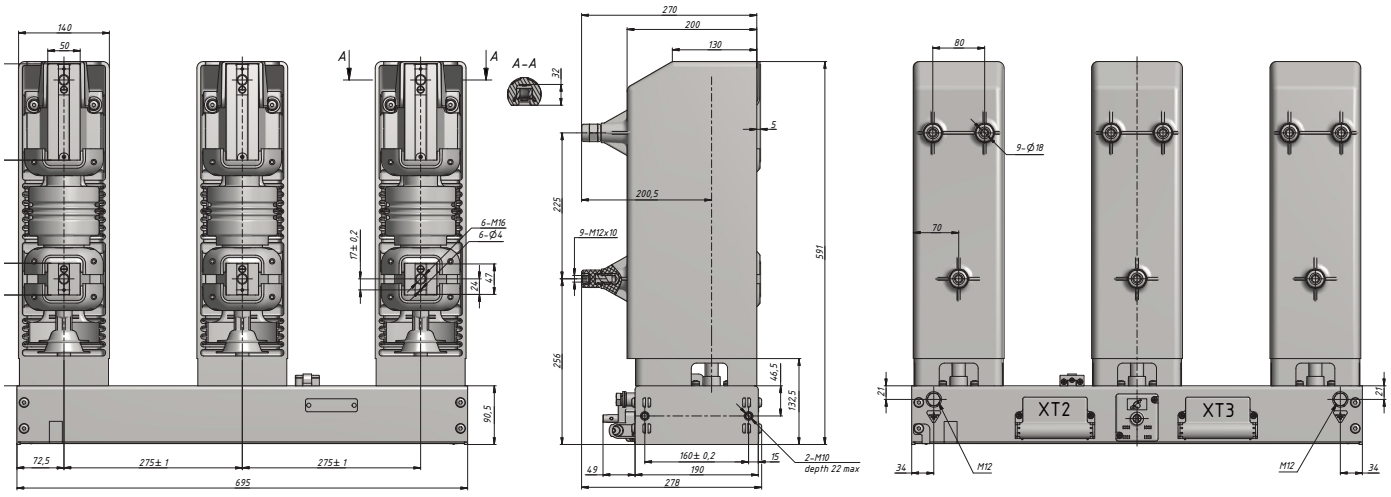
L_{max} = 278 mm
W_{max} = 565 mm
H_{max} = 591 mm



ISM25_Shell_2(210) with CBkit_Shell25_1 installed*,
PCD 210 mm,
Weight: 65,5 kg

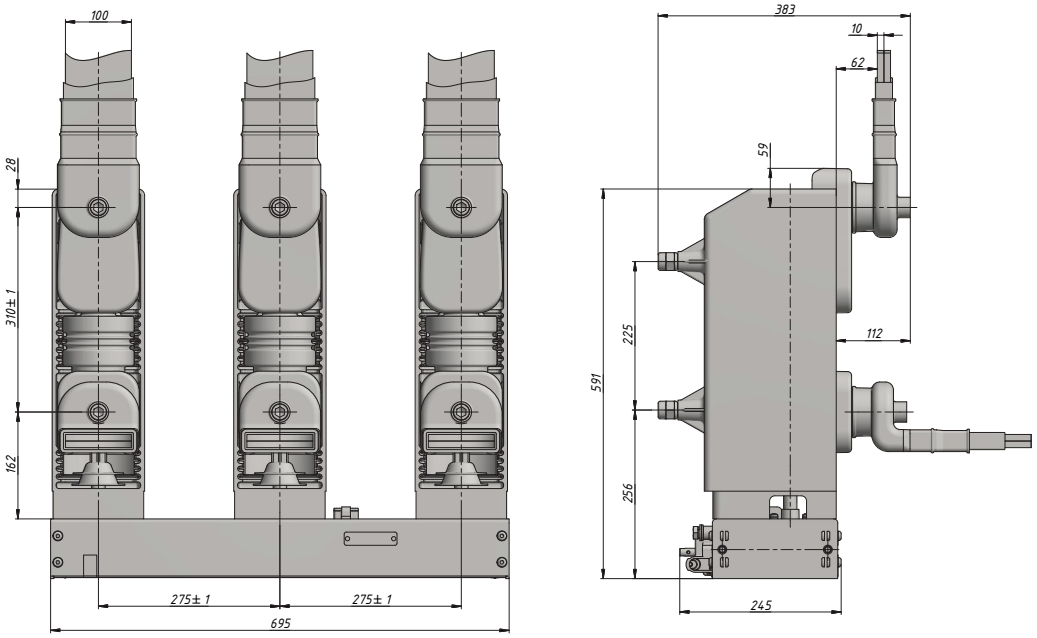
L_{max} = 383 mm
W_{max} = 565 mm
H_{max} = 622 mm

****- busbars shown for reference and are not supplied.***



ISM25_Shell_2(275),
PCD 275 mm,
Weight: 55 kg

L_{max} = 278 mm
W_{max} = 695 mm
H_{max} = 591 mm

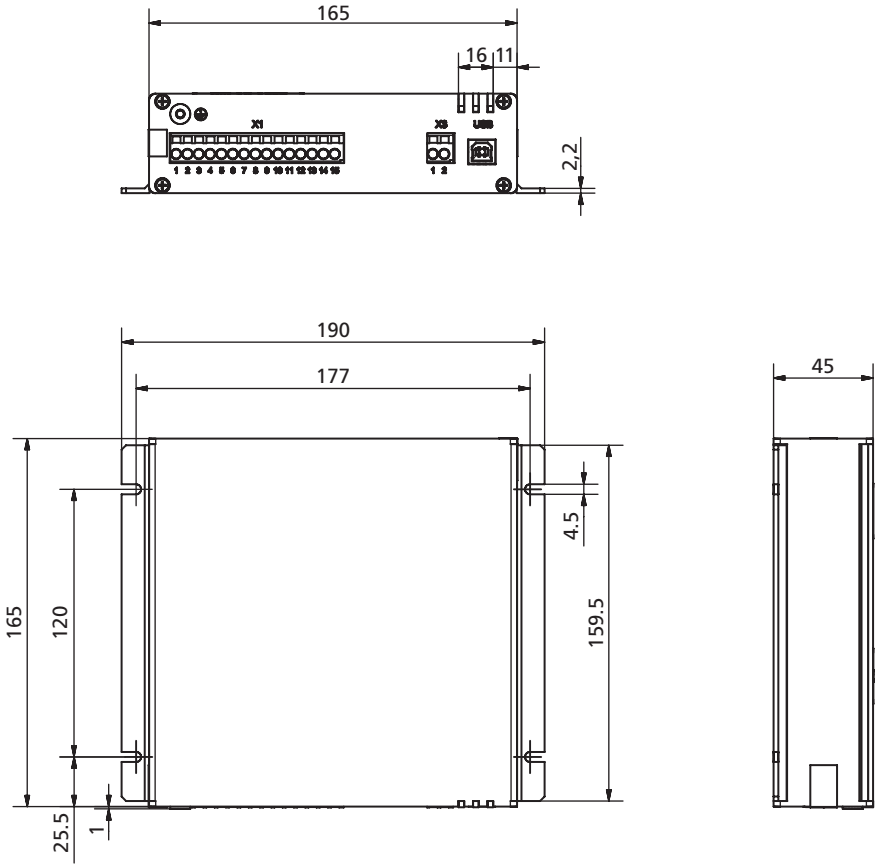


ISM25_Shell_2(275) with CBkit_Shell25_1 installed*,
PCD 275 mm,
Weight: 67,5 kg

L_{max} = 383 mm
W_{max} = 695 mm
H_{max} = 622 mm

****- busbars shown for reference and are not supplied.***

Dimensions of Control Module

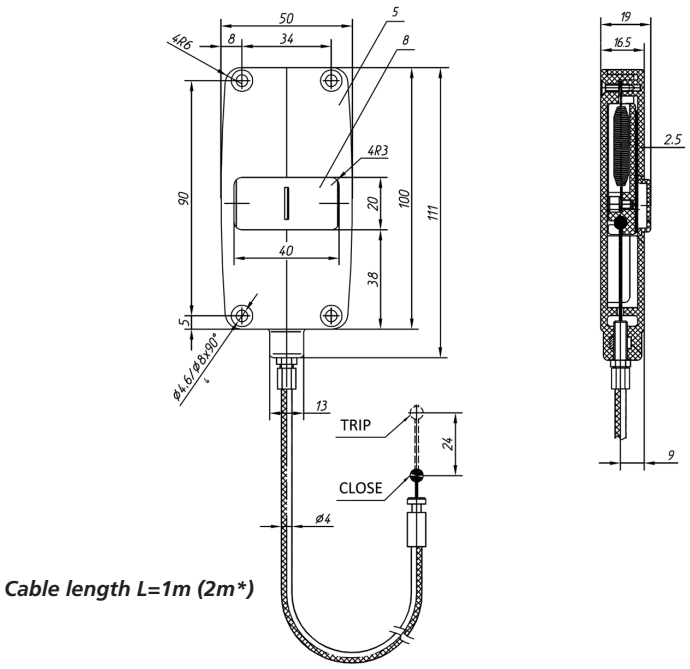


CM_16_1(Par1_Par2_Par3_Par4_Par5)
Weight: 1 kg

L_{max} = 165 mm
W_{max} = 190 mm
H_{max} = 45 mm

Dimensions of accessories

Dimensions of Position Indicator

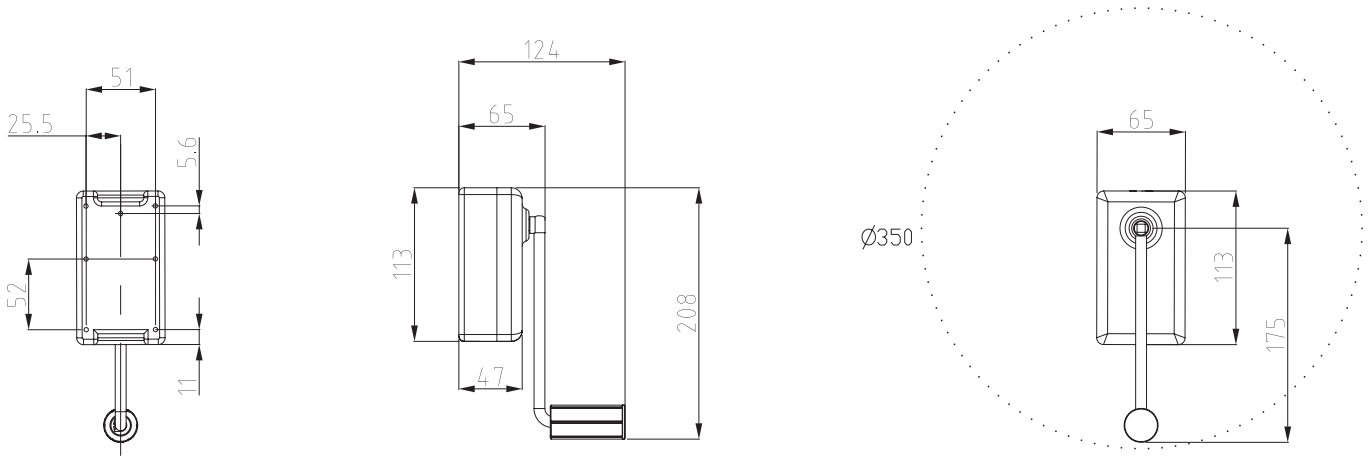


Cable length L=1m (2m*)

