



VCB

Vacuum Circuit Breaker
17.5kV, ...31.5kA, ...2000A
24kV, ...16kA, ...800A

User Guide

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1. Product description

This Product 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 mon-stable 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
EMC	Electromagnetic capability
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	Pole center distance
USB	Universal Serial Bus
VCB	Vacuum Circuit Breaker
VI	Vacuum interrupter
HD ISM	Heavy duty ISM
LD ISM	Light duty ISM

1.2 Definitions

Closing time

The closing time is the time period from the moment the close command is applied to the CM to the time when all ISM poles make contact.

Opening time

The opening time is the time period from the moment the trip command is applied to the CM to the time when all ISM poles are separated.

Break time

The break time is the time period from the moment the trip command is applied to the CM to the time when the arcs in all phases are extinguished.

1.3 Main technical parameters

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

Table 1 - Main technical parameters

Type	VCB15_LD	VCB15_Shell	VCB25_LD
Rated voltage (Ur)	≤ 12 kV	≤ 17.5 kV	≤ 24 kV
Rated normal current (Ir)	≤ 800 A	≤ 1250 A ¹⁾ ≤ 2000 A	≤ 800 A
Rated power frequency withstand voltage (Ud)	28 (42) ²⁾ kV	38 (42) kV ²⁾	50 kV
Rated lightning impulse withstand voltage (peak) (Up)	75 kV	95 kV ³⁾	125 kV
Rated short-circuit breaking current (Isc)	≤ 20 kA ⁴⁾	≤ 31.5 kA ⁴⁾	≤ 16 kA ⁴⁾
Rated peak withstand current (Ip)	≤ 50 kA	≤ 82 kA	≤ 40 kA
Rated short-time withstand current (Ik)	≤ 20 kA	≤ 31.5 kA	≤ 16 kA
Rated duration of short circuit (tk)	4 s		
Rated frequency (fr)	50/60 Hz		
Rated operating sequence	O-0.3s-CO-10s-CO-10s-CO ⁵⁾		
Standards	IEC 62271-100 GB 1984- 2003	IEC 62271-100 GB 1984- 2003	IEC 62271-100
Weight (depending on Pole centre distance) for three-phase ISM	34-36 kg	51-55 kg	36-38 kg
Weight for single phase ISM	13 kg		14 kg
CM supply voltage			
Rated range of supply voltage of CM_16_1(60_x_x)	24V to 60V DC		
Rated range of supply voltage of CM_16_1(220_x_x)	110V to 220V AC/DC		
Power consumption of CM			
Charging the close and trip capacitors of CM_16_1(60_x_x)	≤ 25 W		
Charging the close and trip capacitors of CM_16_1(220_x_x)	≤ 42 W AC ⁶⁾ ≤ 37 W DC		
Permanent power consumption (standby) of CM_16_1(60_x_x)	≤ 5 W		
Permanent power consumption (standby) of CM_16_1(220_x_x)	≤ 7 W AC ⁷⁾ ≤ 5 W DC		
Inrush current of of CM_16_1(60_x_x) with discharged capacitors	≤ 120 A		
Inrush current of of CM_16_1(220_x_x) with discharged capacitors	≤ 18 A		
Inrush time constant of CM_16_1(60_x_x) with discharged capacitors	≤ 0.5 ms		
Inrush time constant of CM_16_1(220_x_x) with discharged capacitors	≤ 4 ms		
Altitude above sea level	1000 m ⁸⁾		
Relative humidity in 24 hours	≤ 95 %		
Relative humidity over 1 month	≤ 90 %		
Temperature range	-25 °C ... +55 °C		

1) For VCB ISM15_Shell with Low upper terminal – up to 1250 A, with High upper terminal – up to 2000 A.

2) The information in brackets refers to the national Chinese standards GB1984-2003 and installation altitude of maximum 1000 m.

3) Parameter valid only when ISM is used with insulation masks. For details see dimensional drawings and accessory information.

4) At 40% d.c. component.

5) The number of sequential Close-Trip operations with interval 10 seconds 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.

6) At $\cos \varphi > 0.66$.

7) At $\cos \varphi > 0.33$.

8) 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.

1.4 Disclaimers

Tavrída 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 present 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. Tavrída Electric will not accept any claims for damages caused by improper usage of the Vacuum Circuit Breakers. In case of special configurations please contact Tavrída Electric prior of usage of the Vacuum Circuit Breakers.

1.5 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 this User Guide.
- The operating conditions of the vacuum circuit breakers shall comply with the technical data specified in this User Guide.
- Personnel installing, operating and maintaining the equipment shall be familiar with this User Guide and its contents.

1.6 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.

ISM nameplates and seals

Each ISM has the following plate and labels:

- Label
- Serial number plate
- Seals

①	TAVRIDA ELECTRIC												
②	Ur	12	kV	Ir	630	A	p	133	mm	⑨			
③	Ud	28	kV	Isc	20	kA	W	55	kg	⑩			
④	Up	75	kV	tk	4	s	Year	2014	⑪				
⑤	IEC 62271-1, IEC 62271-100						O - 0.3s - CO - 15s - CO						⑫
											⑥	⑦	⑧

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. Rated duration of short circuit tk
7. Rated short-circuit current Isc
8. Rated current Ir
9. Pole center distance p
10. Weight W
11. Year of manufacturing
12. 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.

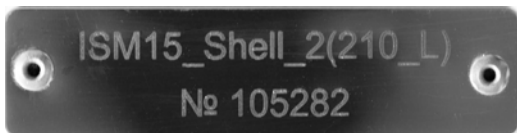


Figure 2
Serial number plate

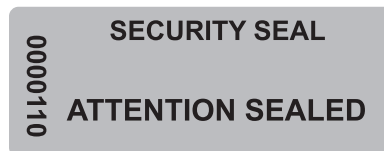


Figure 3
Warranty seal

Label, seal and serial number plate arrangement is shown below



a) LD ISM labeling



b) HD ISM labeling

1. Label
2. Serial number plate
3. Seal

Figure 4
Serial number plate, label and seal arrangement

CM nameplates and seals

Each CM has the following labels :

- Designation label
- Serial number label
- Seals

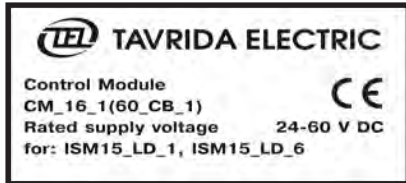


Figure 5
Designation label



Figure 6
Serial number label



1. Serial number label
2. Designation label
3. Warranty seal

Figure 7
Serial number and designation label arrangement

Manual generator nameplates

Each manual generator has the following labels :

- Designation label
- Serial number label



Figure 8
Designation label



Figure 9
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 50°C. 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

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 10
*Lifting of ISM15_LD_1, ISM15_LD_3, ISM25_LD_1,
ISM25_LD_2, ISM15_LD_3*



Figure 11
Lifting of ISM15_Shell_2

All items should be checked visually for:

- mechanical damage, scratches, discoloration, corrosion;
- damage to the seals (Figure 3, Figure 7).

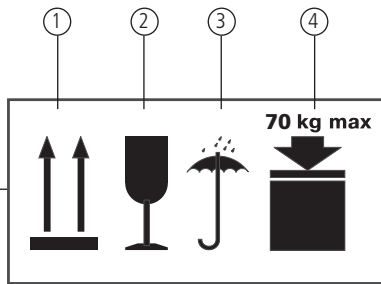
Any transport damage must be reported immediately to the carrier in writing.
Damages shall be photographically documented.

VCB packaging and delivery set

The VCB are placed in cardboard boxes (Figure 14):

- handling symbols label for transport and storage of the delivery unit (Figure 12);
- labels for manufacturers and product information (Figure 15);
- label for logistics data (Figure 13).

The delivery sets of VCB on the level of main components are presented in Appendix 1



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

Figure 12

Label 1 Handling symbols



Figure 14

Carton box

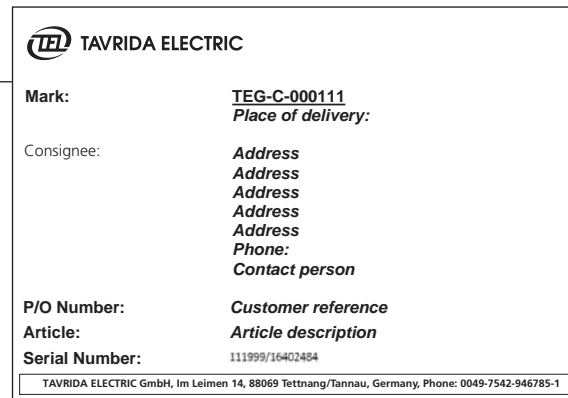


Figure 13

Label 2 Logistics data



Figure 15

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.

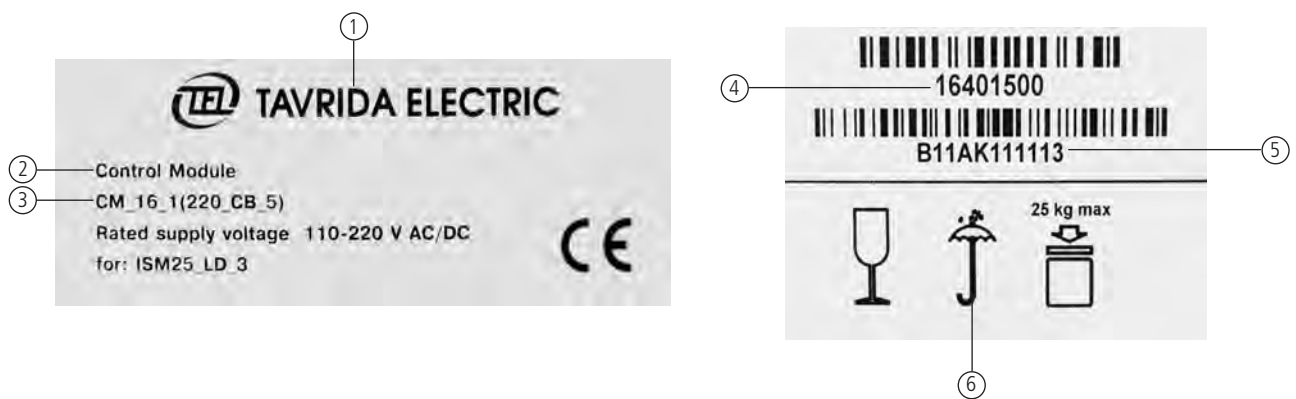
The ISM shall have undamaged warranty seals (appearance of seal is shown in Figure 3, its placement on the ISM (there are two warranty seals on each side of the ISM metal frame) - in Figure 4). The ISM designation and serial number shall comply with data in the VCB packing list and the ISM routine test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

CM packaging and delivery set

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 16
CM packaging



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

Figure 17
CM packaging labels

The CM shall have undamaged warranty seals (its placement on the CM is shown in Figure 7). 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 designation label and serial number label are shown in Figure 5 and Figure 6, their placement on the CM - in Figure 7).

Each CM is supplied with the following components:



a) CM



b) screwdriver
Unit_Screwdriver_1



c) brackets
Det_Holder_84

Figure 18
CM delivery set

ISM packaging and delivery set

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 LD ISM is supplied with the following components:



a) ISM



b) screwdriver
Unit_Screwdriver_1

Figure 19
LD ISM delivery set

Each HD ISM is supplied with the following components:



a) ISM



b) position indicator
Unit_PosInd_1



c) screwdriver
Unit_Screwdriver_1

Figure 20
HD ISM delivery set

CBkit_Ins_3 delivery set

24 kV variants of VCB25_LD1_16F and VCB25_LD3_16F 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 21
CBkit_Ins_3 delivery set

CBkit_Shell15_1 delivery sets

17.5kV variants of VCB15_Shell15_16F include CBkit_Shell15_1 for flat bus bar 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:

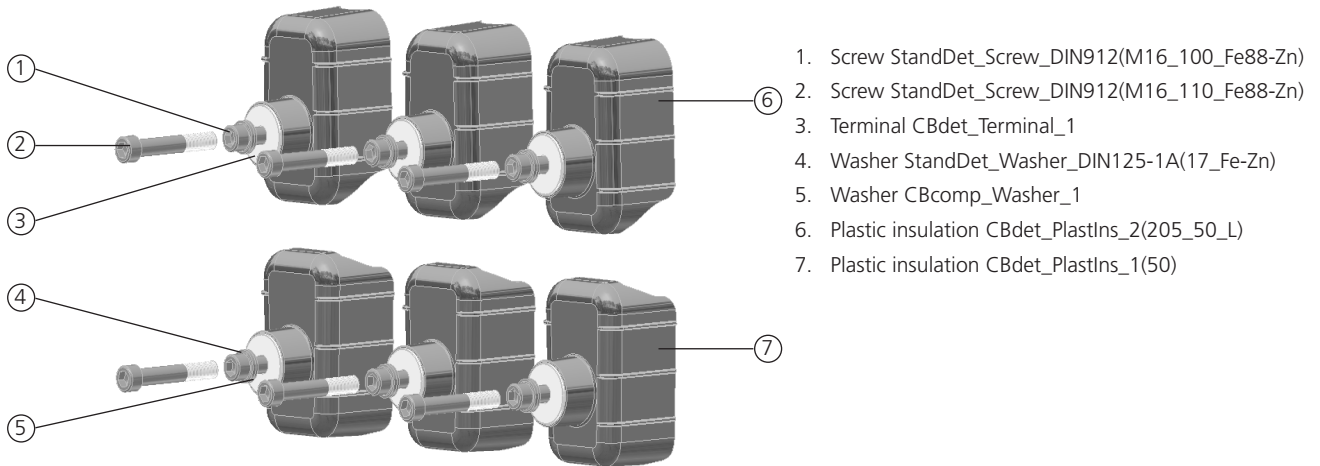


Figure 22
CBkit_Shell15_1(205) delivery set

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

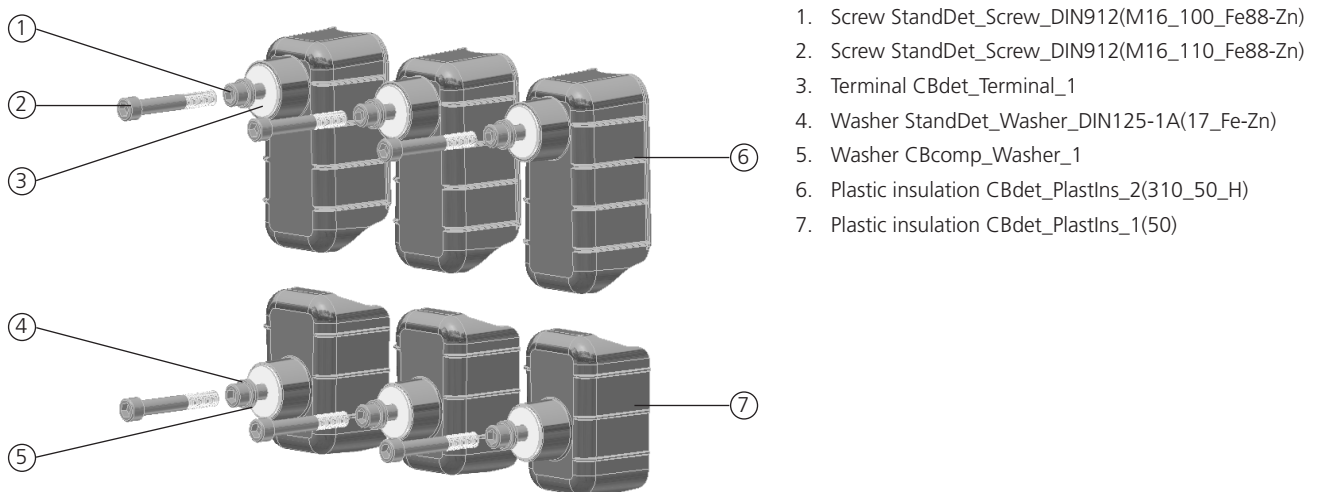


Figure 23
CBkit_Shell15_1(310) delivery set

Two variants of bolts are included in CBkit_Shell15_1:

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

CBkit_LD15_2 and CBkit_LD15_3 delivery sets

VCB15_LD6_16RD 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.