CBkit_PosInd_1(1000)

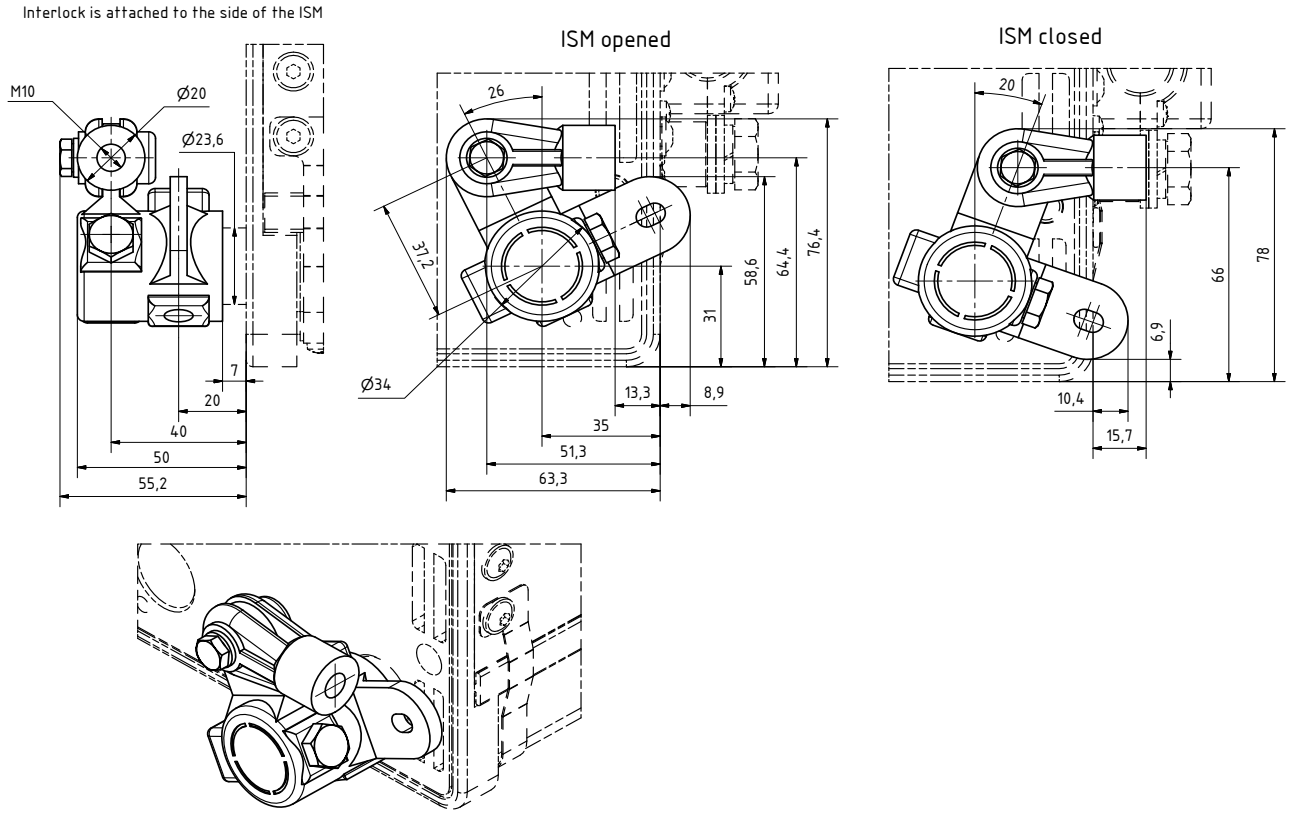
**** 2 m for CBkit_PosInd_1(2000)***

Dimensions of Manual Generator

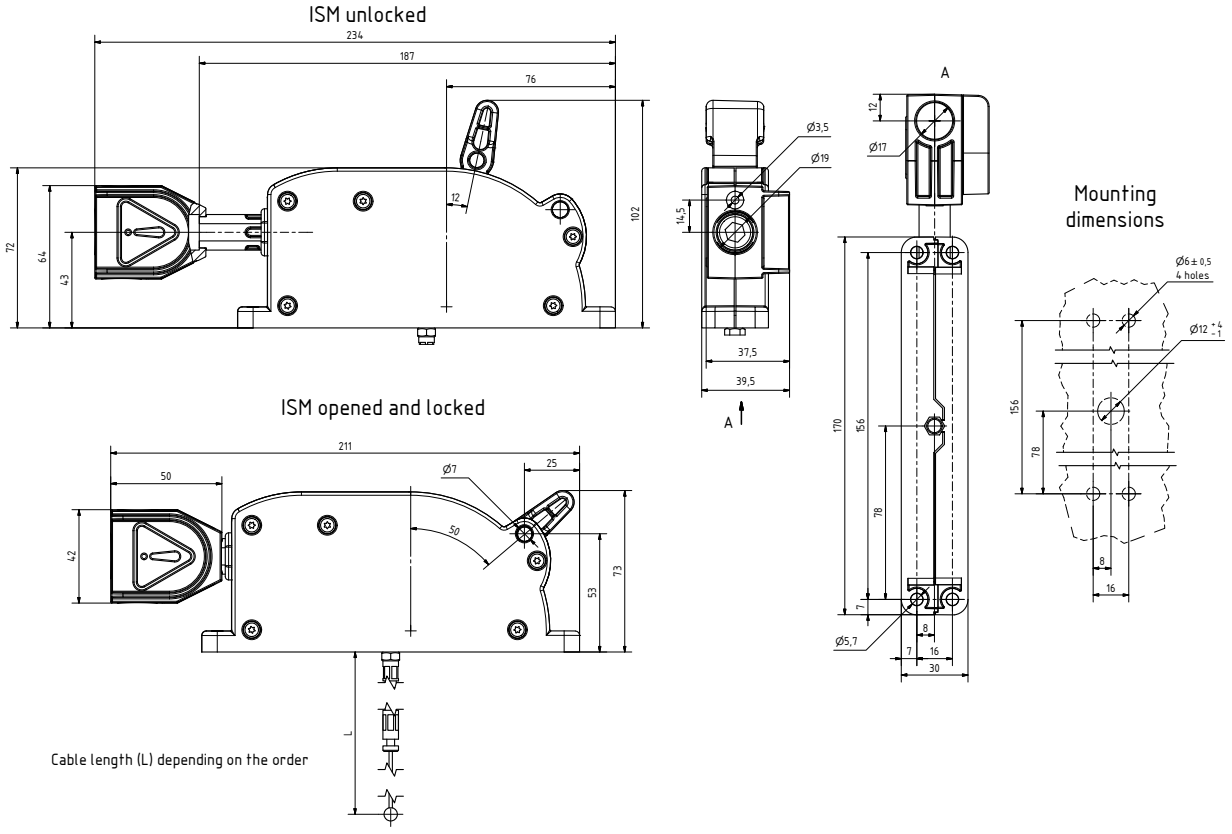


CBunit_ManGen_1, CBunit_ ManGen_2

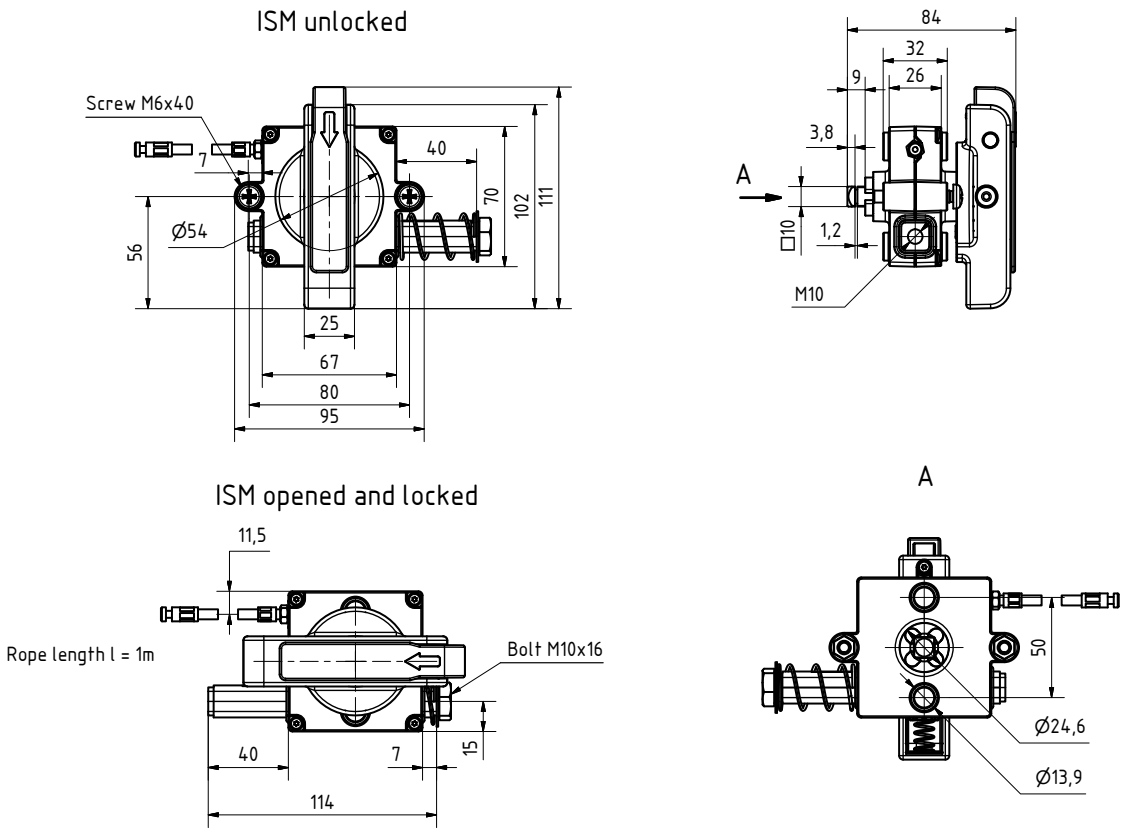
Dimensions of Interlocking Kits



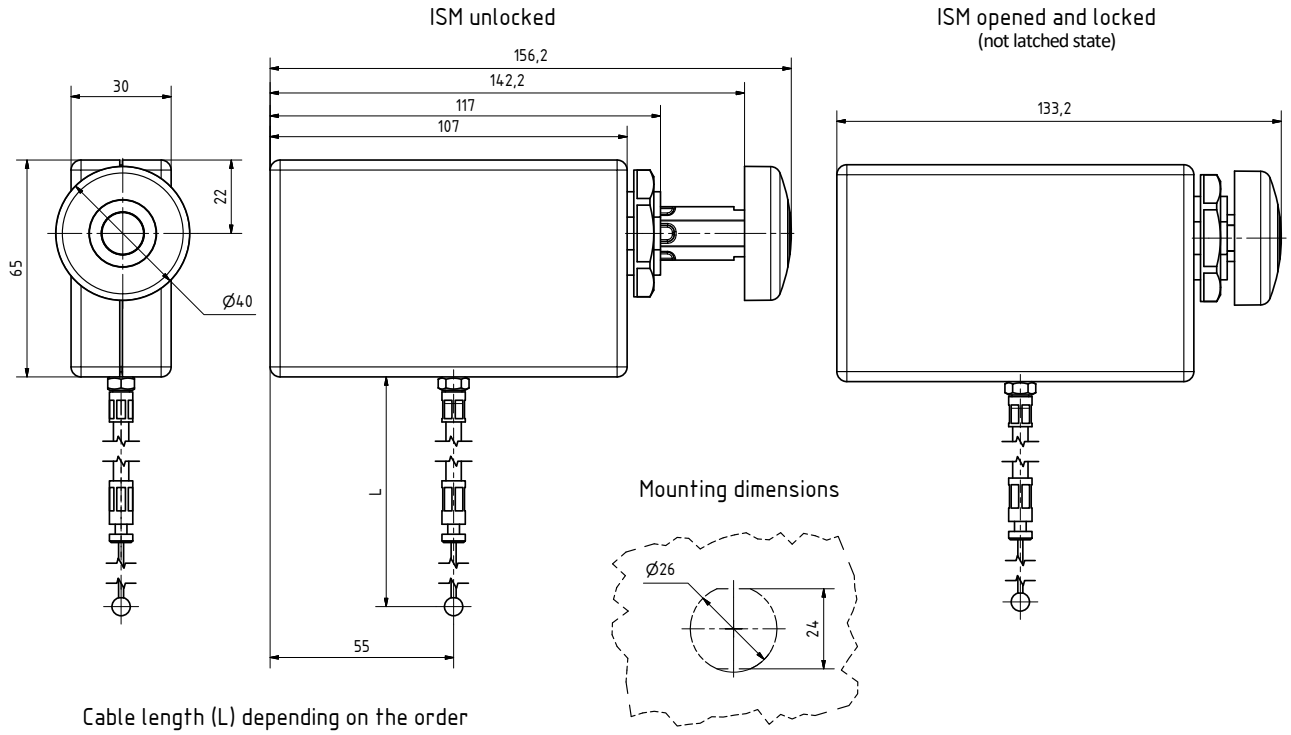
CBkit_Interlock_1



CBkit_Interlock_3



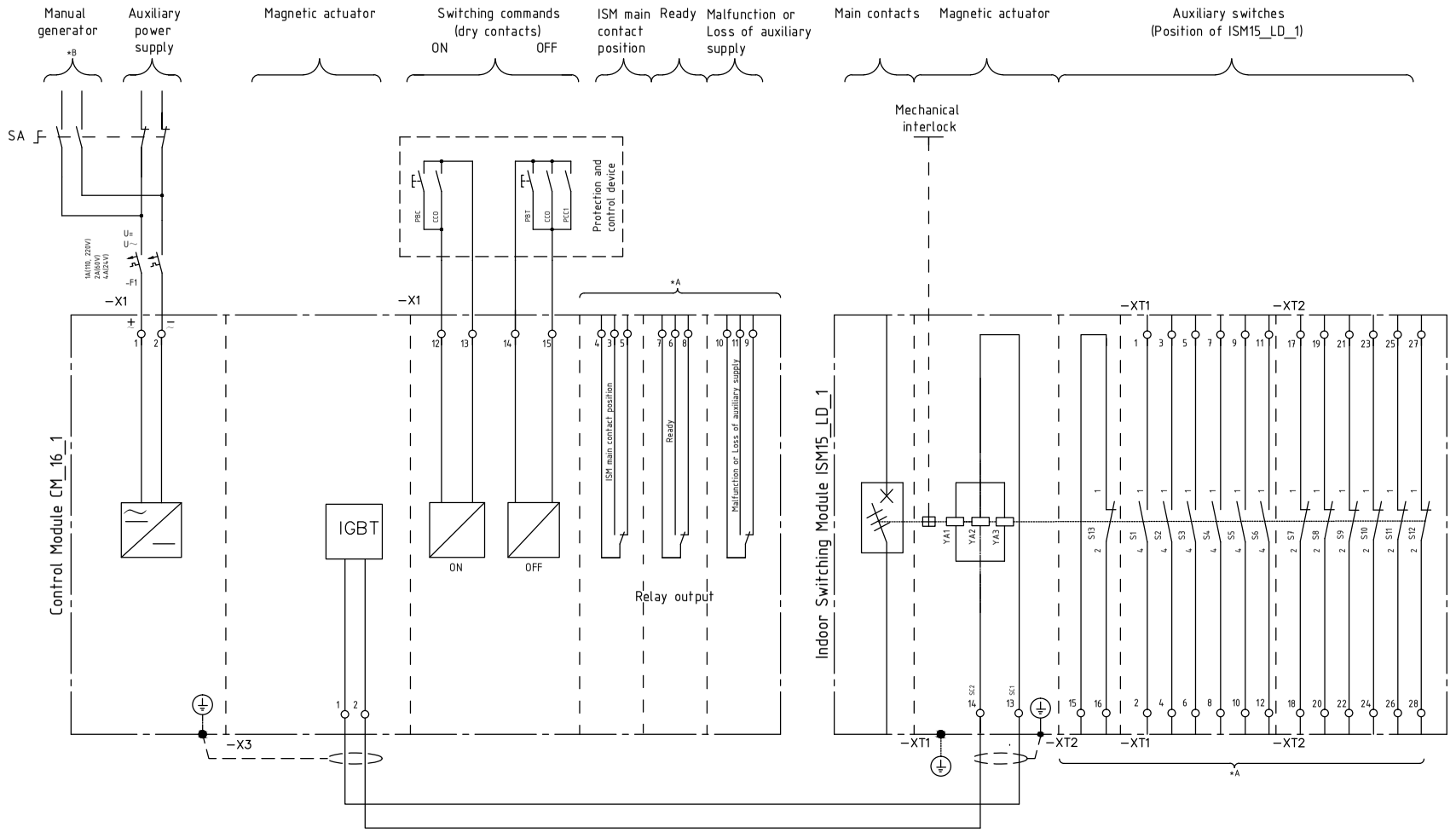
CBkit_Interlock_4



CBkit_Interlock_5

Appendix 3.
Secondary Schemes

VCB15_LD1_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1–XT2	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1, X3	Terminal block of control module;
		S1–S13	Auxiliary switch of ISM;
		YA1–YA3	Actuator coils.
PBC	Push button close;		
PBT	Push button trip;		
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

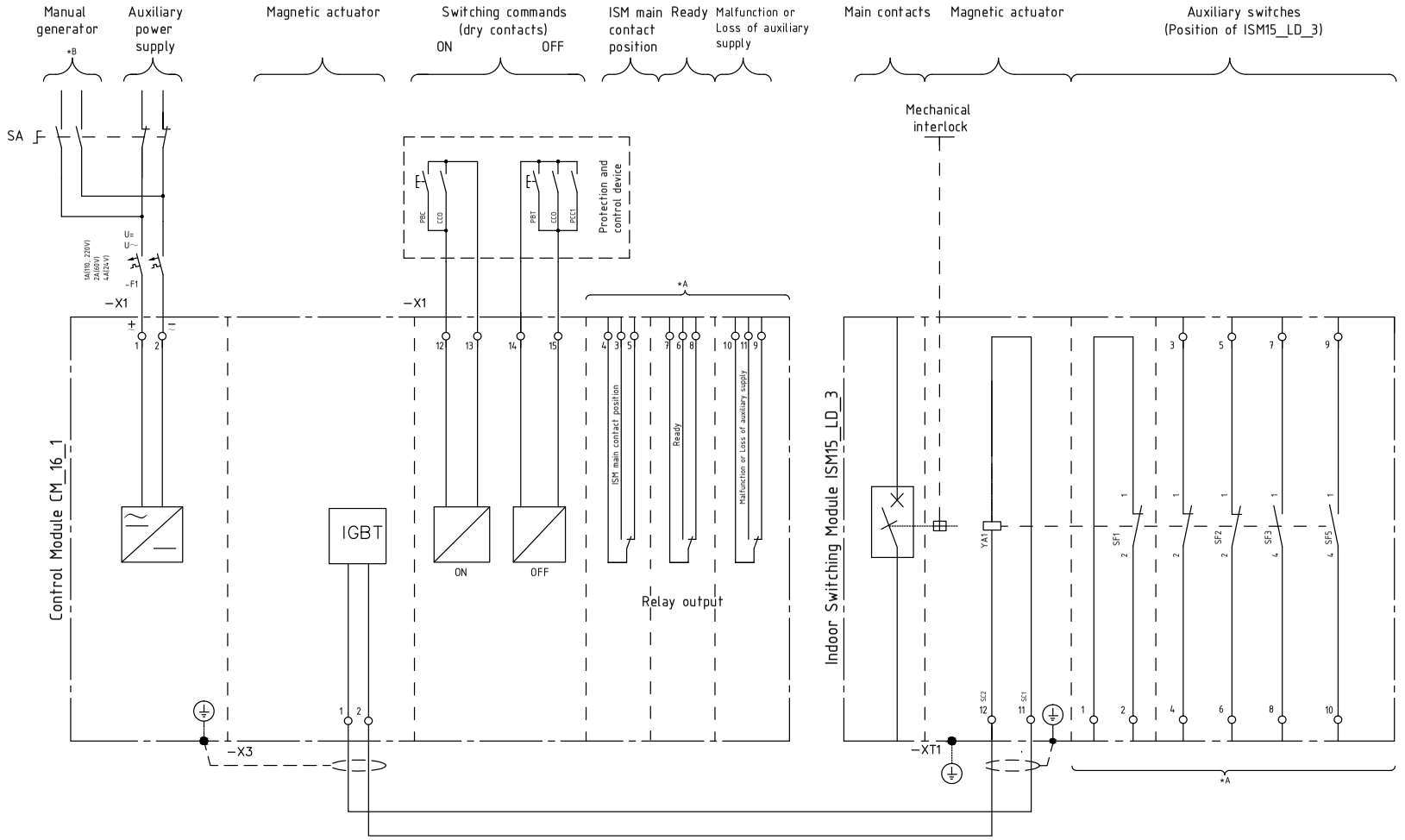
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB15_LD1_16.FED4	07.10.2019	–	

TAVRIDA ELECTRIC TES

Switching module
Electrical Connection Diagram

TES_VCB15_LD1_16.FED4	Edition	Sheet
	B	1 / 1

VCB15_LD3_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	Manual generator (optional);
SA	Power supply selector switch (optional);
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button trip;
IGBT	Transistor bridge (coils control);
CCO	Control command ON, OFF;
PCC1	Protection control contact 1;
XT1	Terminal block of switching module;
X1, X3	Terminal block of control module;
YA1	Actuator coil.

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB15_LD3_16.FED4	07.10.2019	-	

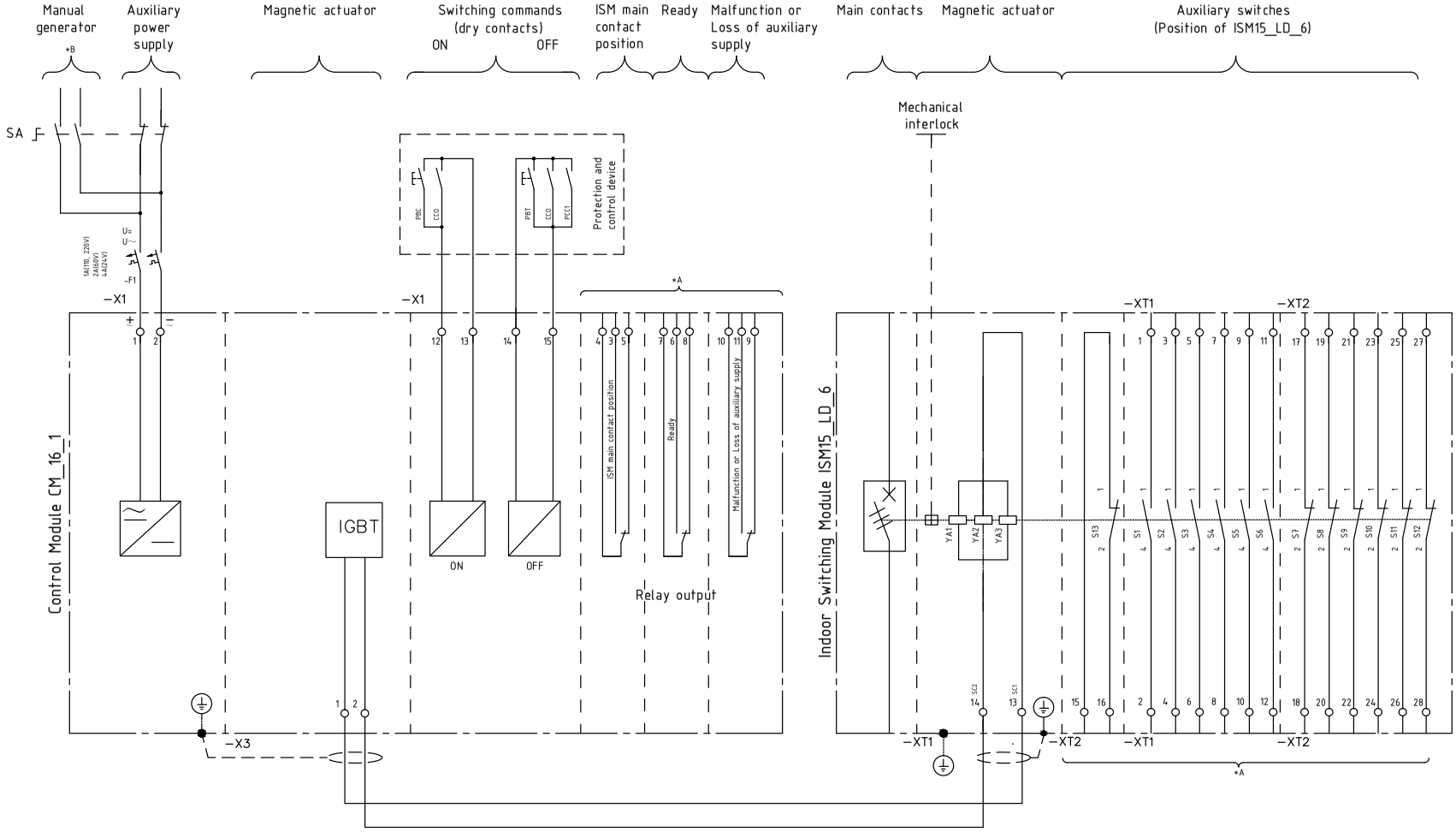
TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_LD3_16.FED4	Edition	Sheet
	B	1 / 1

VCB15_LD6_16.RD

Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1-XT2	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1, X3	Terminal block of control module;
		S1~S13	Auxiliary switch of ISM;
PBC	Push button close;	YA1-YA3	Actuator coils.
PBT	Push button trip;		
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

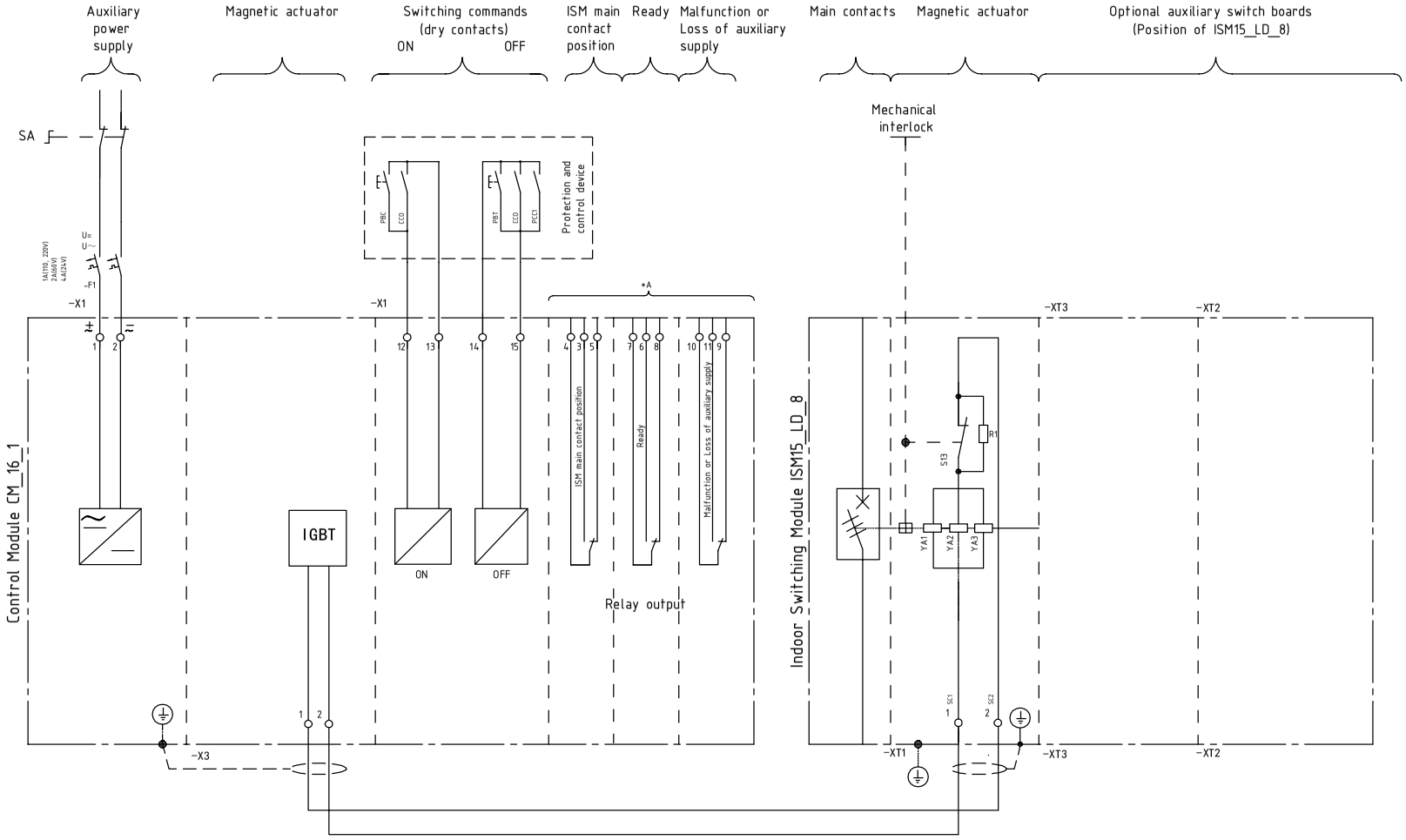
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB15_LD6_16.RDED4	07.10.2019	-	

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_LD6_16.RDED4	Edition	Sheet
	B	1 / 1

VCB15_LD8_16F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
SA	Power supply switch (optional);	PCC1	Protection control contact 1;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	XT1–XT3	Terminal block of switching module;
		X1,X3	Terminal block of control module;
		S1~S12	Auxiliary switch of ISM;
PBC	Push button close;	S13	Auxiliary switch for mechanical interlock; S13 is at inactivated position;
PBT	Push button trip;	YA1–YA3	Actuator coils;
IGBT	Transistor bridge (coils control);	R1	Resistor 22kOhm.