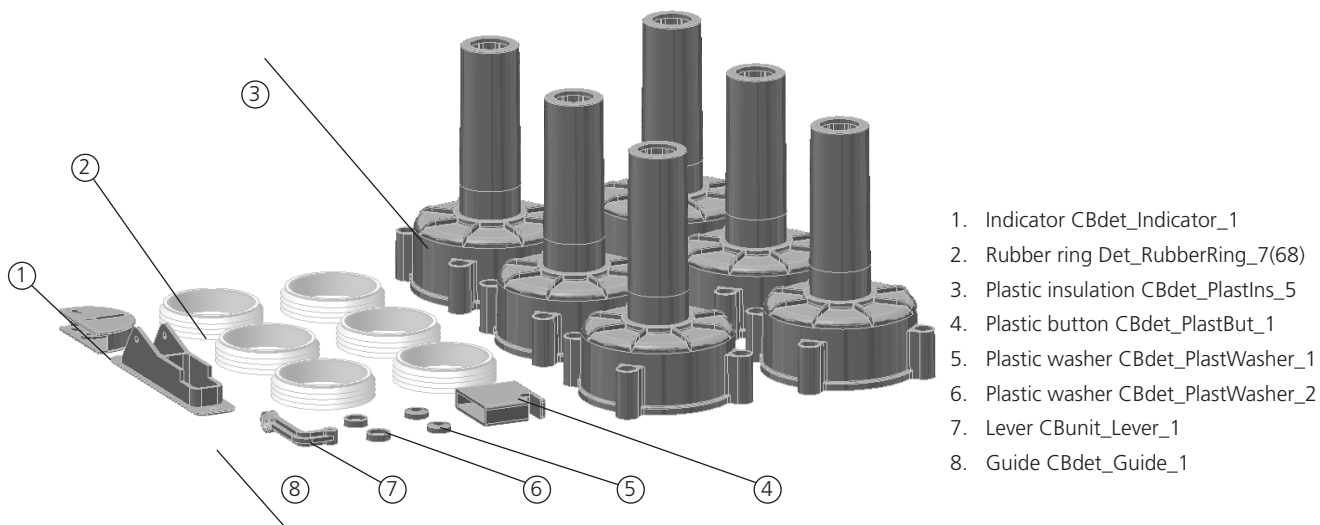


Figure 24
CBkit_LD15_2 delivery set

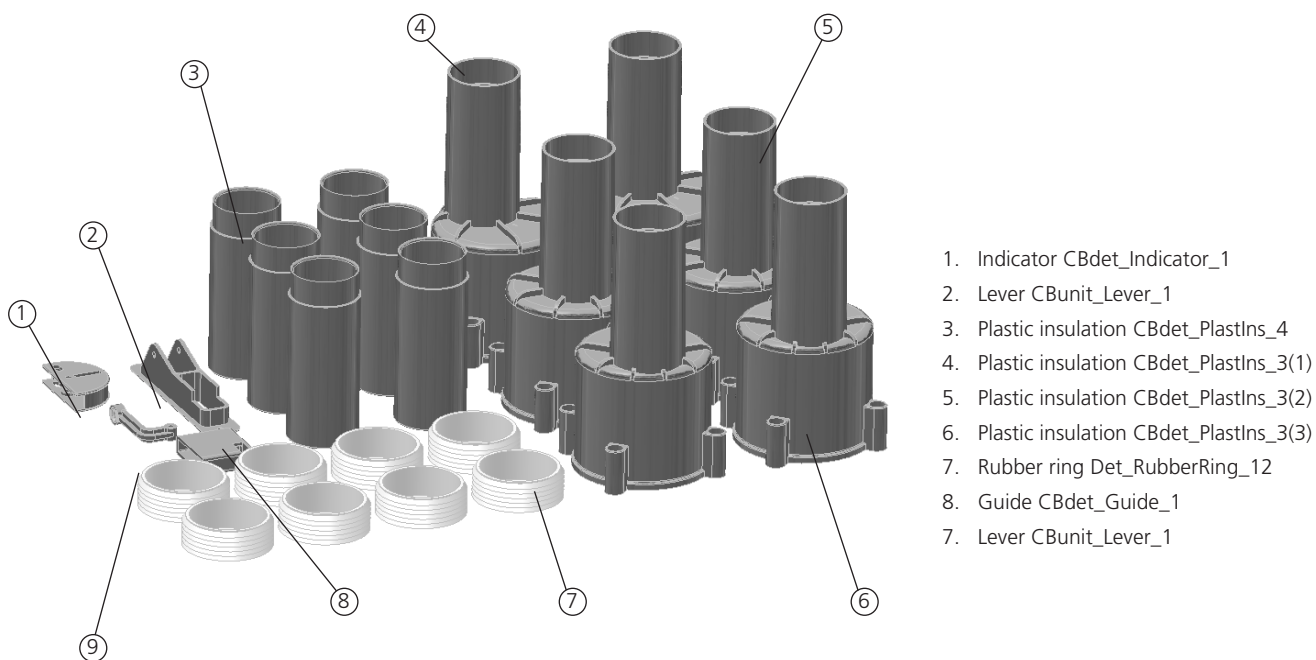


Figure 25
CBkit_LD15_3 delivery set

VCB accessories unpacking and check

CBkit_Interlock_1 packaging and delivery set

CBkit_Interlock_1 can be used for VCB15_LD1_16F and VCB25_LD1_16F as an interface for various manual trip / indication / lockout accessories. The kit is packed in a plastic bag.

The kit includes:

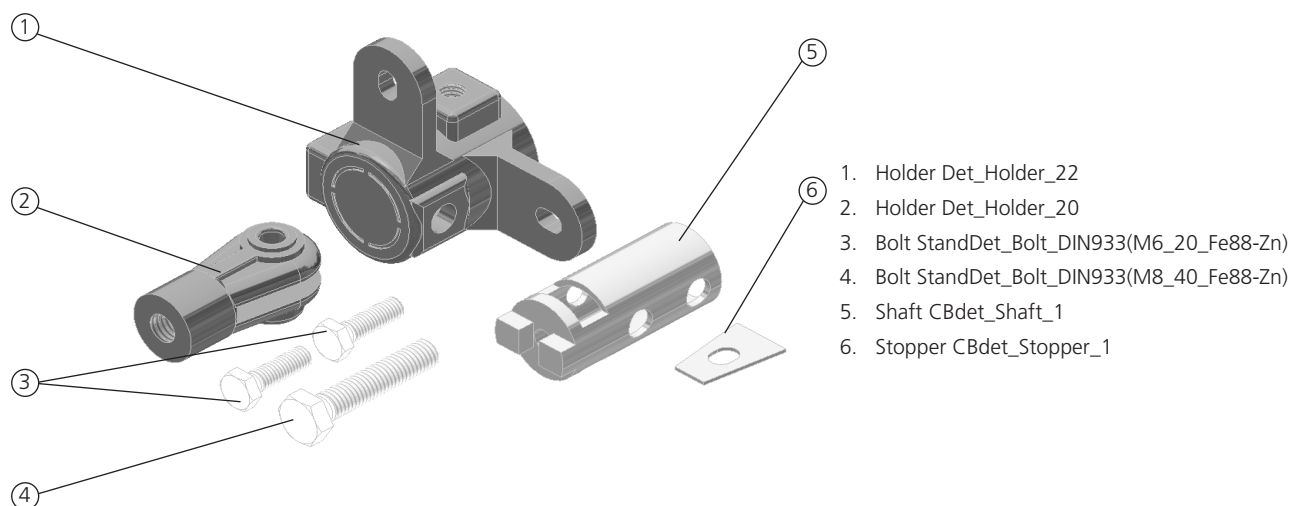


Figure 26

CBkit_Interlock_1 delivery set

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

CBunit_ManGen_1 and CBunit_ManGen_2 packaging and delivery set

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 27
CBunit_ManGen_1 and CBunit_ManGen_2 packing

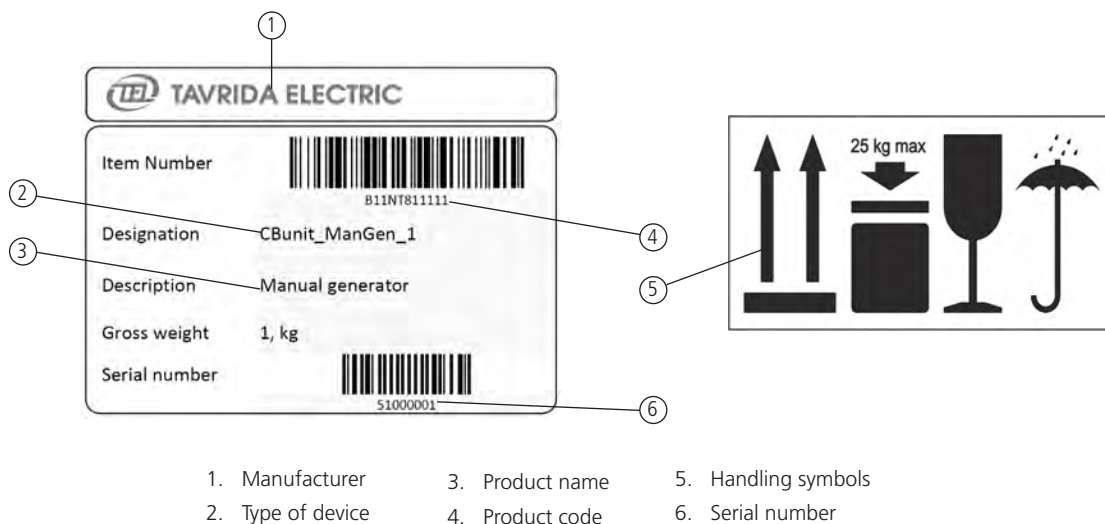


Figure 28
CBunit_ManGen_1 package labeling



Figure 29
CBunit_ManGen_1 and CBunit_ManGen_2 delivery set

CBcomp_RelCable_1 packaging and delivery set

CBcomp_RelCable_1 is a flexible release cable used for connection of ISM main contacts position indicator Unit_PosInd_3 or interlocks to the ISM. VCB15_Shell2_16F and ISM15_Shell_2 already include CBcomp_RelCable_1(1000). In case of separate delivery the cable is packed in a plastic bag.

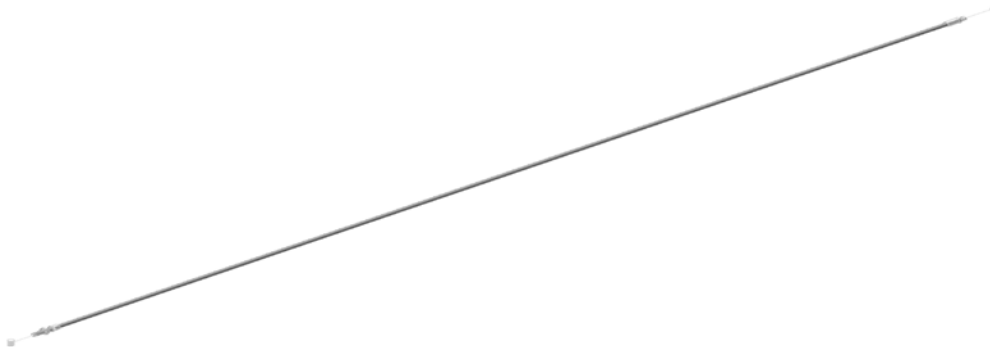


Figure 30
CBcomp_RelCable_1 delivery set

Unit_PosInd_3 packaging and delivery set

Unit_PosInd_3 is used together with CBcomp_RelCable_1 to indicate the ISM main circuit position. VCB15_Shell2_16F and ISM15_Shell_2 already include Unit_PosInd_3. In case of separate delivery the position indicator is packed in a plastic bag.

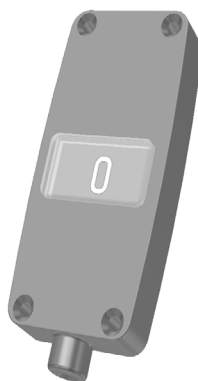


Figure 31
Unit_PosInd_3 delivery set

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 (800 N/mm²), nuts according to EN ISO 890 class 8 (880 N/mm²), washers to DIN 125 and conical spring washers to DIN 6796 (for LD ISM) shall be used. Bolts and washers for HD ISM connection are already included in the CBkit_Shell15_1 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 HD ISM may be installed in position “actuator up”, as well “actuator down” (Figure 32, Figure 33). The LD ISM can be installed in any position (Figure 34).

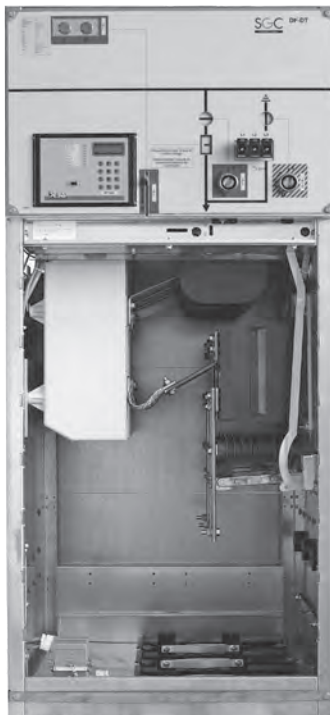


Figure 33
**Fixed compact installation of HD ISM,
vertical arrangement, actuator up**

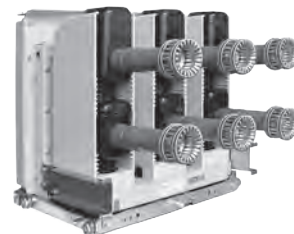


Figure 32
**Withdrawable unit with HD ISM,
vertical arrangement, actuator down**



Figure 34
**Withdrawable unit with LD ISM,
horizontal 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 35).

The unsupported busbar shall not exceed the following length:

ISM15_LD	0.5 m
ISM15_Shell	1.0 m
ISM25_LD	0.5 m

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

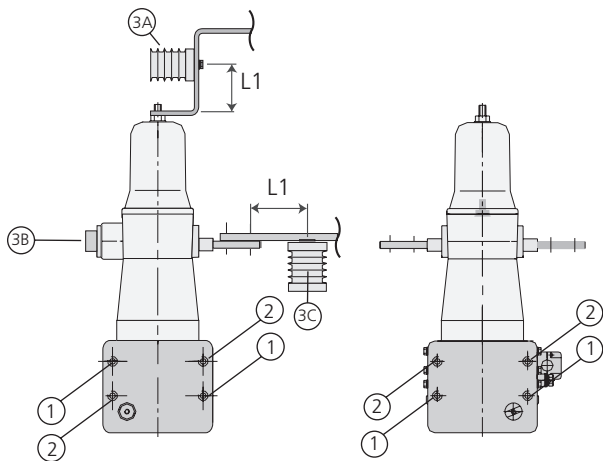


Figure 35
LD ISM mounting points

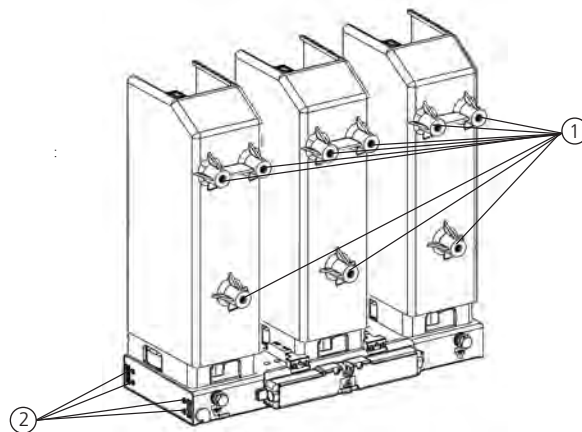


Figure 36
HD ISM mounting points

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

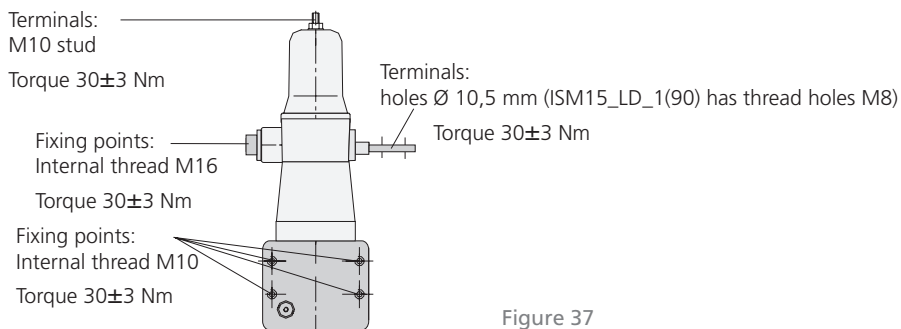


Figure 37
Bolt sizes and torques

Important: It is not allowed to perform any close or trip operation for LD ISM while the nut M10 on the stud of the ISM upper terminal (Figure 37) is not tightened.



Figure 38

HD ISM mounting diagram

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

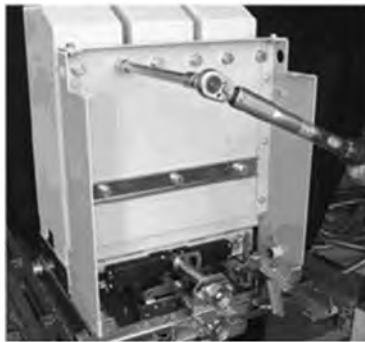


Figure 39

Example of HD ISM fixation

Ensure that the frame to which the ISM will be fixed does not create static load to the switching module. Then fasten the nine bolts (Figure 39; torque is 40 ± 2 Nm).