States of the relays „ Malfunction or Loss of auxiliary supply " and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
A. Ishchenko	V. Shimchenko	A.Migunov	21.02.2020	TES_VCB15_LD8_16FED4	21.02.2020	-	

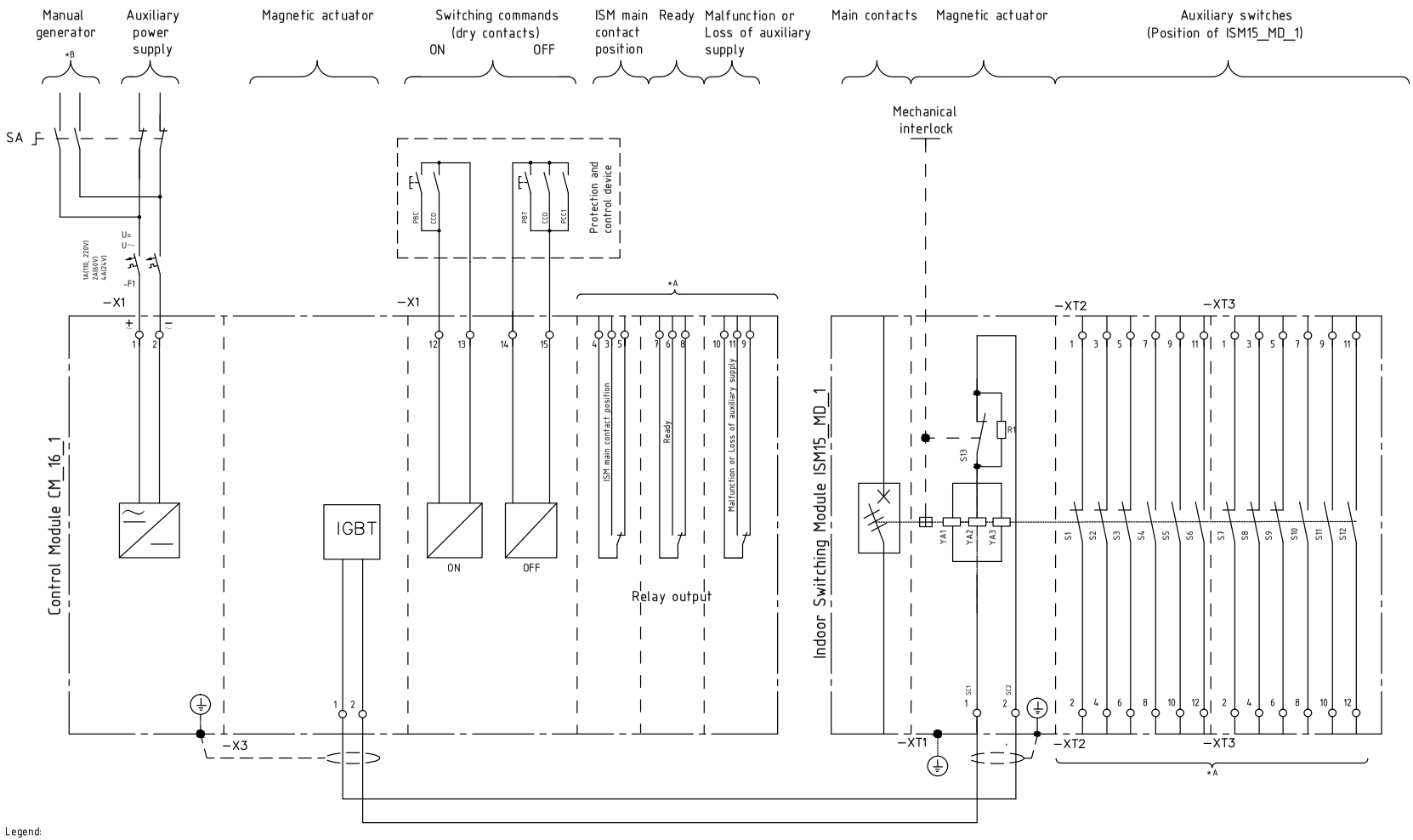
TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_LD8_16FED4	Edition	Sheet
	C	1 / 1

VCB15_MD1_16.F

Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1–XT2	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1,X3	Terminal block of control module;
		S1—S12	Auxiliary switch of ISM;
		S13	Auxiliary switch for mechanical interlock; S13 is at inactivated position;
PBC	Push button close;	YA1–YA3	Actuator coils;
PBT	Push button trip;	R1	Resistor 22kOhm.
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

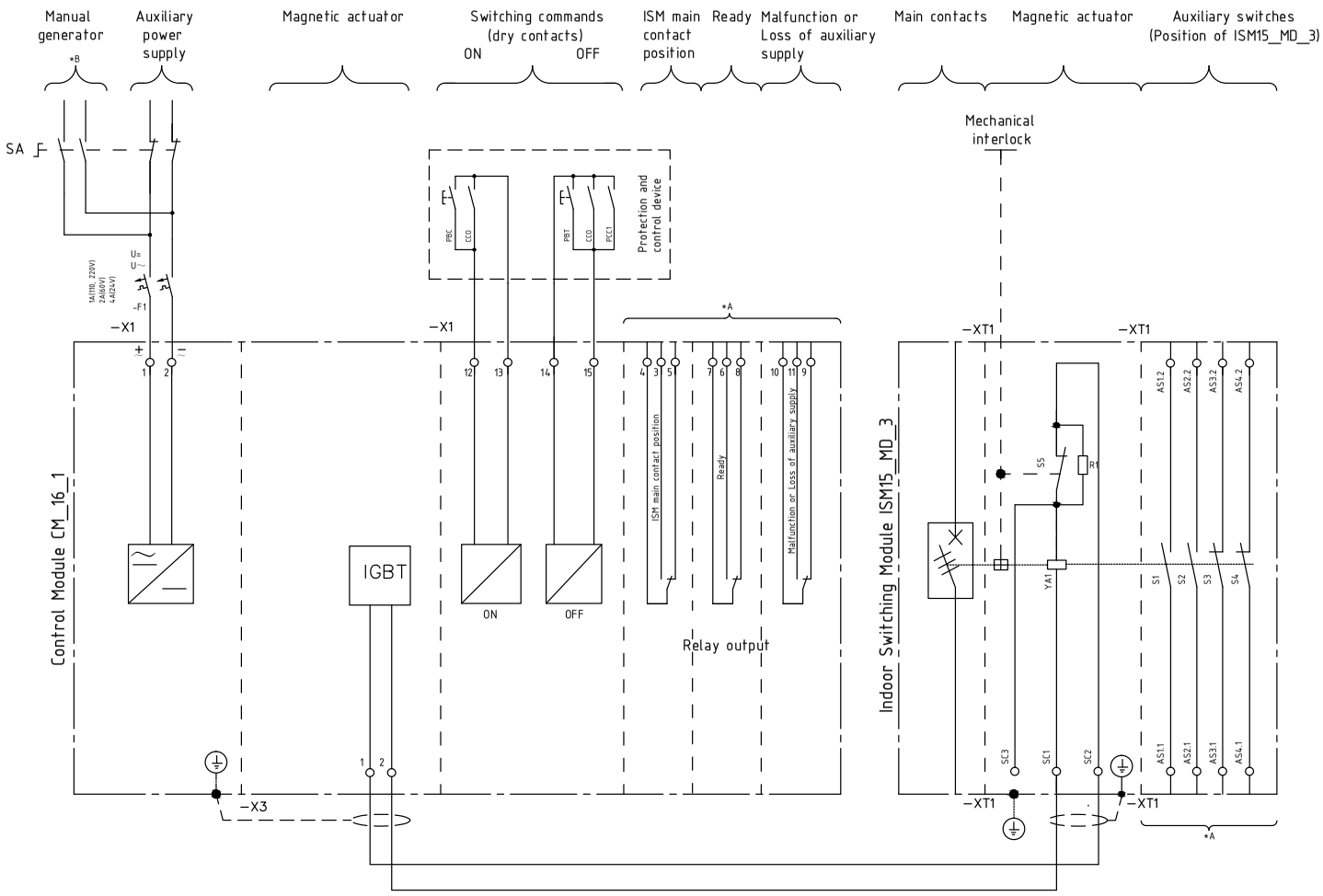
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
A. Ishchenko	V. Shimchenko	A.Migunov	07.10.2019	TES_VCB15_MD1_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_MD1_16.FED4	Edition	Sheet
	B	1 / 1

VCB15_MD3_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1,X3	Terminal block of control module;
		S1—S4	Auxiliary switch of ISM;
		S5	Auxiliary switch for mechanical interlock; S5 is at inactivated position;
PBC	Push button close;	YA1	Actuator coil;
PBT	Push button trip;	R1	Resistor 22kOhm.
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