4.1.3 Main terminal connections of LD ISM

Primary terminals connection

Bus bars can be connected to terminals of LD ISM by means of M10 screws. M10 bolts and nuts fixing busbars to LD ISM terminals should be tightened with a torque of 30 ± 3 Nm. To connect bus bars 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 LD 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.

Maximum clearances due to electrodynamic forces

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 2.

Table 2 - Additional support insulators installation minimum distances

ISM	Short-circuit current	
	16 kA	20 kA
	L1, mm	
ISM15_LD_1	980	700
ISM25_LD_1	980	NA

Minimum clearances due to electromagnetic influence

Short-circuit current can pass its magnetic field influences to the ISM magnetic actuator. To avoid unwanted tripping, the minimum clearances between bus bars and the ISM frame should be not less than 120 mm (Figure 40).

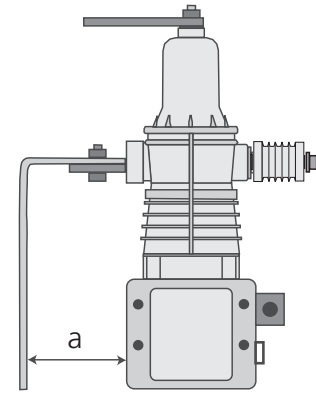


Figure 40

Electromagnetic clearances limitations

Minimum clearances due to rated insulation voltage

The recommended minimum open air clearances between phase to phase and phase to earth are stated in Table 3. Shorter clearances shall be verified by a voltage test.

Table 3 - Minimum clearances due to rated insulation voltage

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

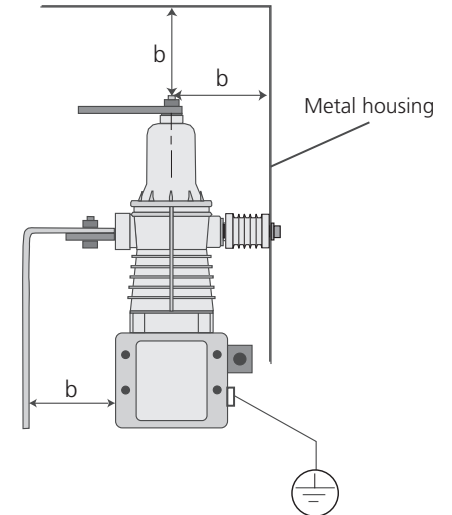


Figure 41

LD ISM insulating clearances limitations

Coordination of minimum clearances

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

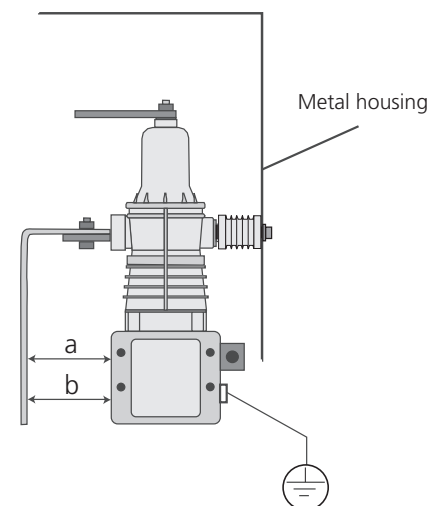


Figure 42

Clearance coordination

Measures for complying with the rated insulation level

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 with insulation cap set CBkit_Ins_3. The arrangement is shown in Figure 43.

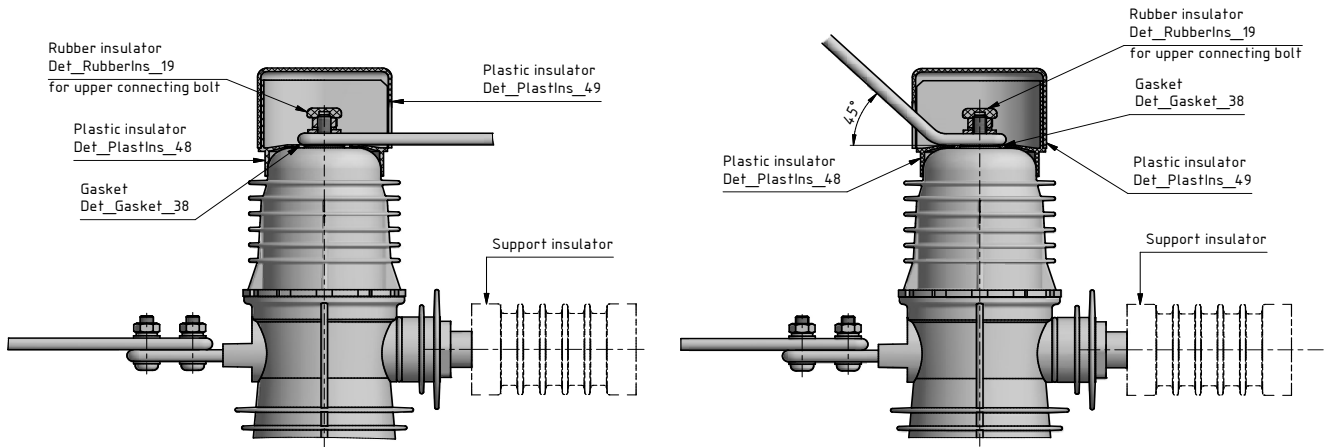


Figure 43
CBkit_Ins_3 installation

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 44.

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.

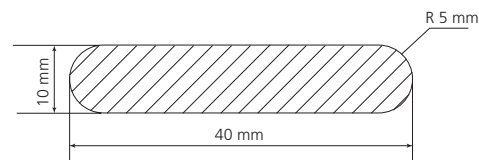


Figure 44
Cross-section of the busbar connected to the pole

4.1.4 Main terminal connections of HD ISM

Primary terminals connection

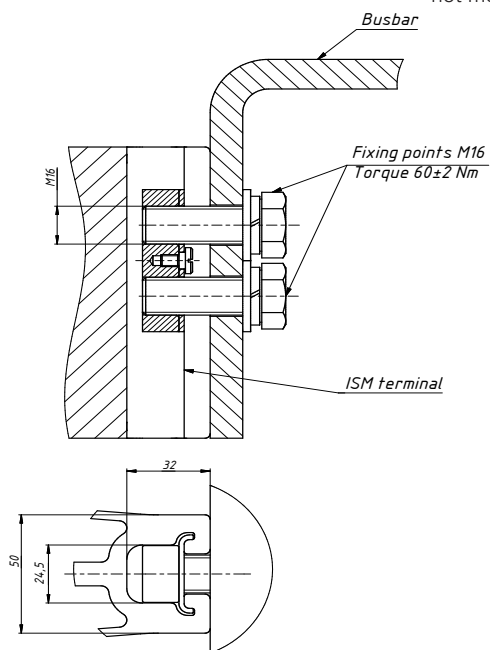
To comply with the rated impulse withstand voltage of 95 kV (75 kV for 150 mm PCD) according to IEC 62271-1 it is recommended to use CBkit_Shell15_1.

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

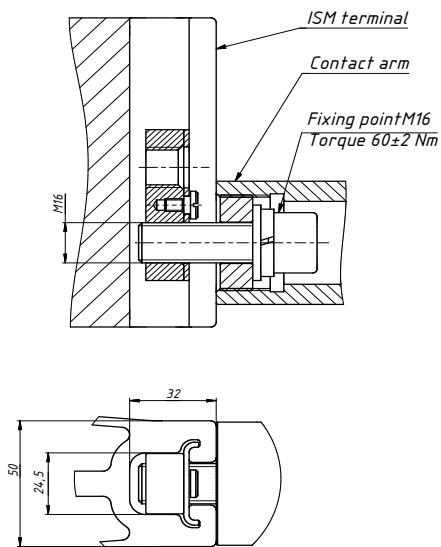
M16 bolts fixing busbars (or contact arms) to HD ISM terminals should be tightened with a torque of 60 ± 2 Nm.

To prevent static load on the ISM poles it is not allowed to fasten busbars to the HD 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.

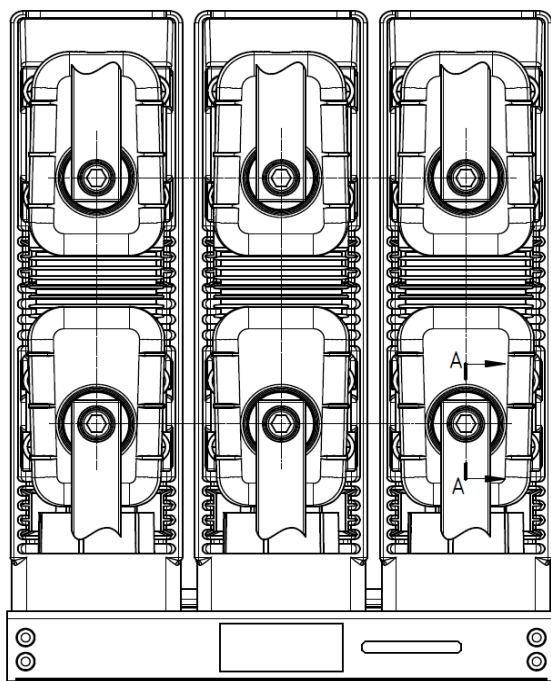
The gap between the busbar and the ISM terminal just before this fastening should be not more than one millimeter.



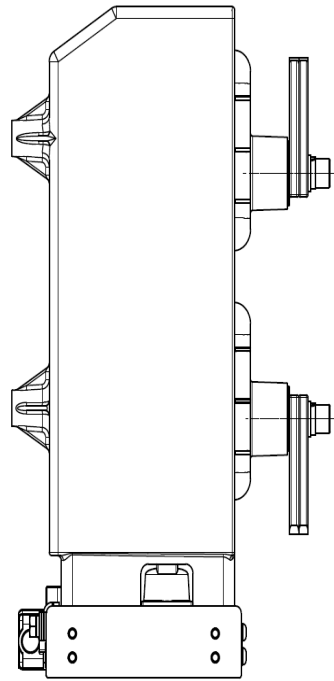
a) Details of HD ISM terminals connection to rectangular cross-shaped bus bars (at fixed installation, for example)



b) Details of HD ISM terminals connection to cylindrical cross-shaped bus bars (withdrawable unit contact arm, for example)



c) Details of HD ISM terminals connection to rectangular cross-shaped bus bars with help of CBkit_Shell15_1 (at fixed installation, for example)



A-A

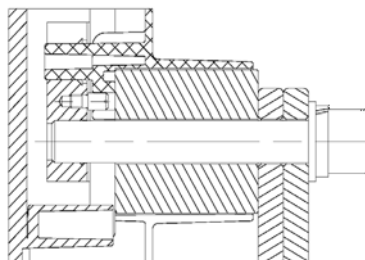


Figure 45
Bus bar fixation to HD ISM terminal

Maximum clearances due to electrodynamic forces

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 4.

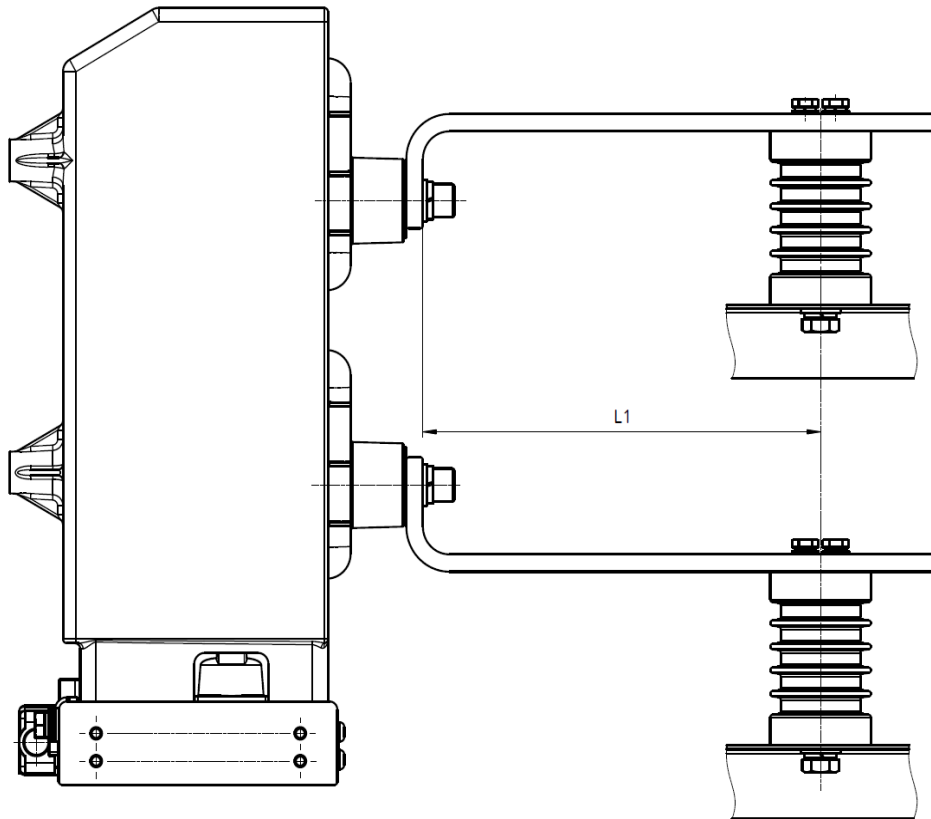


Figure 46
ISM support insulators installation distance

Table 4 - Additional support insulators installation minimum distances

ISM	Short-circuit current		
	20 kA	25 kA	31.5 kA
	L1, mm		
ISM15_Shell_2(150_L)	700	450	300
ISM15_Shell_2(210_L) ISM15_Shell_2(210_H)	980	630	420
ISM15_Shell_2(275_H)	1200	820	550

Minimum clearances due to electromagnetic influence

To avoid primary current effect on ISM actuator, the minimum clearance between bus bars and the ISM frame (Figure 47) should be no less than stated in the Table 5.

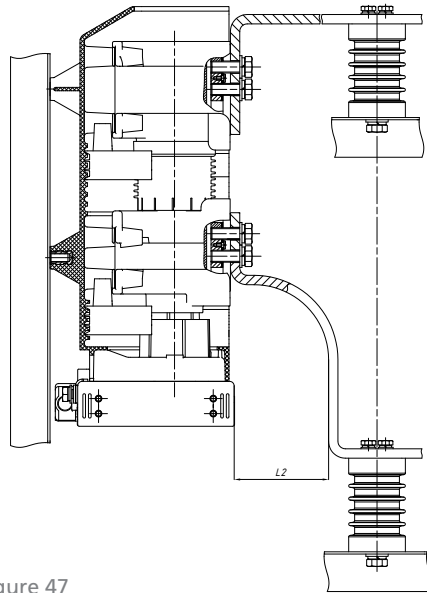


Figure 47
Electromagnetic clearances limitations

Table 5 - Minimum clearances due to electromagnetic influence

Short circuit current	Minimum clearance (a)
25 kA	150 mm
31.5 kA	190 mm

Minimum clearances due to rated insulation voltage

The recommended minimum open air clearances between phase to phase and phase to earth are stated in Table 6. Shorter distances shall be verified by a voltage test.

Table 6 - Minimum clearances due to rated insulation voltage

Power frequency rated voltage	Impulse test voltage (BIL)	Minimum clearance (L2)
12 kV	75 kV	120 mm
17.5 kV	95 kV	140 mm

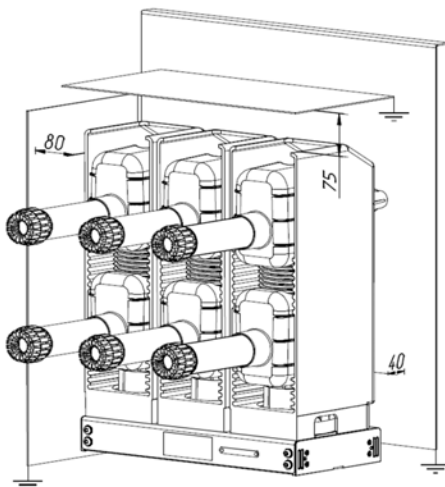


Figure 48
Insulating clearance limitations of HD ISM with low upper terminal

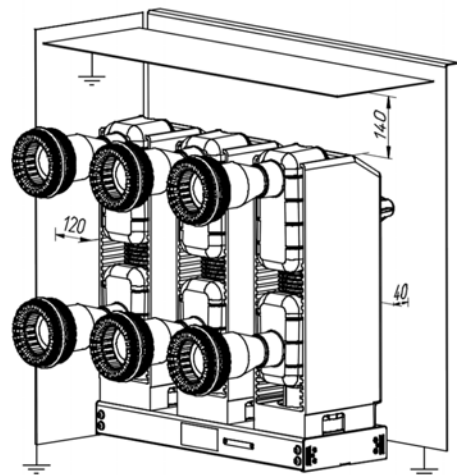


Figure 49
Insulating clearance limitations of HD ISM with high upper terminal

Coordination of minimum clearances

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

4.1.5 LD ISM interlocks

The ISM provides the following interfaces for interlocking (Figure 51):

- stub shafts at both sides with grooves and tapped holes (Figure 51, details 1 and 3);
- two interlocking pins with tapped holes (Figure 51, detail 2).