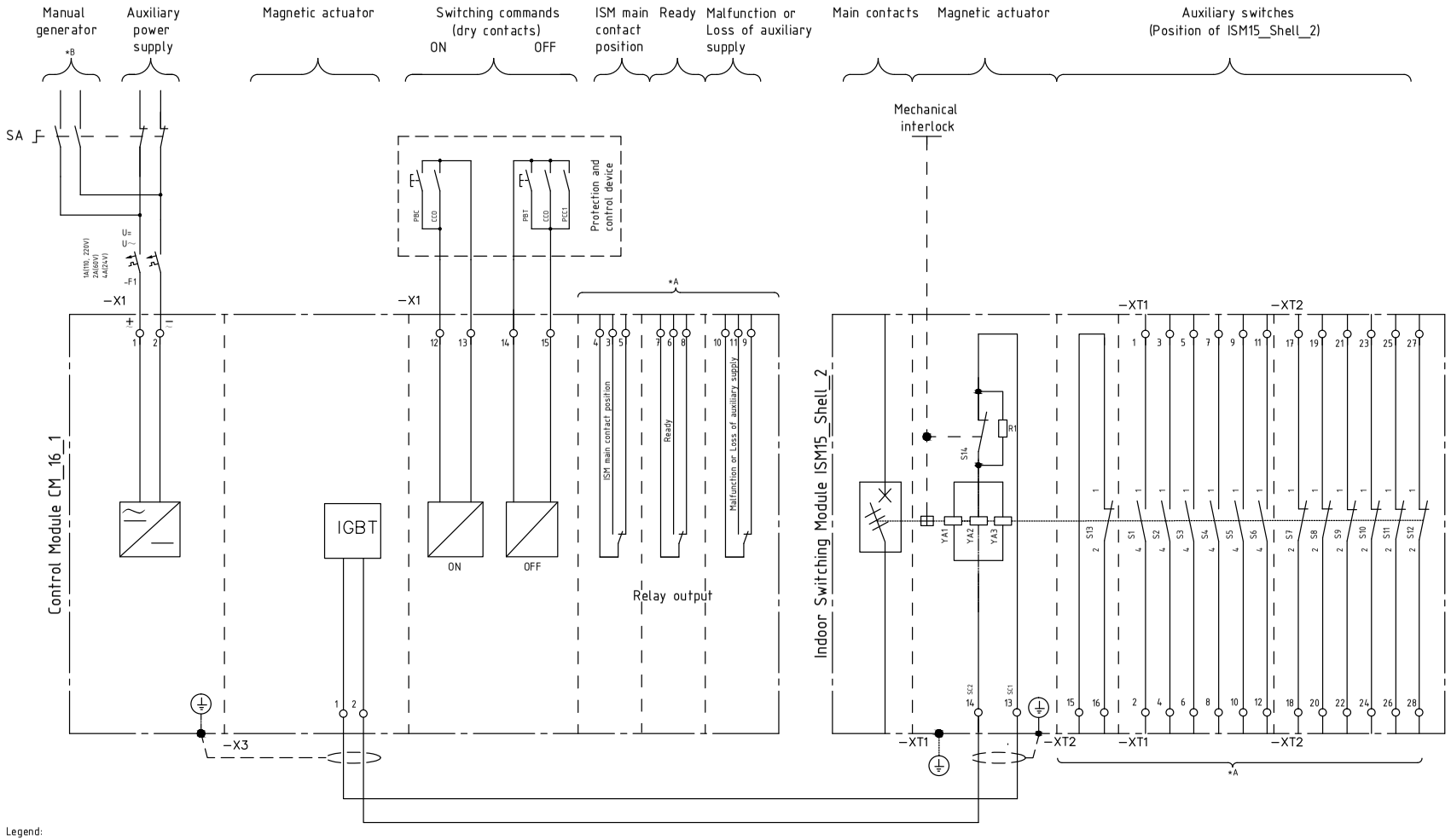
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
R.Mudrak	A.Migunov	V.Minaev	07.10.2019	TES_VCB15_MD3_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC TES

Switching module
Electrical Connection Diagram

TES_VCB15_MD3_16.FED4	Edition	Sheet
	B	1 / 1

VCB15_Shell2_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	Manual generator (optional);
SA	Power supply selector switch (optional);
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button trip;
IGBT	Transistor bridge (coils control);
CCO	Control command ON, OFF;
PCC1	Protection control contact 1;
XT1-XT2	Terminal block of switching module;
X1,X3	Terminal block of control module;
S1~S13	Auxiliary switch of ISM;
S14	Auxiliary switch for mechanical interlock; S14 is at inactivated position;
YA1-YA3	Actuator coils;
R1	Resistor 22kOhm.

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

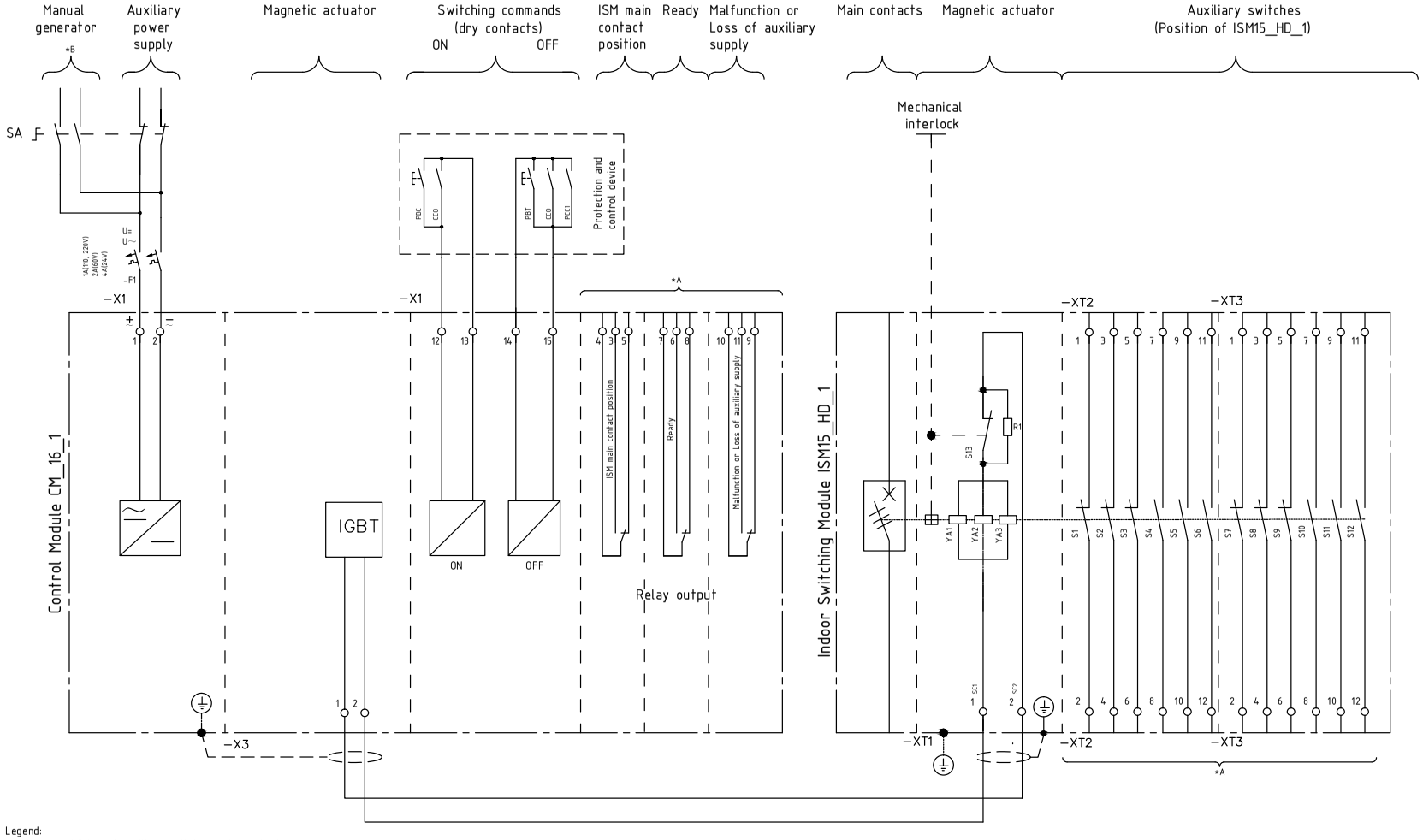
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB15_Shell2_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_Shell2_16.FED4	Edition	Sheet
	B	1 / 1

VCB15_HD1_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	Manual generator (optional);
SA	Power supply selector switch (optional);
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button trip;
IGBT	Transistor bridge (coils control);
CCO	Control command ON, OFF;
PCC1	Protection control contact 1;
XT1–XT2	Terminal block of switching module;
X1,X3	Terminal block of control module;
S1~S12	Auxiliary switch of ISM;
S13	Auxiliary switch for mechanical interlock; S13 is at inactivated position;
YA1–YA3	Actuator coils;
R1	Resistor 22kOhm.

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection
Dimensions in mm

Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
A. Ishchenko	V. Shimchenko	A.Migunov	07.10.2019	TES_VCB15_HD1_16.FED4	07.10.2019	–	

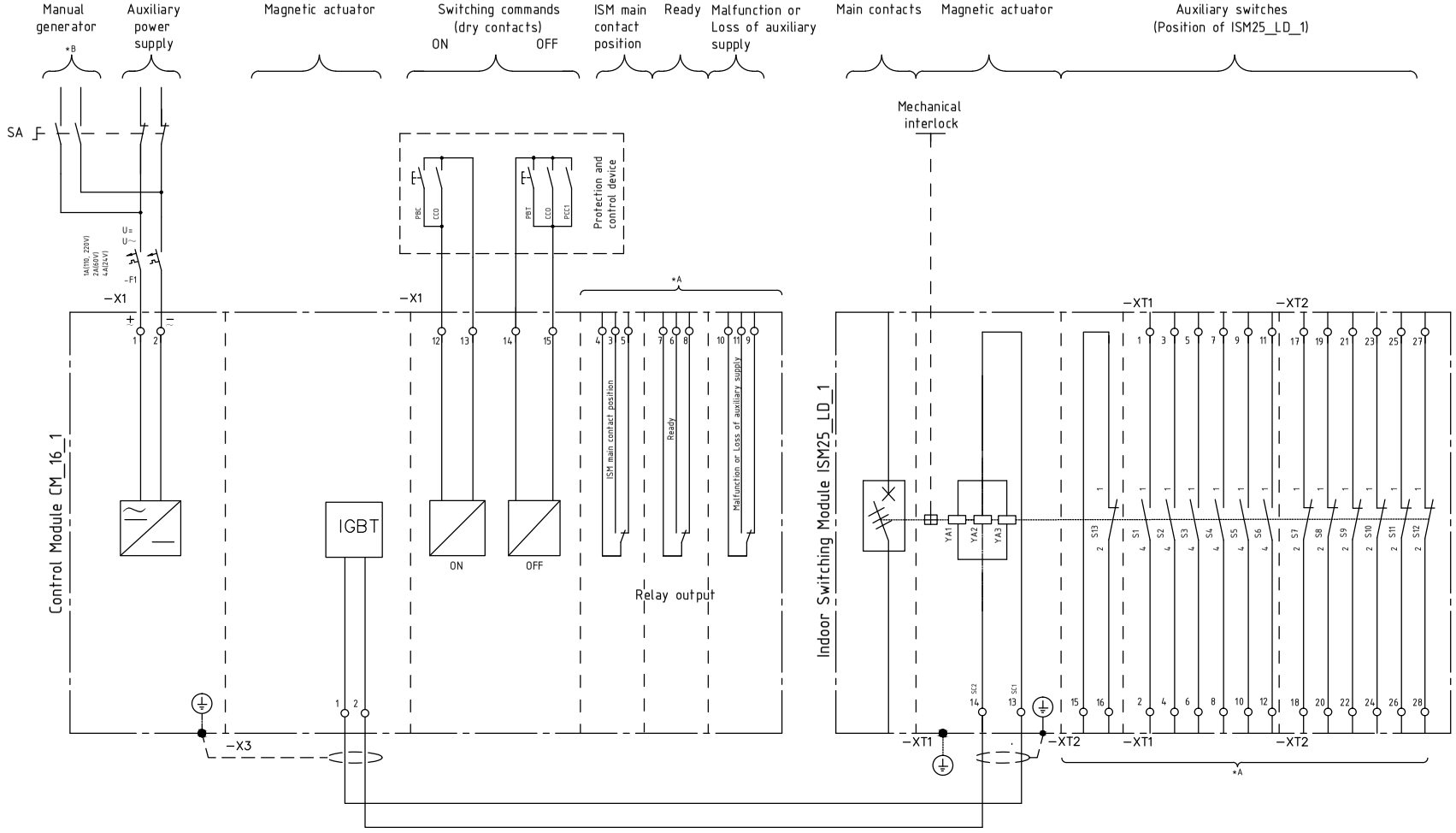
TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB15_HD1_16.FED4 | Edition B | Sheet 1 / 1

VCB25_LD1_16.F

Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1–XT2	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1, X3	Terminal block of control module;
		S1~S13	Auxiliary switch of ISM;
		YA1–YA3	Actuator coils.
PBC	Push button close;		
PBT	Push button trip;		
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

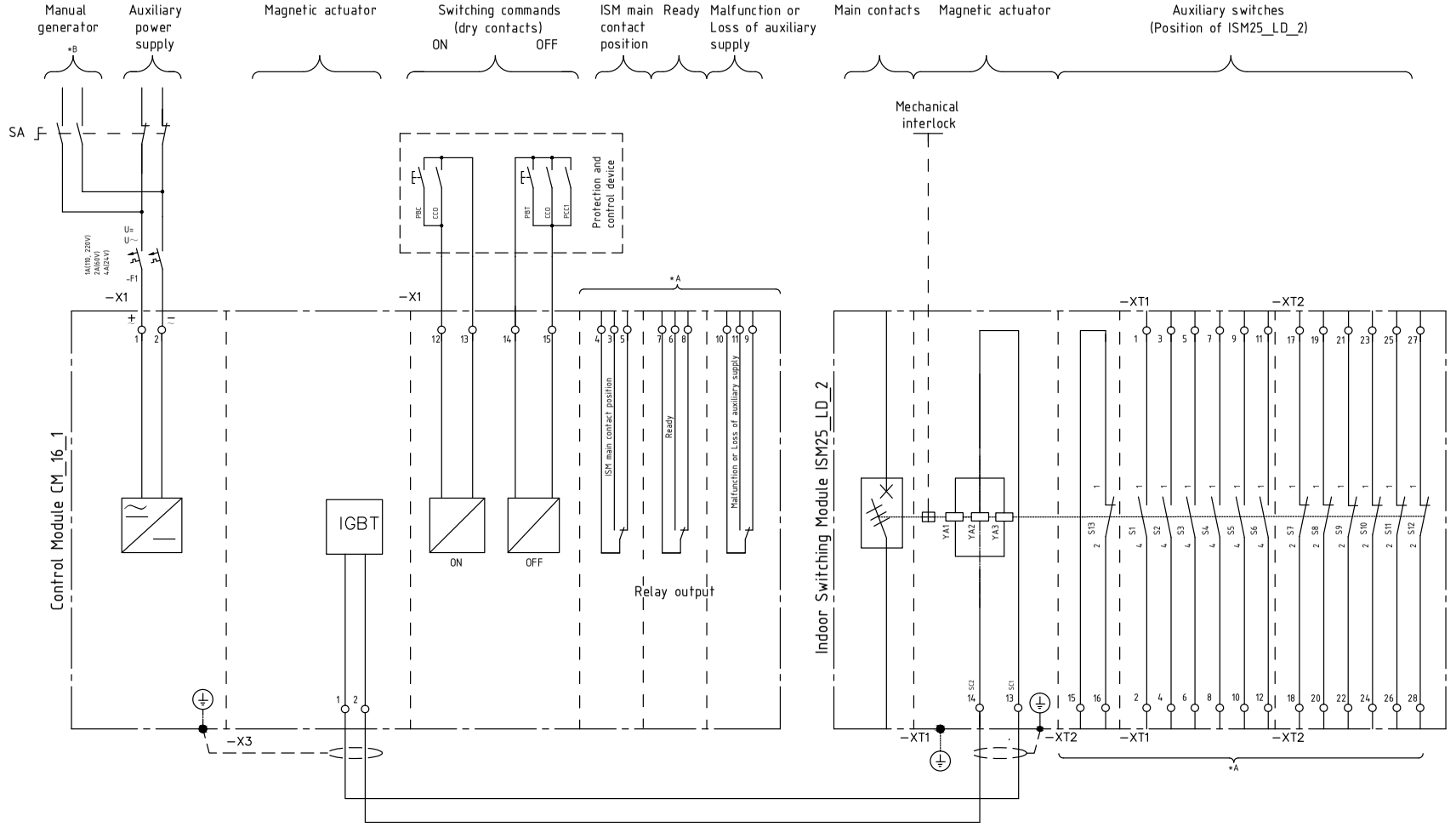
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB25_LD1_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC TES

Switching module
Electrical Connection Diagram

TES_VCB25_LD1_16.FED4	Edition	Sheet
	B	1 / 1

VCB25_LD2_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	CCO	Control command ON, OFF;
*B	Manual generator (optional);	PCC1	Protection control contact 1;
SA	Power supply selector switch (optional);	XT1–XT2	Terminal block of switching module;
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;	X1, X3	Terminal block of control module;
		S1–S13	Auxiliary switch of ISM;
PBC	Push button close;	YA1–YA3	Actuator coils.
PBT	Push button trip;		
IGBT	Transistor bridge (coils control);		

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

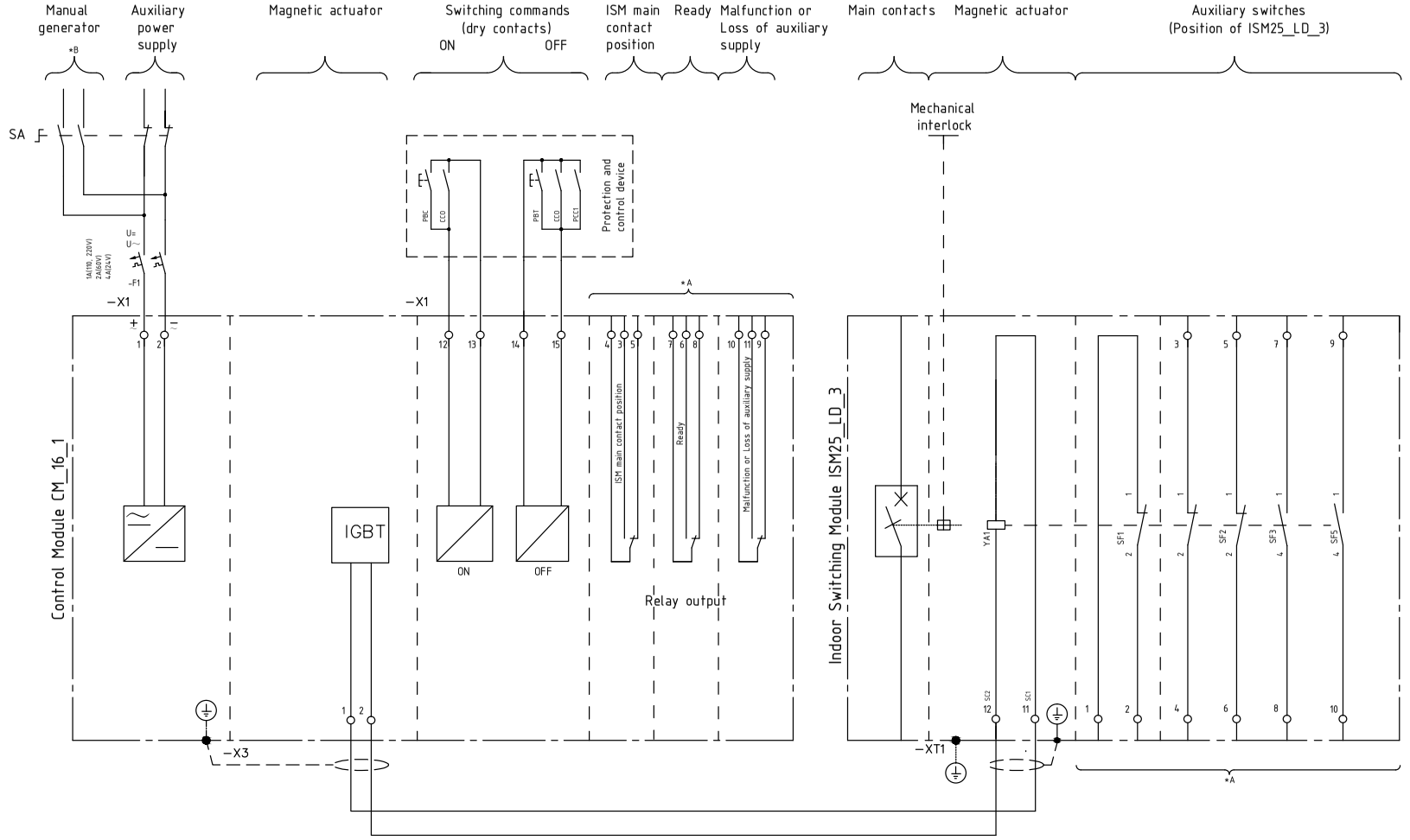
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB25_LD2_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC TES

Switching module
Electrical Connection Diagram

TES_VCB25_LD2_16.FED4	Edition	Sheet
	B	1 / 1

VCB25_LD3_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	Manual generator (optional);
SA	Power supply selector switch (optional);
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button trip;
IGBT	Transistor bridge (coils control);
CCO	Control command ON, OFF;
PCC1	Protection control contact 1;
XT1	Terminal block of switching module;
X1, X3	Terminal block of control module;
YA1	Actuator coil.