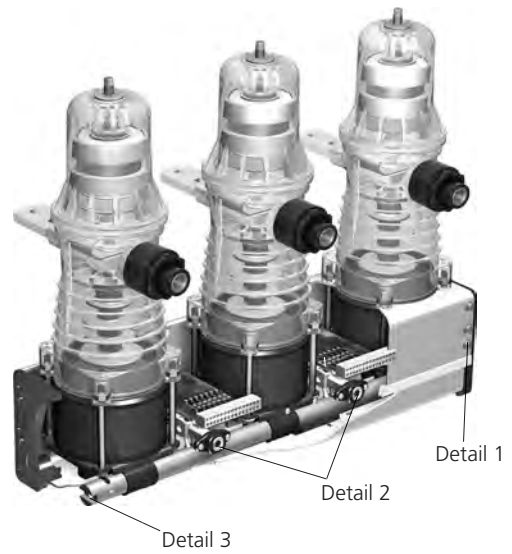
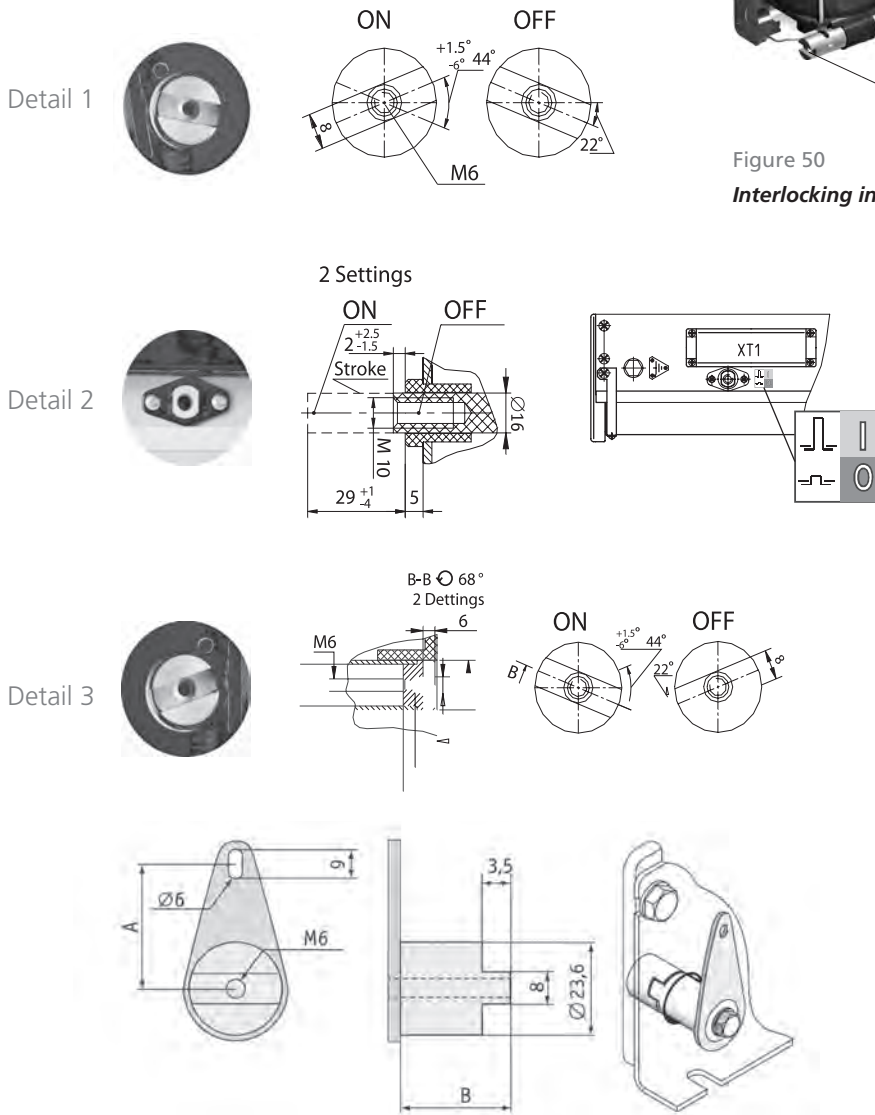


Figure 50
Interlocking interface of LD ISM



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

Figure 51
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 52).
- 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 53).
- If the interlocking mechanism is directly attached with the synchronizing shaft the moment of inertia of the attached mechanism shall not exceed $4.3 \times 10^{-4} \text{ kg}\cdot\text{m}^2$. If both stub shafts of the synchronizing shaft are used, the sum of the attached moments of inertia shall not exceed $4.3 \times 10^{-4} \text{ kg}\cdot\text{m}^2$ respectively $1.2 \times 10^{-4} \text{ kg}\cdot\text{m}^2$ (Figure 51).
- 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 52).
- It is not allowed to perform electrical trip/close commands while the interlocking pins or the synchronizing shaft are blocked mechanically.

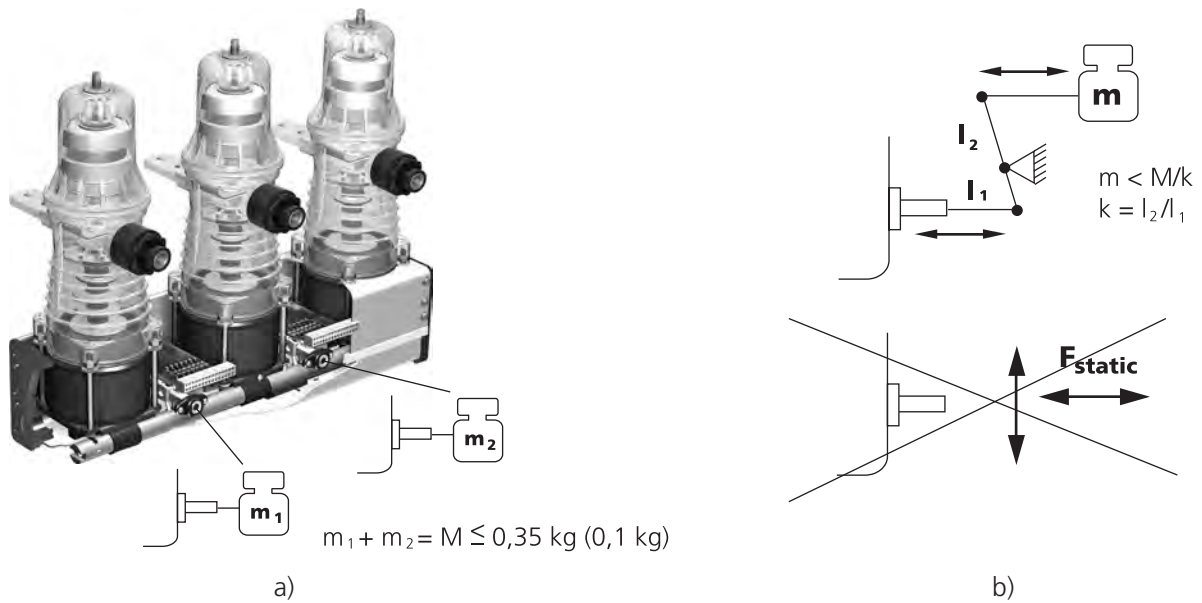


Figure 52
Mechanical interlocking by interlocking pins

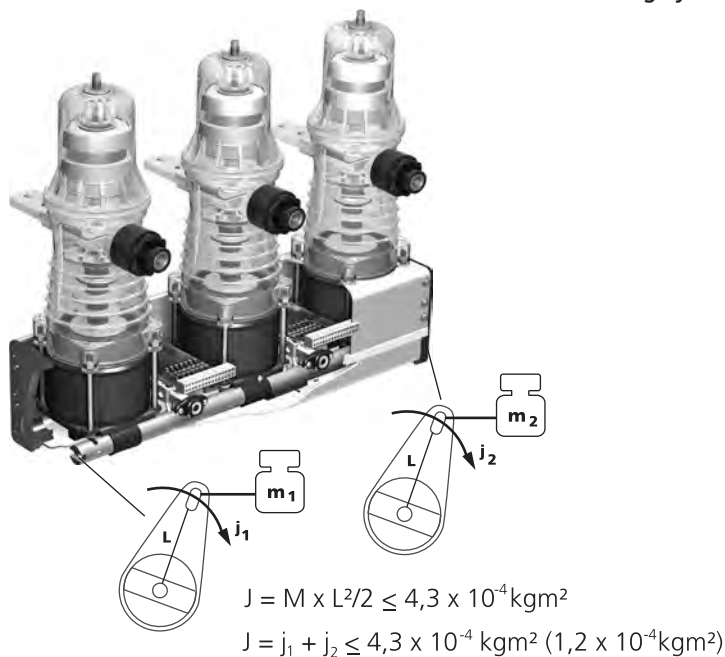
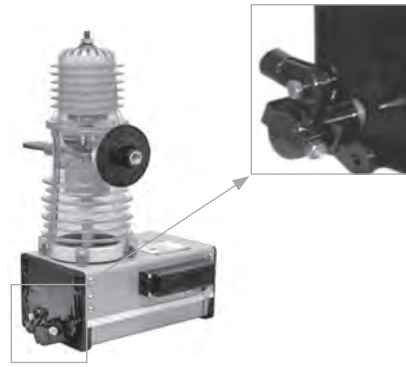
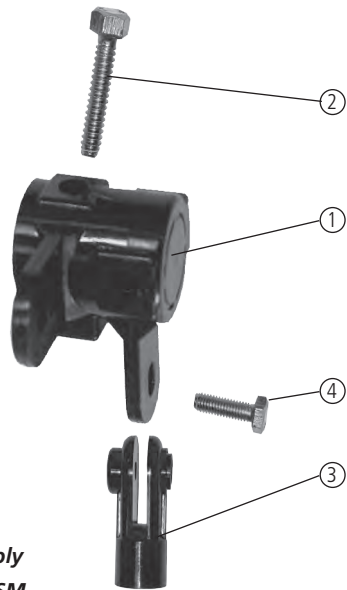


Figure 53
Direct connection of the interlocking mechanism to the synchronizing shaft

Design of mechanical interlocking at the side stub shafts

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

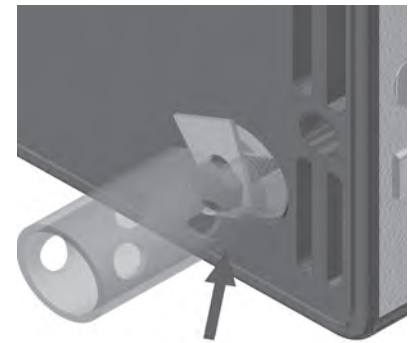
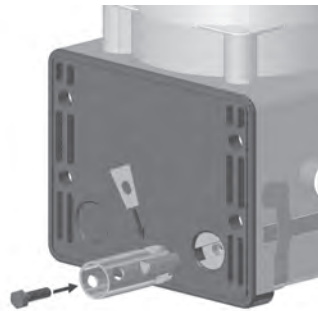
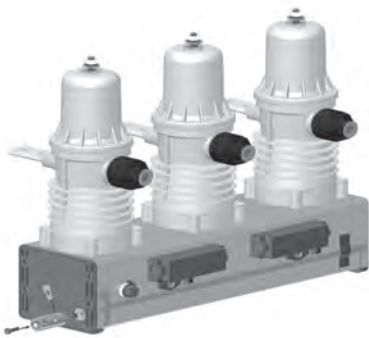


1. Holder Det_Holder_22;
2. Bolt StandDet_Bolt_DIN933(M8_40_Fe88-Zn) - bolt M8x40;
3. Holder Det_Holder_20;
4. Bolt StandDet_Bolt_DIN933(M6_20_Fe88-Zn) - bolt M6x20.

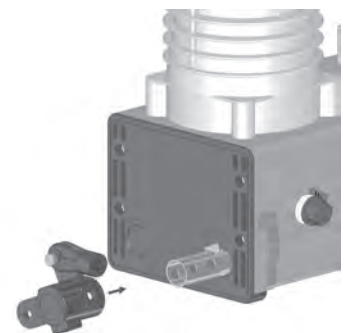
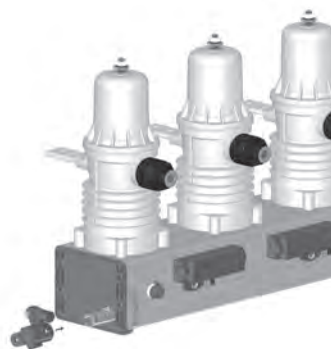
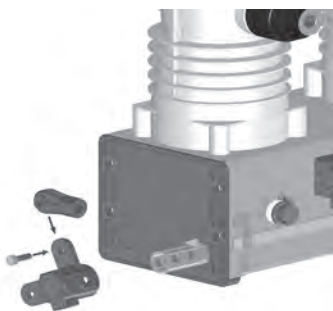
Figure 54

Interlocking lever assembly design for single phase ISM

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



a) Install CBdet_Shaf_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_Shaf_1



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

Figure 55
**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 (disconnecter or draw-out truck, etc.) as shown in the Figure 56.

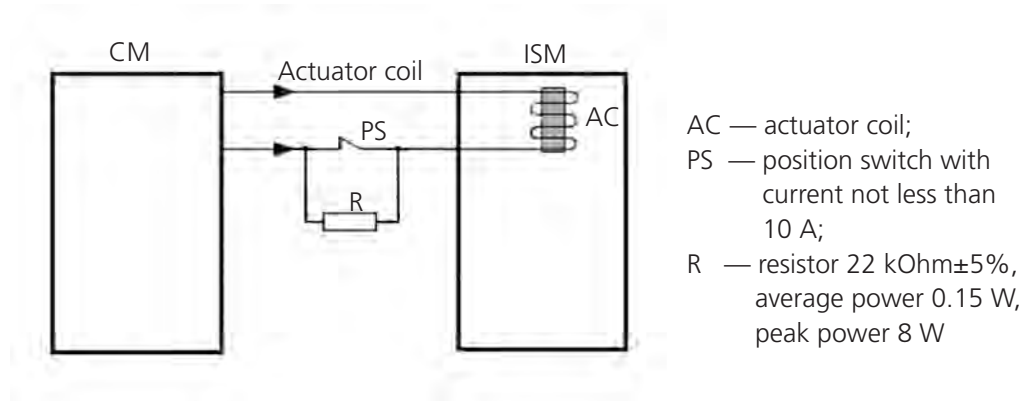


Figure 56
Electrical interlock diagram

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.

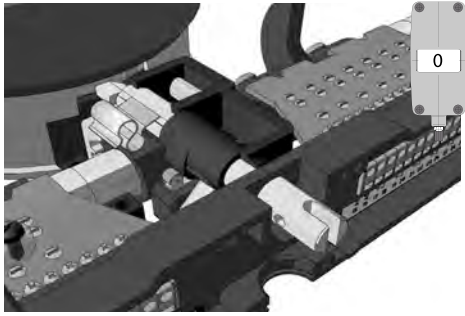
4.1.6 HD ISM interlocks

Interlocking mechanism

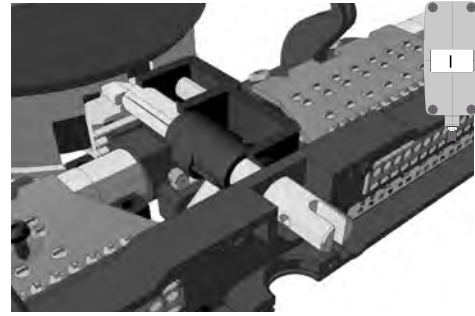
The HD ISM is equipped with an interlocking shaft that can be rotated clockwise to the "unlatched" position or counter-clockwise to the "open and locked" position. In the "unlatched" position the HD ISM can perform "close" and "open" operations.

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.

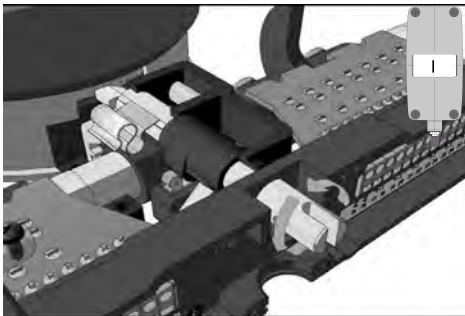
If the HD ISM is closed, rotation of the interlocking shaft from "unlatched" to "open and locked" position leads to manual tripping. The CM indicates alarm "Manual Trip".