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power suppl

Projection

Dimensions in mm

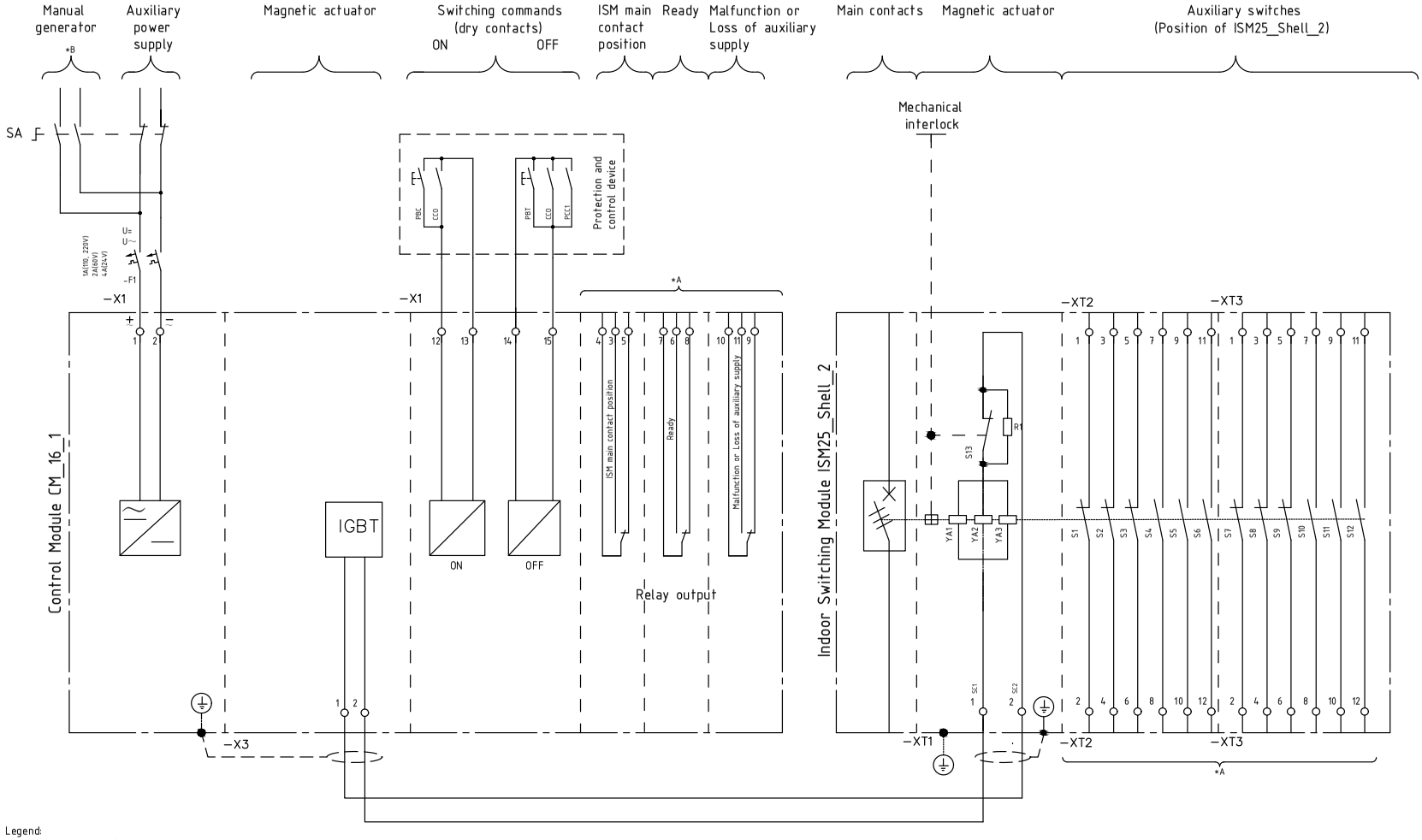
Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
I.Matlakova	A.Migunov	A.Migunov	07.10.2019	TES_VCB25_LD3_16.FED4	07.10.2019	-	

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB25_LD3_16.FED4	Edition	Sheet
	B	1 / 1

VCB25_Shell2_16.F
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	Manual generator (optional);
SA	Power supply selector switch (optional);
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button trip;
IGBT	Transistor bridge (coils control);
CCO	Control command ON, OFF;
PCC1	Protection control contact 1;
XT1–XT2	Terminal block of switching module;
X1,X3	Terminal block of control module;
S1—S12	Auxiliary switch of ISM;
S13	Auxiliary switch for mechanical interlock; S13 is at inactivated position;
YA1–YA3	Actuator coils;
R1	Resistor 22kOhm.

States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

Projection

Dimensions in mm

Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
A. Ishchenko	A. Migunov	A. Migunov	23.03.2021	TES_VCB25_Shell2_16.FED4	23.03.2021	-	

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

TES_VCB25_Shell2_16.FED4	Edition	Sheet
	A	1 / 1

List of changes

Documents Version	Change Date	Scope of Change	Reason of Change	Version Author
1.0	25.08.2015	Document creation	-	may
1.1	01.10.2015	Document correction according to changes in the TES development procedure	TES MD request	may
1.2	07.10.2015	Front page pictures and text correction	TES MD request	may
1.3	30.10.2015	Really Malfunction functionality is changed from Malfunction to Malfunction OR Loss of supply Rated operating sequence is changed to O-0.3s-CO-10s-CO-10s-CO	TEG TD request	may
1.4	02.12.2015	Parameter name "Rated supply voltage of auxiliary circuits" change to "Rated auxiliary supply voltage" Change of relay 3 name from „Malfunction" to „Malfunction or Loss of auxiliary supply" and adding for relay „ISM main contact position" detailed description of its state change Amendment of Secondary schemes in Appendix 3	TES ED and TES TD requests	may
1.5	25.01.2016	Change of relays 1 and 2 contacts in the Table 10 from NC to NO and vice-versa	Mistype correction	may
1.6	05.05.2016	Adding of comment that CM's relay can have incorrect state in case CM is not operable due to absence of auxiliary supply; Adding of description that USB port is not used in service; Adding of CBkit_Interlock_2 in scope of optional kits.	Mistype correction and TES MD request	may
1.7	09.11.2016	Photos on the page 45 were changed	There was obsolete ISM15_Shell_1 on the photos	may
1.8	27.01.2018	Rated operating sequence at rated short-circuit breaking current elaboration; ISM15_Shell_2 in horizontal actuator position; Primary circuits contact resistance check elaboration;	Documentation elaboration; Mistypes correction;	may
9	11.09.2018	Adding of VCB15_MD1_16F and VCB15_HD1_16F; Mistakes correction	Product range change	may
10	21.02.2019	Mistypes correction	Documentation elaboration;	may
11	14.10.2019	Adding of VCB15_MD3_16.F. Change of VCB, ISM and CM classification. Removing of CBkit_Interlock_2, adding of CBkit_Interlock_8	Product range change	may
12	29.10.2019	Adding of the CBmount_CM_1	Product range change	may
13	28.02.2020	Adding of VCB15_LD8_16F, adding of interlocking kits drawings, mistypes correction	Product range change	Zhdi
14	20.04.2020	VCB15_LD8_16.F scope of supply change	Product range change	Zhdi
15	20.09.2021	Interlock interface for LD breakers added	Product range change	Zhdi
16	25.07.2022	Adding of VCB25_Shell2_16F Correction of the "CM terminal arrangement" table Division of the technical parameters table into VCB15 and VCB25	Product range change	may mariy

TAVRIDA ELECTRIC

Europe

Tavrida Electric GmbH

Im Leimen 14, 88069 Tettnang,
Germany
Phone: +49 7542 94 678 51
Fax: +49 7542 94 678 61
E-mail: info@tavrida.de

South Africa

Tavrida Electric Africa (Pty) Ltd.

Unit 8, N12 Industrial Park,
188 Dr Vosloo Road, Bartlett,
Boksburg, 1459 South Africa
Phone: +27 11 9142199
Fax: +27 11 9142323
E-Mail: support@tavrida.co.za

North America

Tavrida Electric North America Inc.

1105 Cliveden Ave.
Delta, BC V3M 6G9 Canada
Phone: +1 (866) 551-8362
E-mail: info@tavrida-na.com

Brazil

Tavrida Electric do Brazil

Av. Ireno da Silva Venâncio,199
GP04A - Protestantes
Votorantim / SP, Brazil
Phone: +55 (15) 3243-2555
Fax: +55 (15) 3243-4233
E-Mail: info@tavrida.com.br

Rest of the world

Tavrida Electric AG

Bahnhofstrasse 27, 6300
Zug, Switzerland
Phone: + 49 7542 9467851
E-mail: TES_SM@tavrida.ch

www.tavrida.com

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