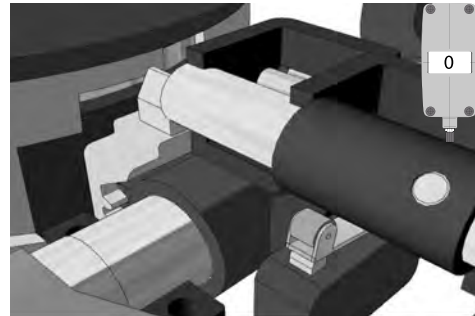
a) Interlocking shaft in unlatched position.
ISM is open



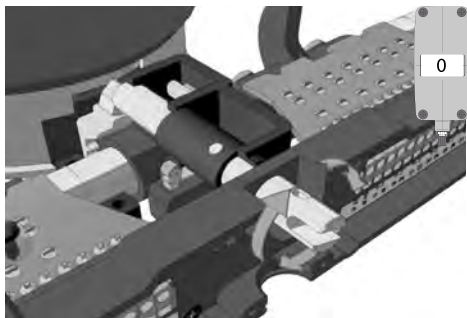
b) Interlocking shaft in unlatched position.
ISM is closed



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 57

HD ISM interlock operating principle

Load capacity of HD ISM interlocking shaft

- The torque on the interlocking shaft shall not exceed 20 Nm;
- The angle of the interlocking shaft rotation shall not exceed 90 °.

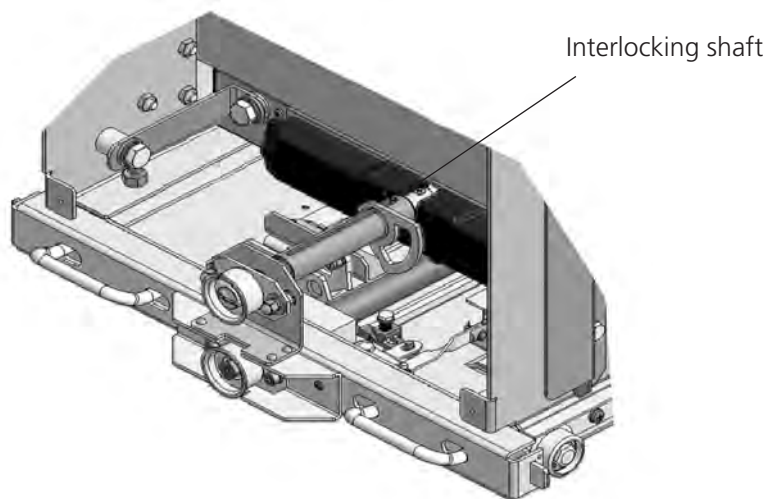
Exceeding any of the above limitations can lead to damage of the interlocking mechanism.



a)



b)



c)

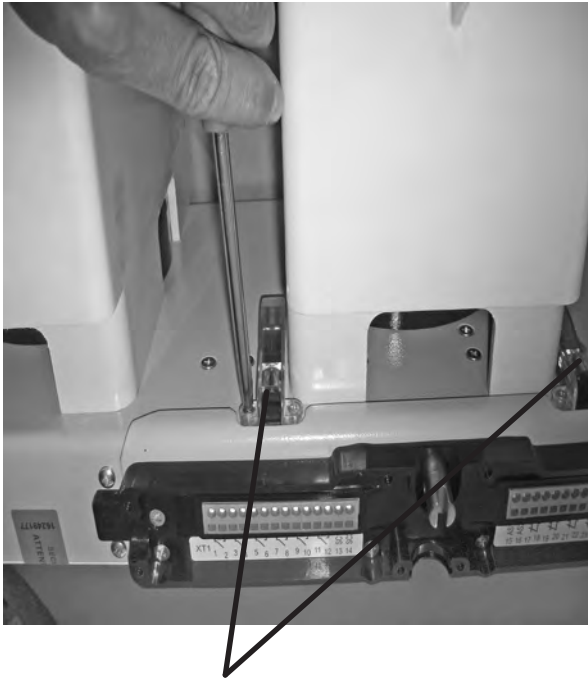
Figure 58

Examples of HD ISM mechanical interlock connection

4.1.7 Installation of HD ISM main contacts position indicator

The installation of the main contacts position indicator is shown below. (Figure 59 - Figure 62). The ISM shall be in the Closed position.

Note: The bending radius of the flexible rod shall be not less than 40 mm.



There are two possibilities (left, right) to connect the flexible rod.



Figure 60

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

Figure 59

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

Figure 61

Return the cover and fasten it to the ISM.



Figure 62
Adjust the indicator for both closed and opened states of the switching module.



Figure 63
Position indicator shows that main contacts are open



Figure 64
Position indicator shows that main contacts are closed

4.1.8 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 flat 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 7 - 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 mm ²
20 kA	300 °C	70-120 mm ²
25 kA	300 °C	95-140 mm ²
31.5 kA	300 °C	120-190 mm ²

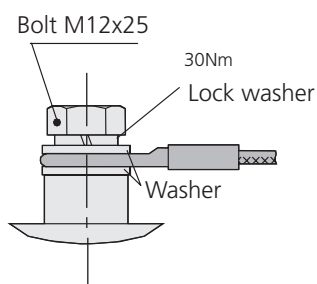


Figure 65
ISM protective earthing connection

The method of LD ISM earthing is shown in the Figure 66.

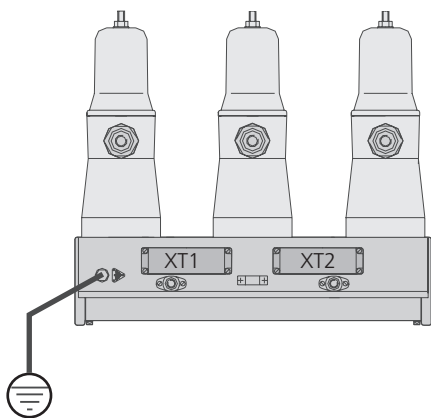


Figure 66
LD ISM earthing

An example of one side copper bar earthing is represented in Figure 67.

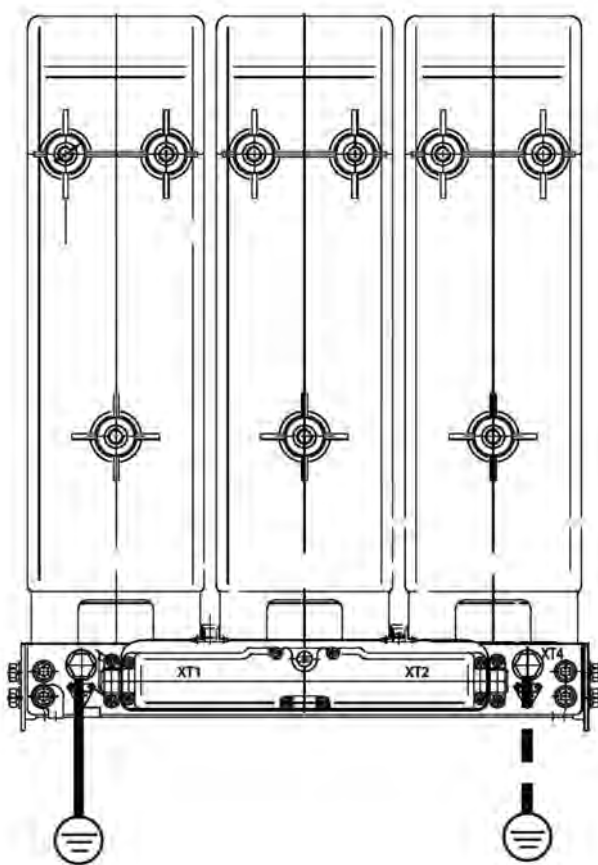


Figure 67
HD ISM earthing



Figure 68
Example of earthing the HD ISM by copper bus bar

4.2 Secondary part

4.2.1 Three-phase ISM secondary connections

All three-phase ISMs have secondary connectors as shown below.

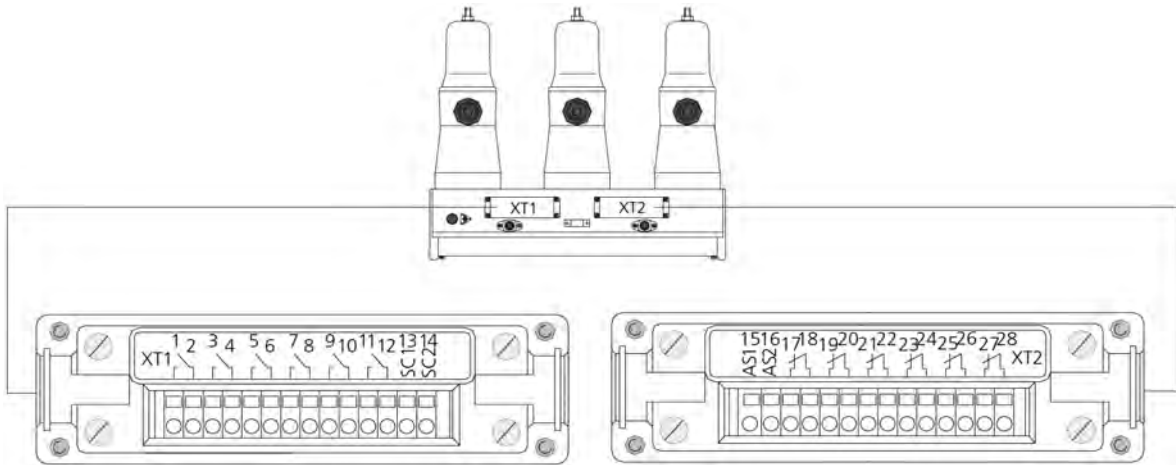


Figure 69

Terminal arrangement of the three-phase ISM

Table 8 - Three-phase ISM 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)

4.2.2 Single-phase ISM secondary connections

All single-phase ISMs have secondary connectors as shown below.

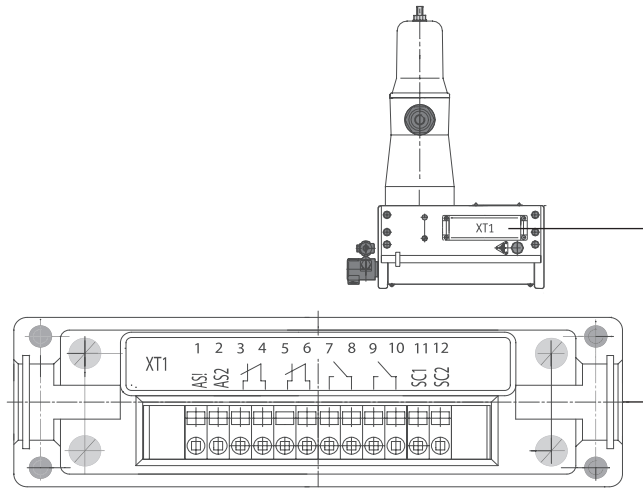


Figure 70

Terminal arrangement of the single-phase ISM

Table 9 - Single-phase ISM 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)

4.2.3 CM secondary connections

CM_16_1 has secondary connectors as shown below.



Figure 71
Terminal arrangement of the the CM

Table 10 - CM terminal arrangement

X1		X3	
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 input		
13	Close input		
14	Trip input		
15	Trip input		

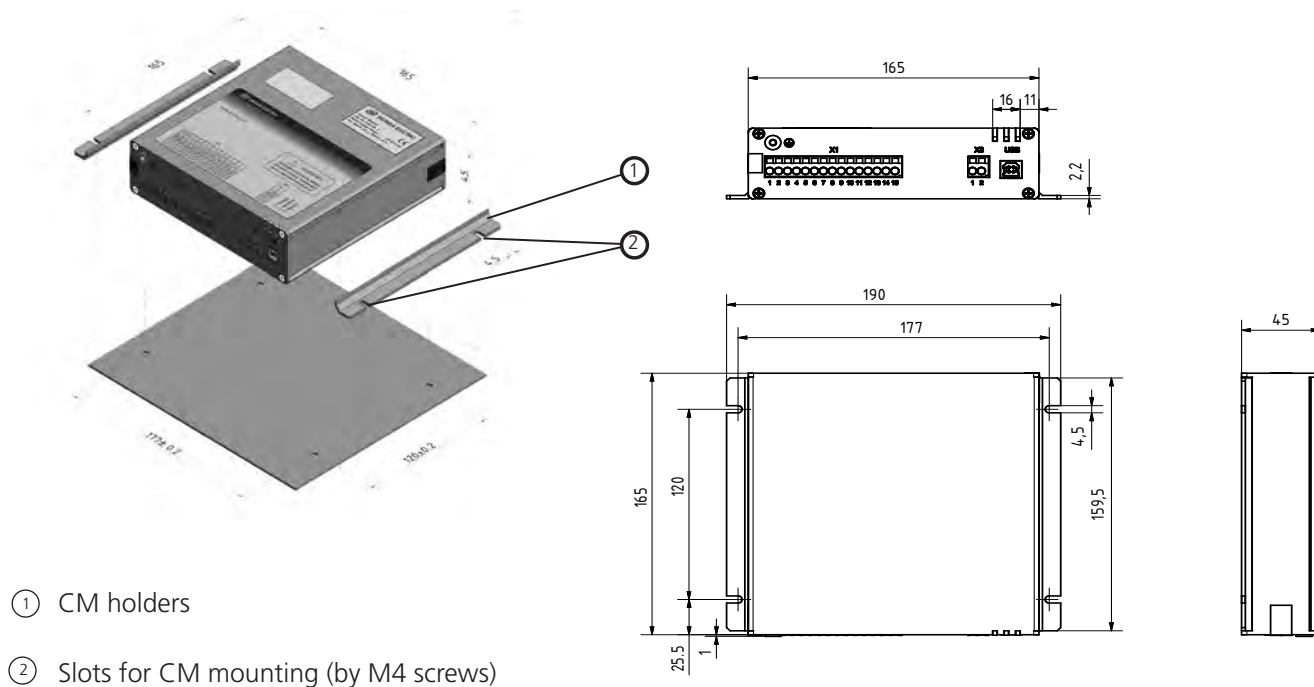
CM relay functionality:

- Relay 1 - "ISM main contact position" relay;
- Relay 2 - "Ready" relay;
- Relay 3 - "Malfunction" relay.

Relay "ISM main contact position" keeps its state after CM power supply disconnection.

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 72

Provisions for CM_16 installation

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

Wires are connected to the CM terminals by using a screwdriver (Figure 18). The terminals can accept solid and stranded wire within the range 0.5–1.5 mm². The insulation stripping length shall be 6–10 mm. Insulated auxiliary circuits shall provide 2 kV power frequency dielectric strength.

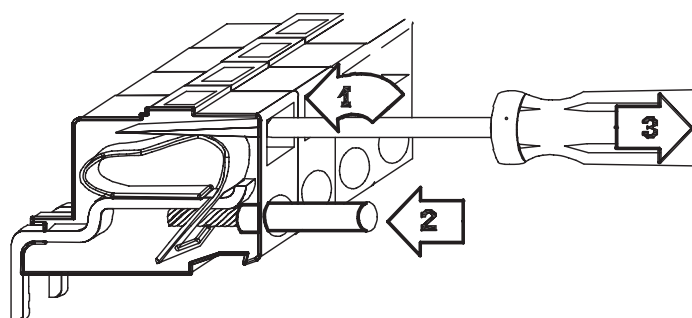


Figure 73

Installation to CM terminals

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 5 and CM packing label - Figure 17) 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 74, Figure 75, Figure 76). 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.

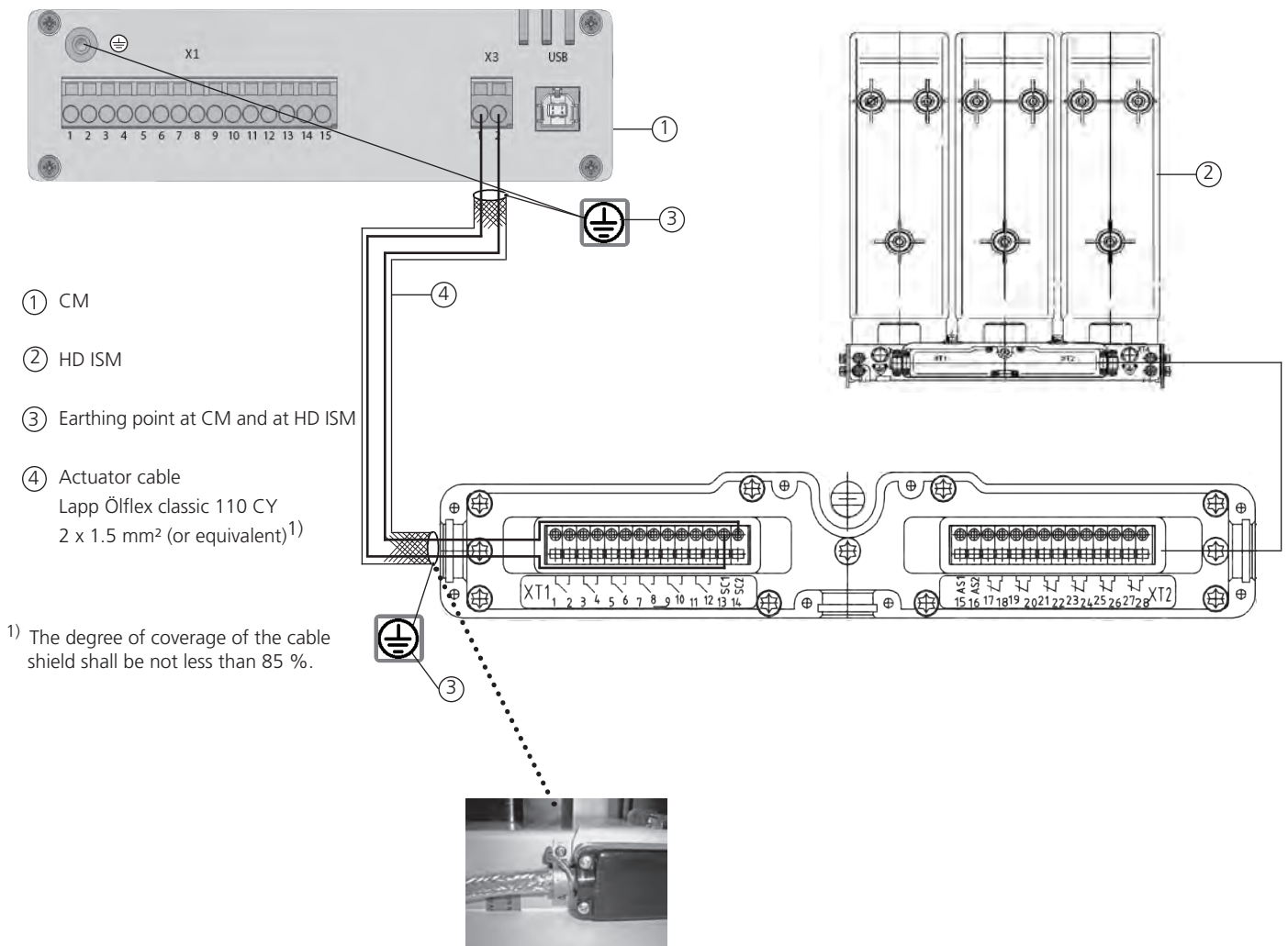


Figure 74

Secondary cables between HD ISM and CM

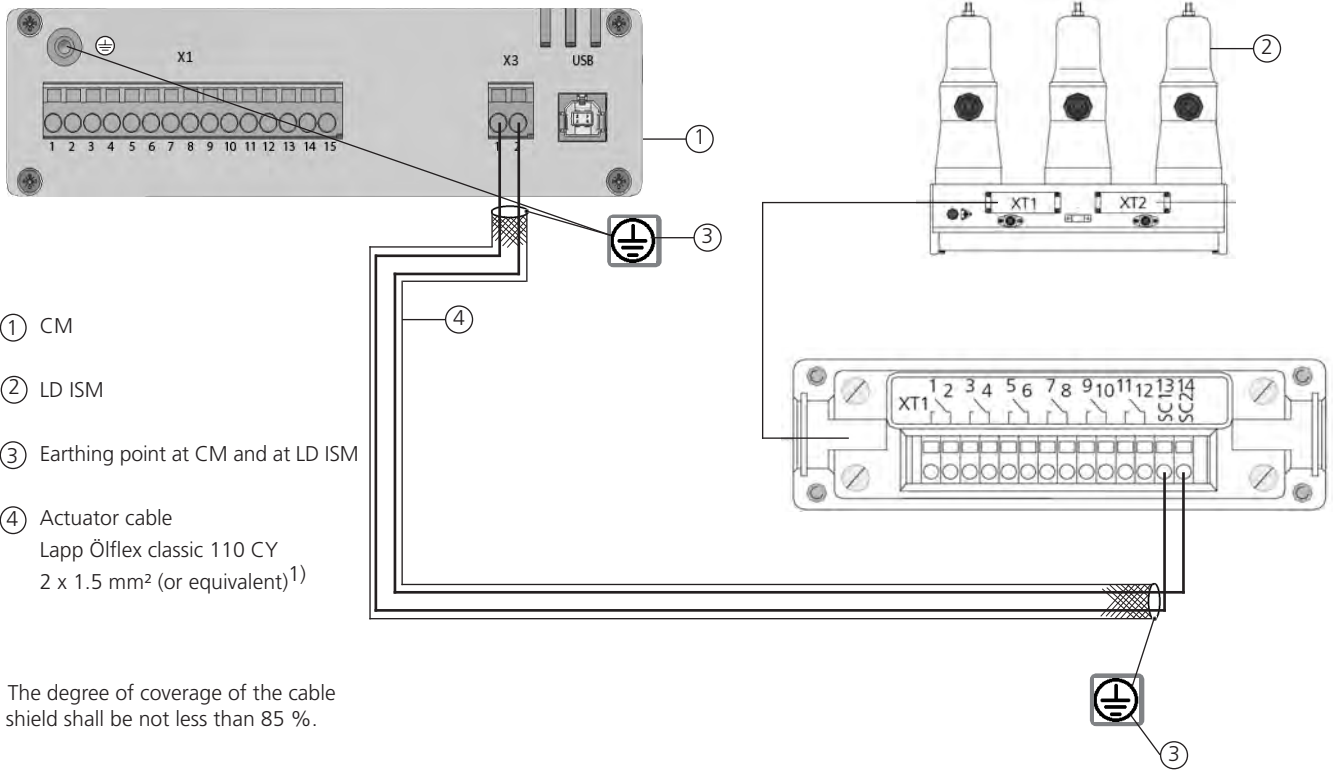


Figure 75
Secondary cables between three phases LD ISM and CM

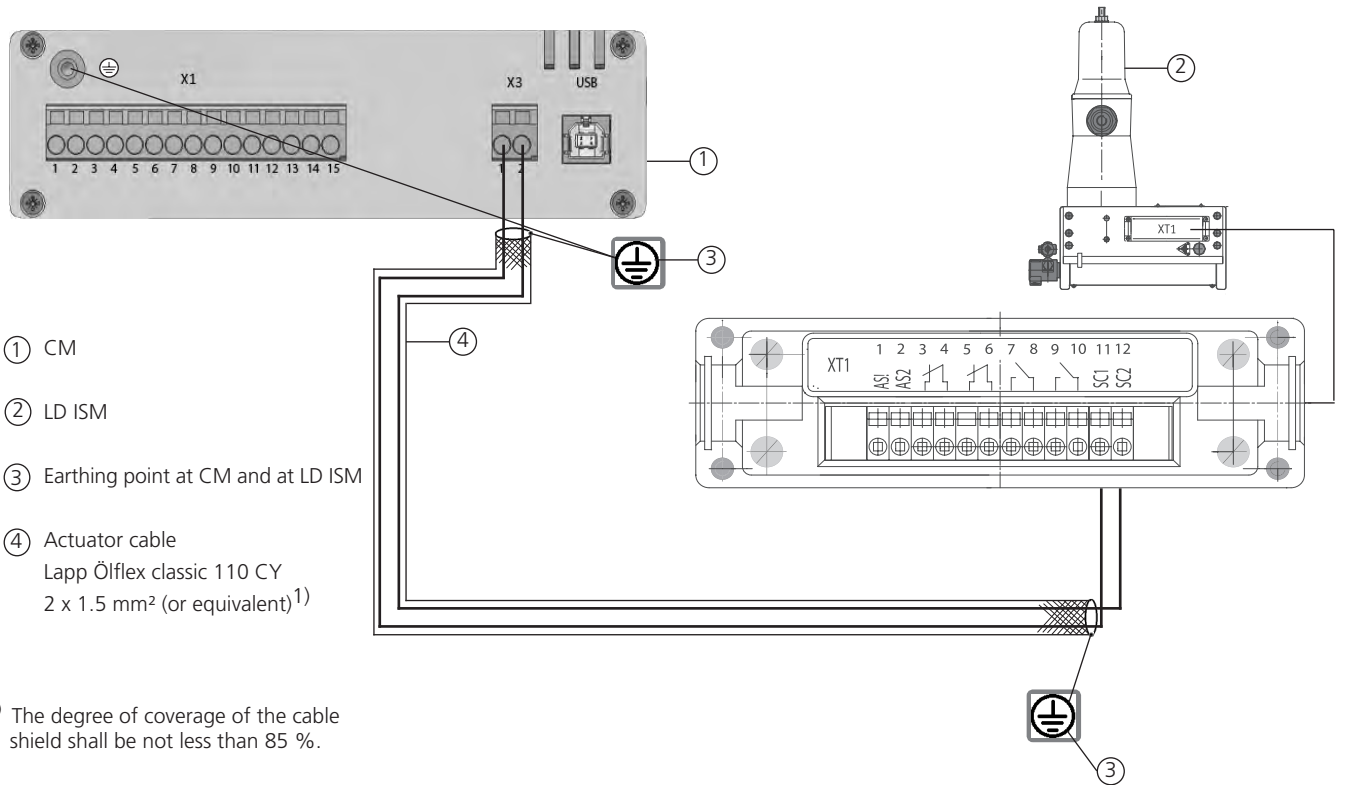
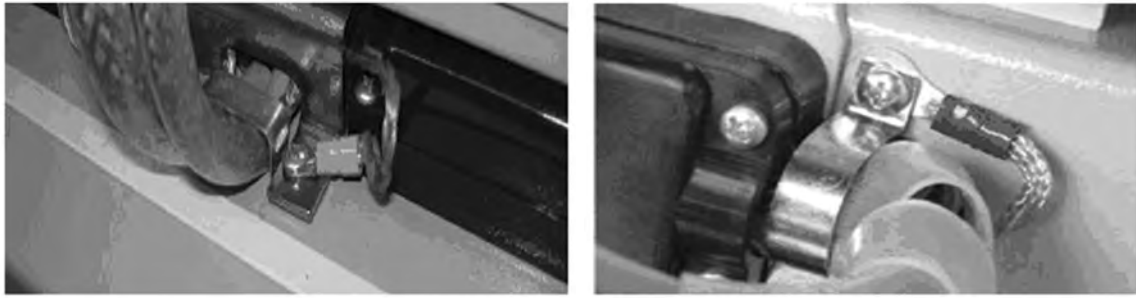


Figure 76
Secondary cables between single phase LD ISM and CM

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) HD ISM

Figure 77

Sample of earthed cable shielding on ISM side

4.2.6 Auxiliary supply

Connection of CM_16_1 to power supply is shown below.

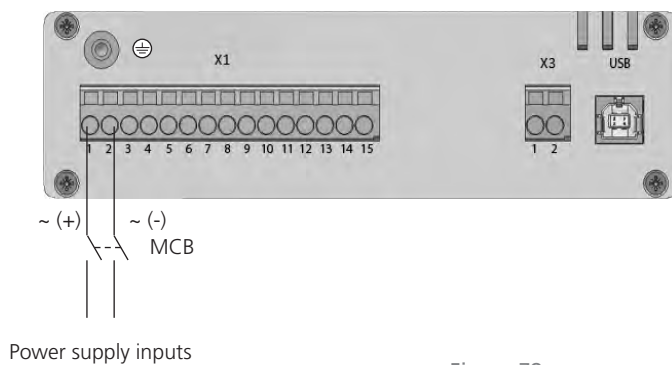


Figure 78

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(60_Par2_Par3).

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. Pay special attention to the correct polarity for CM_16_1(60_Par2_Par3).

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 79. The LED indicators are visible from two directions.

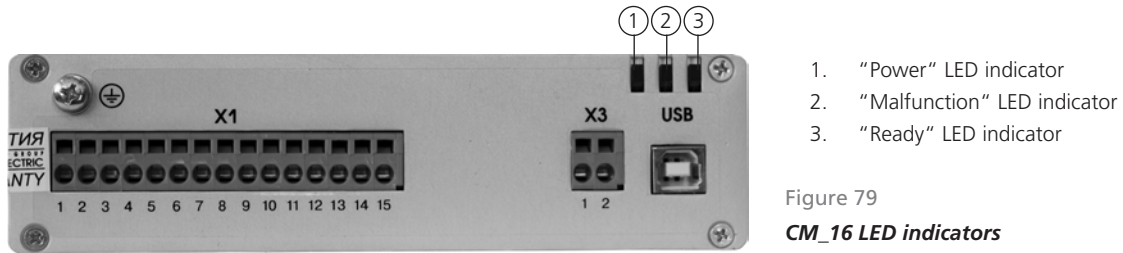


Figure 79

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 Relay state. The explanation of the LED blink codes is given in Table 11.

Table 11 - CM indication

CM state	Indication		
	LED Power	LED Ready	LED Malfunction
Power supply voltage is absent more than 3 minutes	off	off	off
"Close" operation is preparing	continuous	off	off
CM is ready and operable	continuous	continuous	off
Power supply voltage is absent for more than 1.5 seconds	off	continuous	1 blink
Excessive trip or close time	continuous	off	2 blinks
Actuator coil isolated	continuous	off	3 blinks
Short circuit of Actuator coil	continuous	off	4 blinks
Manual Trip and Lock	continuous	off	5 blinks
Overheat	continuous	off	6 blinks
State of ISM is not defined	continuous	off	7 blinks
Internal fault of the CM	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 highest one:

1. CM overheat ;
2. ISM state is open without command from the CM;
3. Excessive trip or close time;
4. Manual Trip and Lock;
5. Short circuit of Actuator coil;
6. Actuator coil isolated;
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 12 - CM relay Ready contacts operation

CM state	Relay Ready contacts state	
	NO	NC
CM is ready for close or open operation	Open	Closed
CM is not ready for close or open operation	Closed	Open

Table 13 - CM relay "ISM main contact position" contacts operation

ISM state	Relay "ISM main contact position" contacts state	
	NO	NC
ISM is closed	Open	Closed
ISM is open	Closed	Open

Table 14 - CM relay Malfunction contacts operation

CM state	Relay Malfunction contacts state	
	NO	NC
Power supply voltage is absent for more than 1.5 seconds (1 blink of LED Malfunction)	Closed	Open
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
Overheat (6 blinks of LED Malfunction)	Closed	Open
State of ISM is not defined (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 15 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 15 - 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 or contamination	Visual check, no tool is required	2 minutes
Unsupported busbar length shall be according to Table 2 for LD ISM and Table 4 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 35 - Figure 38	Visual check, no tool is required	1 minute
Bolts and torques shall be according to Figure 35 - Figure 38	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 4.1.8	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	Multimeter - for validation of correct wiring connections (utilizing the continuity function of the meter)	5 minutes

Operation description	Required tool	Approximate timing
Operation check		
Turn on the CM auxiliary power supply then check the following: <ul style="list-style-type: none"> - 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" 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
Apply close command to the CM then check the following: <ul style="list-style-type: none"> - 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" 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: <ul style="list-style-type: none"> - 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" 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

Operation description	Required tool	Approximate timing
<p>Do not remove trip command and apply close command to the CM then check the following:</p> <ul style="list-style-type: none"> - 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" 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). 	<p>Visual check, no tool is required</p>	<p>1 minute</p>
<p>Remove close and trip commands to the CM then check the following:</p> <ul style="list-style-type: none"> - 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" relay contact must not change its state; - The "ISM main contact position" relay must change its state; - ISM main contacts must change their state (ISM shall remain open). 	<p>Visual check, no tool is required</p>	<p>1 minute</p>
<p>Apply and keep close command and then apply trip command to the CM then check the following:</p> <ul style="list-style-type: none"> - 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" 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. 	<p>Visual check, no tool is required</p>	<p>1 minute</p>

Operation description	Required tool	Approximate timing
Primary circuits insulation check¹⁾		
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 verified 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 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 80 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.

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 81 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 must not exceed limits specified in Table 1.	Visual check, no tool is required	-

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

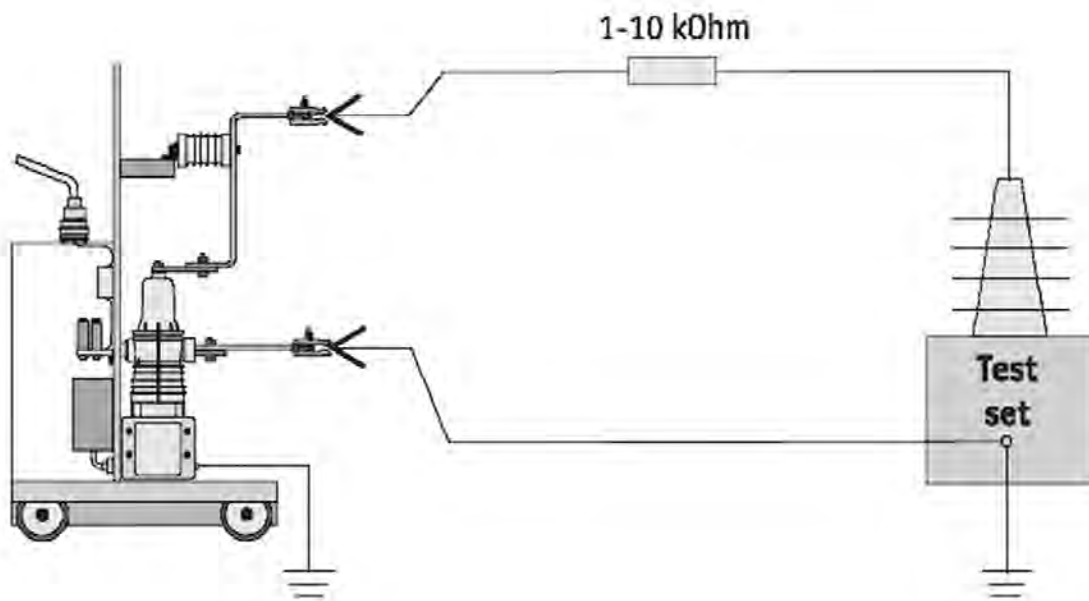


Figure 80
The Vacuum integrity and solid insulation test installation

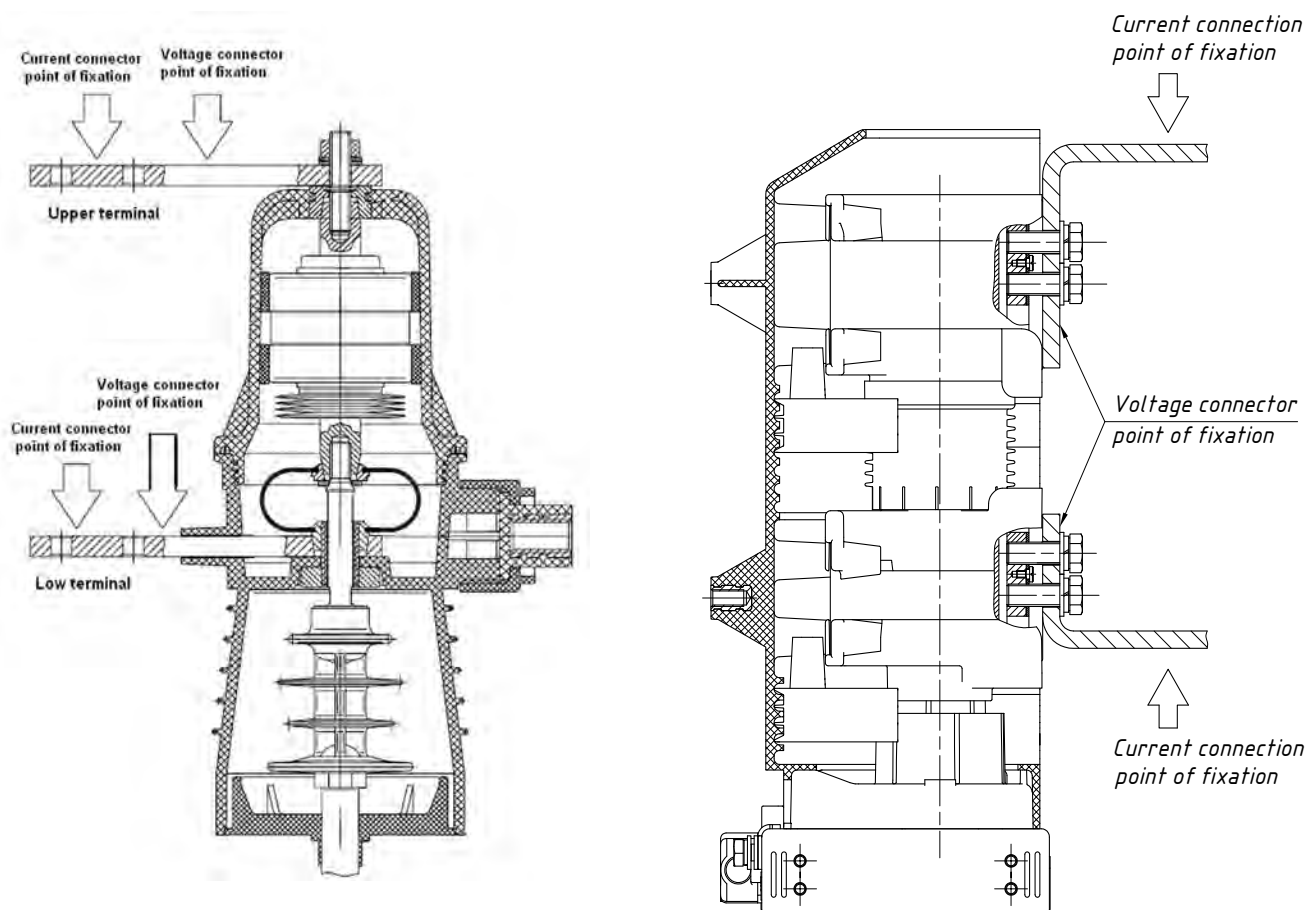


Figure 81
The connection points of the contact resistance meter

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_Shell_2 only).

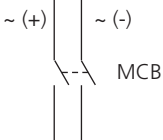
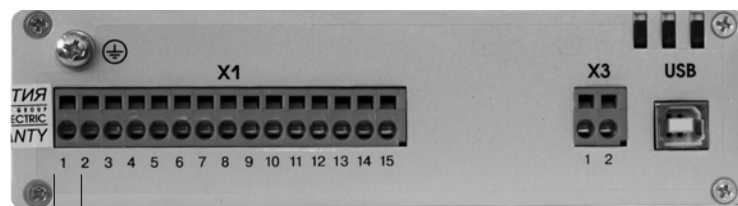
If Close command is applied and held before the CM is in a “Ready” state the Close command will not be accepted. If auxiliary power is not available, the manual generator CBunit_ManGen shall be used to charge the CM capacitors and to close the ISM. Mechanical closing is not possible.



1. Close command input
2. Trip command input

Figure 82
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.



Power supply inputs

Figure 83
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 83) of CM_16_1. Pay special attention to the correct polarity for CM_16_1(60_Par2_Par3).

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_Shell_2 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 and ISM25_LD manually, the force shall be applied to the interlocking pins or torque shall be applied to the stub shaft - see Figure 84. 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 rotation and shall not be applied to the pin or shaft before ISM closing.

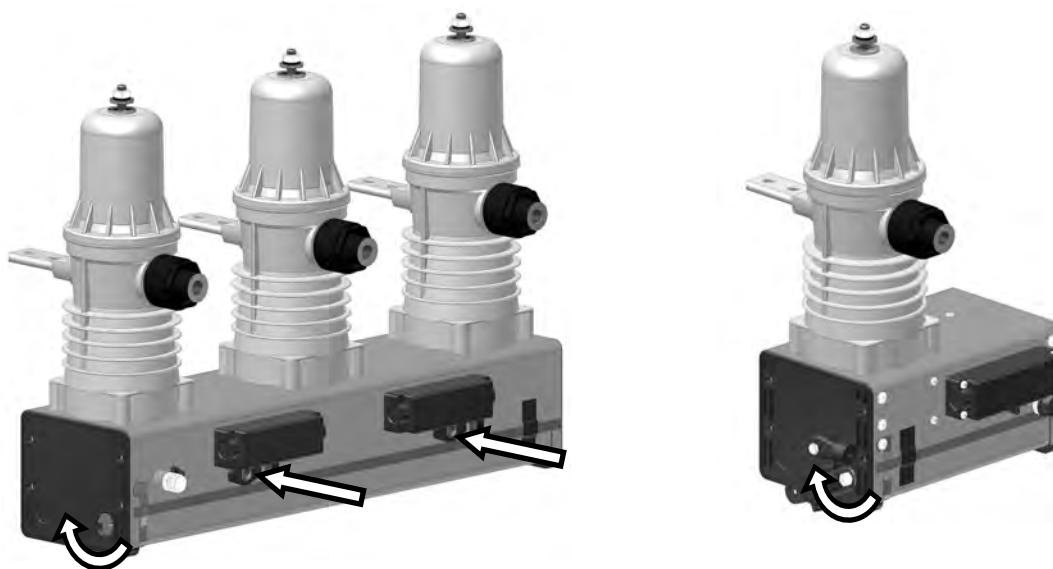


Figure 84

ISM15_LD and ISM25_LD manual trip execution.

Force or torque can be applied to any of the points shown above

To open the ISM15_Shell manually, the torque shall be applied to the interlocking shaft - see Figure 85. 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_Shell_2 has 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.

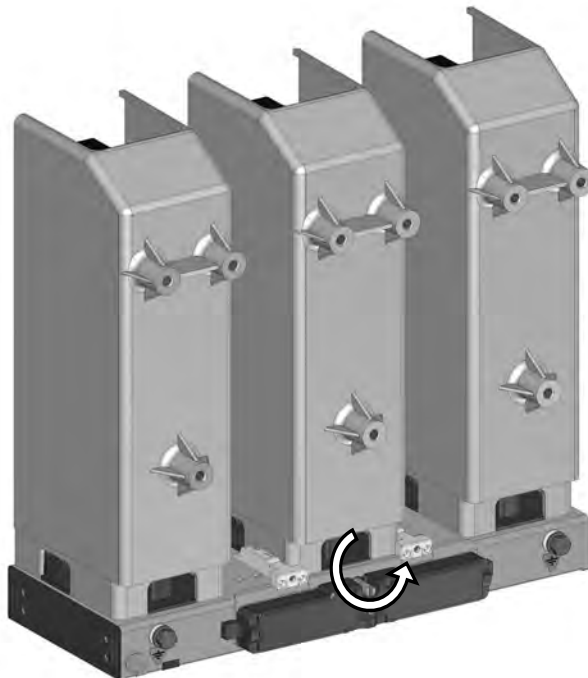


Figure 85
ISM15_Shell manual trip execution

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 16.

Table 16 - List of tests and check-ups of ISM during maintenance

Operation description	Required tool	Approximate timing
Check for damage, remove any dirt or contamination	Dry napless cloth or a napless cloth soaked in alcohol to clean the insulation	5 minutes
Bolts and torques shall be according to Figure 35 - Figure 38	Torque wrench according to torque value	2 minutes
Protective earthing shall be according to subchapter 4.1.8	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 check¹⁾		
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 verified 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 80 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.

Operation description	Required tool	Approximate timing
Primary circuits contact resistance check¹⁾		
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 81 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 must not exceed limits specified in Table 1. ¹⁾	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:

$$I_a < I_r \sqrt{\frac{R_r}{R_a}}$$

where:

I_a , R_a — actual current and corresponding contact resistance,

I_r , R_r — 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 17.

Table 17 - 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 18 prior to contacting our regional representative.

Table 18 - 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	Overheating of CM	Stop performing CO operations until the blinks stop
7 blinks of CM "Malfunction" LED	State of ISM is not defined	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.

Product range

VCB Product range, delivery sets and package parameters

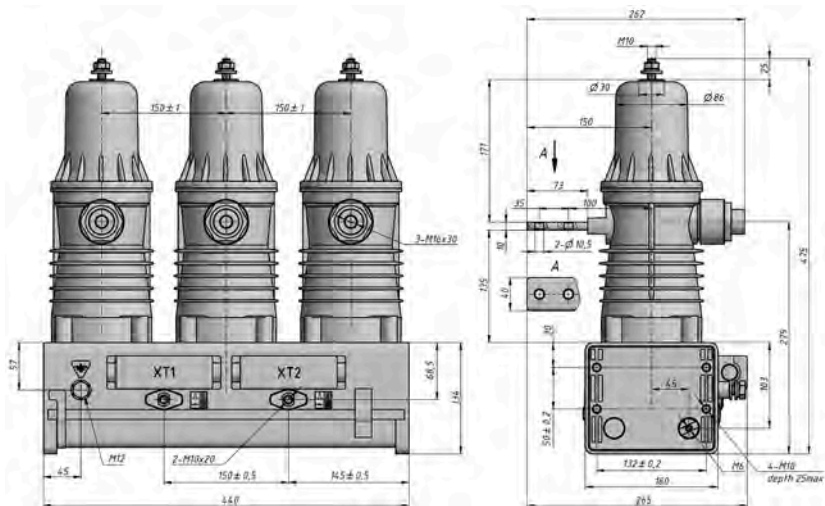
VCB designation	Item	Quantity	Package dimensions (LxWxH), mm	Gross weight, kg	Net weight, kg
VCB15_LD1_16F(CB_12_20_800_210_1_60_No)	ISM15_LD_1(55)	1	645x290x550	39.1	37
	CM_16_1(60_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_210_1_220_No)	ISM15_LD_1(55)	1	645x290x550	39.1	37
	CM_16_1(220_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_150_1_60_No)	ISM15_LD_1(67)	1	645x290x550	37.1	35
	CM_16_1(60_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_150_1_220_No)	ISM15_LD_1(67)	1	645x290x550	37.1	35
	CM_16_1(220_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_150_2_60_No)	ISM15_LD_1(80)	1	645x330x550	39.1	37
	CM_16_1(60_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_150_2_220_No)	ISM15_LD_1(80)	1	645x330x550	39.1	37
	CM_16_1(220_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_180_1_60_No)	ISM15_LD_1(90)	1	645x290x550	39.1	37
	CM_16_1(60_CB_1)	1			
VCB15_LD1_16F(CB_12_20_800_180_1_220_No)	ISM15_LD_1(90)	1	645x290x550	39.1	37
	CM_16_1(220_CB_1)	1			
VCB15_LD3_16F(CB_12_20_800_NA_1_60_No)	ISM15_LD_3	1	645x290x550	17.1	14
	CM_16_1(60_CB_2)	1			
VCB15_LD3_16F(CB_12_20_800_NA_1_220_No)	ISM15_LD_3	1	645x290x550	17.1	14
	CM_16_1(220_CB_2)	1			
VCB15_LD6_16RD(CB_12_20_630_133_1_60_AG16)	ISM15_LD_6	1	470x410x700	62.3	59.3
	CM_16_1(60_CB_1)	1			
	CBkit_LD15_3	1			
VCB15_LD6_16RD(CB_12_20_630_133_1_220_AG16)	ISM15_LD_6	1	470x410x700	62.3	59.3
	CM_16_1(220_CB_1)	1			
	CBkit_LD15_3	1			
VCB15_LD6_16RD(CB_12_20_630_133_1_60_LMT)	ISM15_LD_6	1	470x410x700	60.8	57.8
	CM_16_1(60_CB_1)	1			
	CBkit_LD15_2	1			
VCB15_LD6_16RD(CB_12_20_630_133_1_220_LMT)	ISM15_LD_6	1	470x410x700	60.8	57.8
	CM_16_1(220_CB_1)	1			
	CBkit_LD15_2	1			
VCB15_Shell2_16F(CB_17.5_31.5_1250_150_1_60_No)	ISM15_Shell_2(150_L)	1	790x275x800	66.3	60.9
	CM_16_1(60_CB_3)	1			
	CBkit_Shell15_1(205)	1			
VCB15_Shell2_16F(CB_17.5_31.5_1250_150_1_220_No)	ISM15_Shell_2(150_L)	1	790x275x800	66.3	60.9
	CM_16_1(220_CB_3)	1			
	CBkit_Shell15_1(205)	1			
VCB15_Shell2_16F(CB_12_31.5_1250_210_1_60_No)	ISM15_Shell_2(210_L)	1	790x275x600	57.1	53
	CM_16_1(60_CB_3)	1			
VCB15_Shell2_16F(CB_12_31.5_1250_210_1_220_No)	ISM15_Shell_2(210_L)	1	790x275x600	57.1	53
	CM_16_1(220_CB_3)	1			
VCB15_Shell2_16F(CB_17.5_31.5_1250_210_1_60_No)	ISM15_Shell_2(210_L)	1	790x275x800	66.4	61.9
	CM_16_1(60_CB_3)	1			
	CBkit_Shell15_1(205)	1			
VCB15_Shell2_16F(CB_17.5_31.5_1250_210_1_220_No)	ISM15_Shell_2(210_L)	1	790x275x800	66.4	61.9
	CM_16_1(220_CB_3)	1			
	CBkit_Shell15_1(205)	1			

VCB designation	Item	Quantity	Package dimensions (LxWxH), mm	Gross weight, kg	Net weight, kg
VCB15_Shell2_16F(CB_12_31.5_2000_210_1_60_No)	ISM15_Shell_2(210_H) CM_16_1(60_CB_3)	1 1	790x275x600	58.6	62.5
VCB15_Shell2_16F(CB_12_31.5_2000_210_1_220_No)	ISM15_Shell_2(210_H) CM_16_1(220_CB_3)	1 1	790x275x600	58.6	62.5
VCB15_Shell2_16F(CB_17.5_31.5_2000_210_1_60_No)	ISM15_Shell_2(210_H) CM_16_1(60_CB_3) CBkit_Shell15_1(310)	1 1 1	790x275x800	67.4	62.9
VCB15_Shell2_16F(CB_17.5_31.5_2000_210_1_220_No)	ISM15_Shell_2(210_H) CM_16_1(220_CB_3) CBkit_Shell15_1(310)	1 1 1	790x275x800	67.4	62.9
VCB15_Shell2_16F(CB_12_31.5_2000_275_1_60_No)	ISM15_Shell_2(275_H) CM_16_1(60_CB_3)	1 1	790x275x600	59.1	56
VCB15_Shell2_16F(CB_12_31.5_2000_275_1_220_No)	ISM15_Shell_2(275_H) CM_16_1(220_CB_3)	1 1	790x275x600	59.1	56
VCB15_Shell2_16F(CB_17.5_31.5_2000_275_1_60_No)	ISM15_Shell_2(275_H) CM_16_1(60_CB_3) CBkit_Shell15_1(310)	1 1 1	790x275x800	68.4	64.9
VCB15_Shell2_16F(CB_17.5_31.5_2000_275_1_220_No)	ISM15_Shell_2(275_H) CM_16_1(220_CB_3) CBkit_Shell15_1(310)	1 1 1	790x275x800	68.4	64.9
VCB25_LD1_16F(CB_17.5_16_800_210_1_60_No)	ISM25_LD_1(210_S) CM_16_1(60_CB_4)	1 1	645x290x550	39.1	37
VCB25_LD1_16F(CB_17.5_16_800_210_1_220_No)	ISM25_LD_1(210_S) CM_16_1(220_CB_4)	1 1	645x290x550	39.1	37
VCB25_LD1_16F(CB_24_16_800_210_1_60_No)	ISM25_LD_1(210_S) CM_16_1(60_CB_4) CBkit_Ins_3	1 1 3	645x290x550	39.7	37.6
VCB25_LD1_16F(CB_24_16_800_210_1_220_No)	ISM25_LD_1(210_S) CM_16_1(220_CB_4) CBkit_Ins_3	1 1 3	645x290x550	39.7	37.6
VCB25_LD1_16F(CB_24_12.5_630_210_1_60_DY800)	ISM25_LD_1(210_G_1) CM_16_1(60_CB_4)	1 1	645x290x550	39.1	37
VCB25_LD1_16F(CB_24_16_800_275_1_60_No)	ISM25_LD_1(210_S) CM_16_1(60_CB_4) CBkit_Ins_3	1 1 3	775x290x550	41.7	39.6
VCB25_LD1_16F(CB_24_16_800_275_1_220_No)	ISM25_LD_1(210_S) CM_16_1(220_CB_4) CBkit_Ins_3	1 1 3	775x290x550	41.7	39.6
VCB25_LD2_16F(CB_24_16_630_150_1_60_No)	ISM25_LD_2(1) CM_16_1(60_CB_4)	1 1	645x290x550	38.1	36
VCB25_LD2_16F(CB_24_16_630_150_1_220_No)	ISM25_LD_2(1) CM_16_1(220_CB_4)	1 1	645x290x550	38.1	36
VCB25_LD2_16F(CB_24_16_630_150_2_60_No)	ISM25_LD_2(2) CM_16_1(60_CB_4)	1 1	645x330x550	40.1	38
VCB25_LD2_16F(CB_24_16_630_150_2_220_No)	ISM25_LD_2(2) CM_16_1(220_CB_4)	1 1	645x330x550	40.1	38
VCB25_LD3_16F(CB_24_16_800_NA_1_60_No)	ISM25_LD_3 CM_16_1(60_CB_5) CBkit_Ins_3	1 1 1	645x290x550	18.3	15.2
VCB25_LD3_16F(CB_24_16_800_NA_1_220_No)	ISM25_LD_3 CM_16_1(220_CB_5) CBkit_Ins_3	1 1 1	645x290x550	18.3	15.2

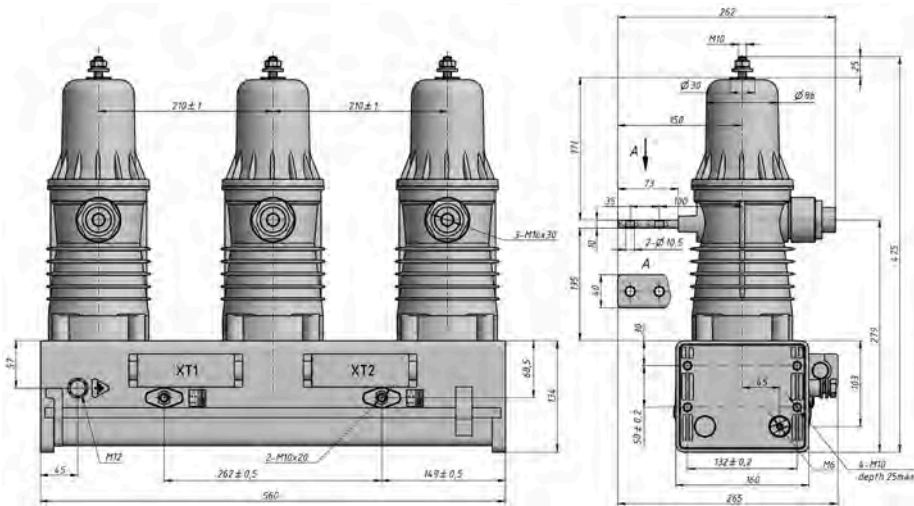
Appendix 2.

Overall drawings

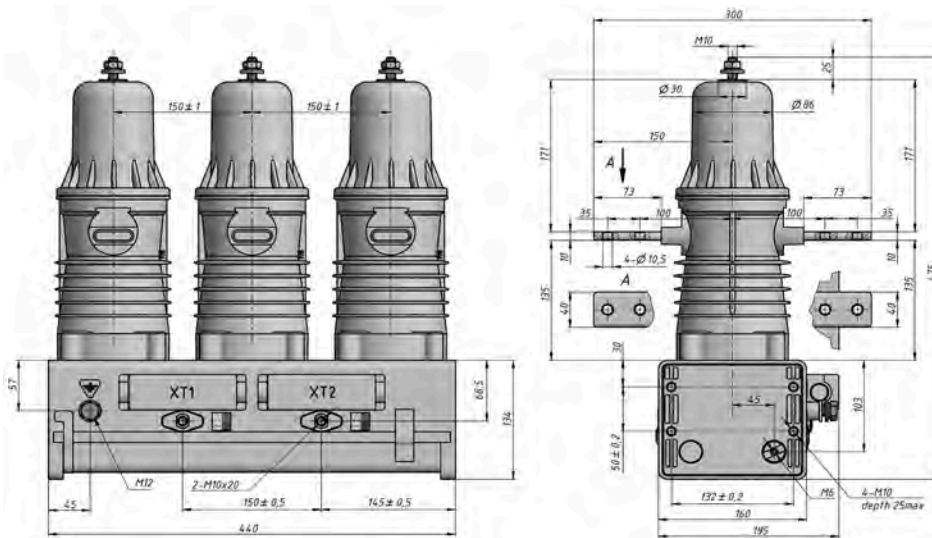
Dimensions of Indoor Switching Modules



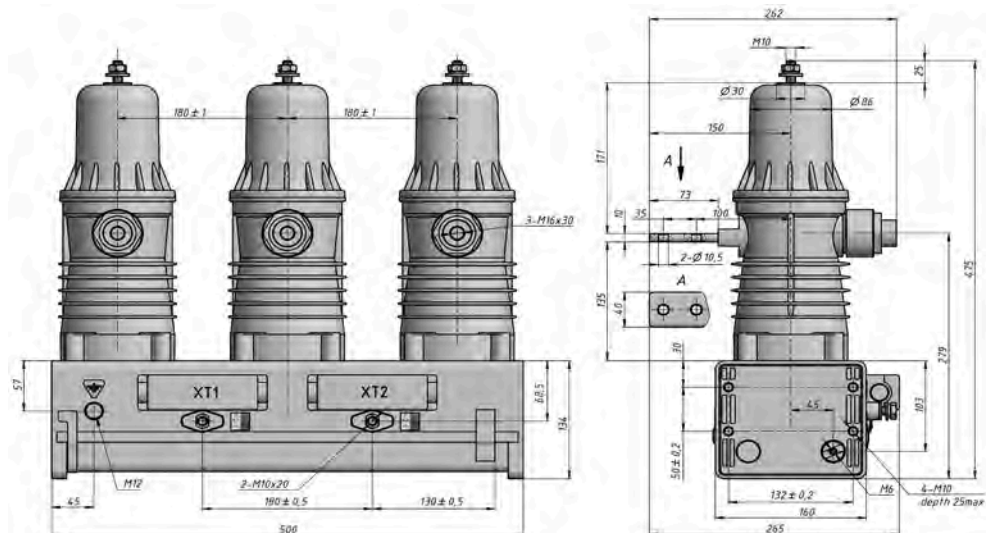
ISM15_LD_1(67),
PCD 150 mm
Weight: 34 kg



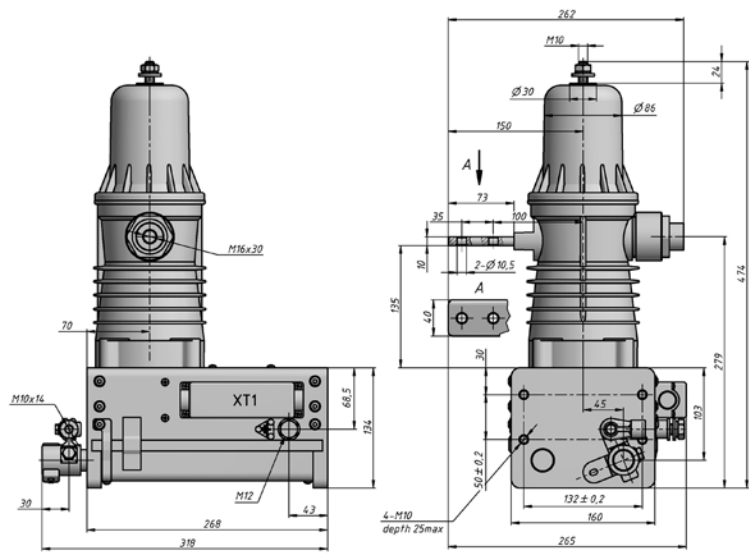
ISM15_LD_1(55),
PCD 210 mm
Weight: 36 kg



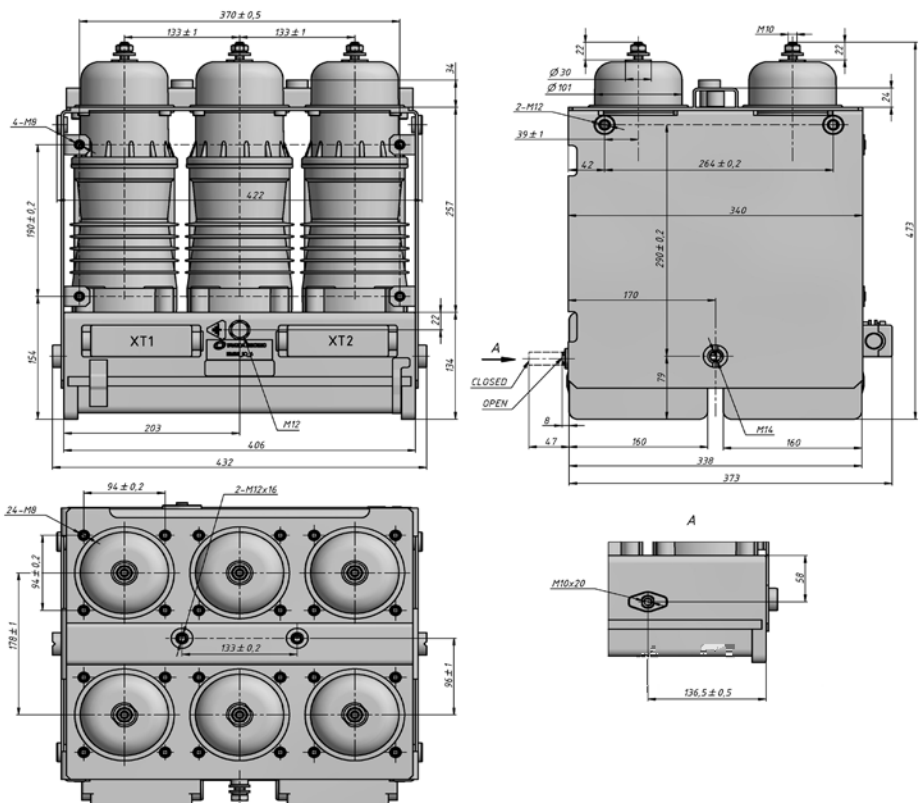
**ISM15_LD_1(80), two lower terminals (continuous busbar),
PCD 150 mm
Weight: 36 kg**



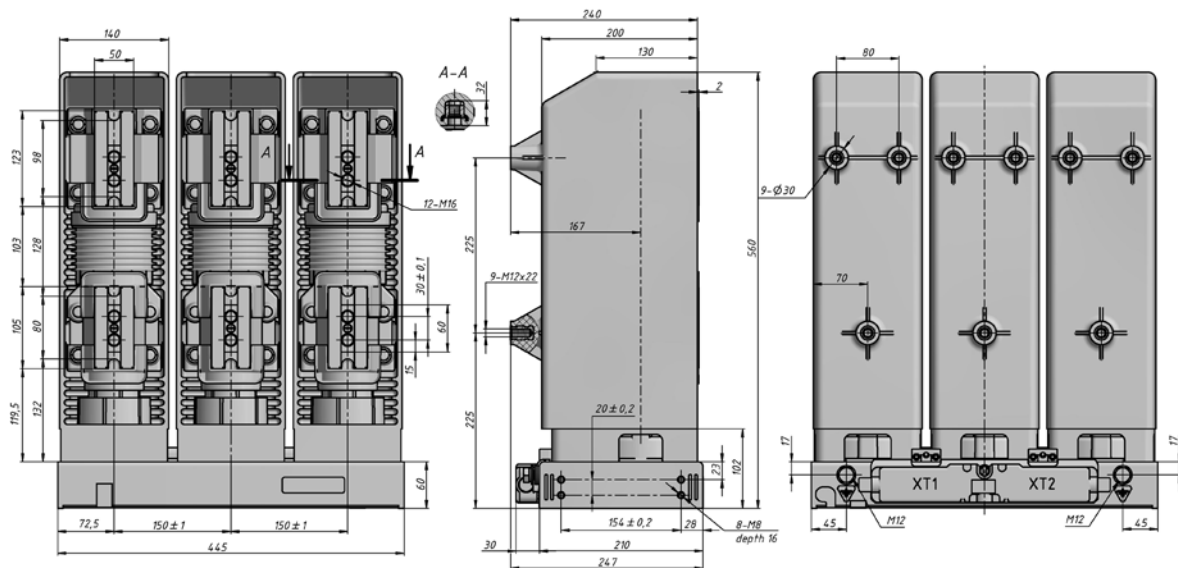
**ISM15_LD_1(90),
PCD 180 mm
Weight: 36 kg**



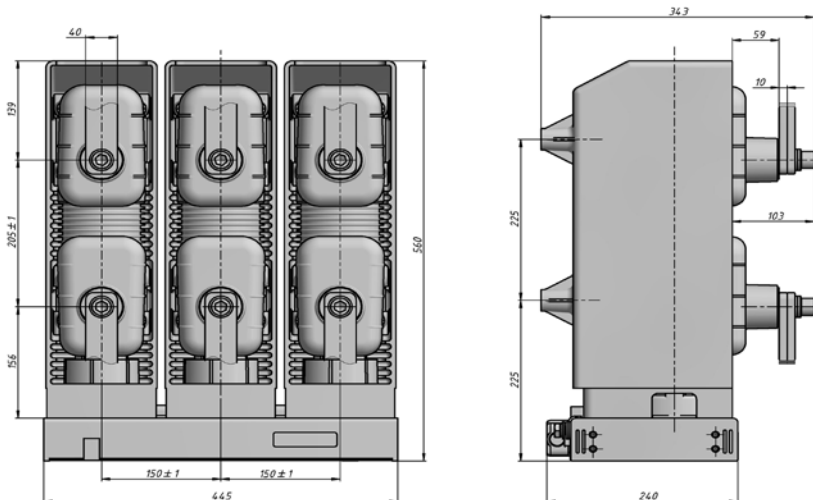
ISM15_LD_3,
Weight: 13 kg



ISM15_LD_6,
PCD 133 mm
Weight: 55 kg

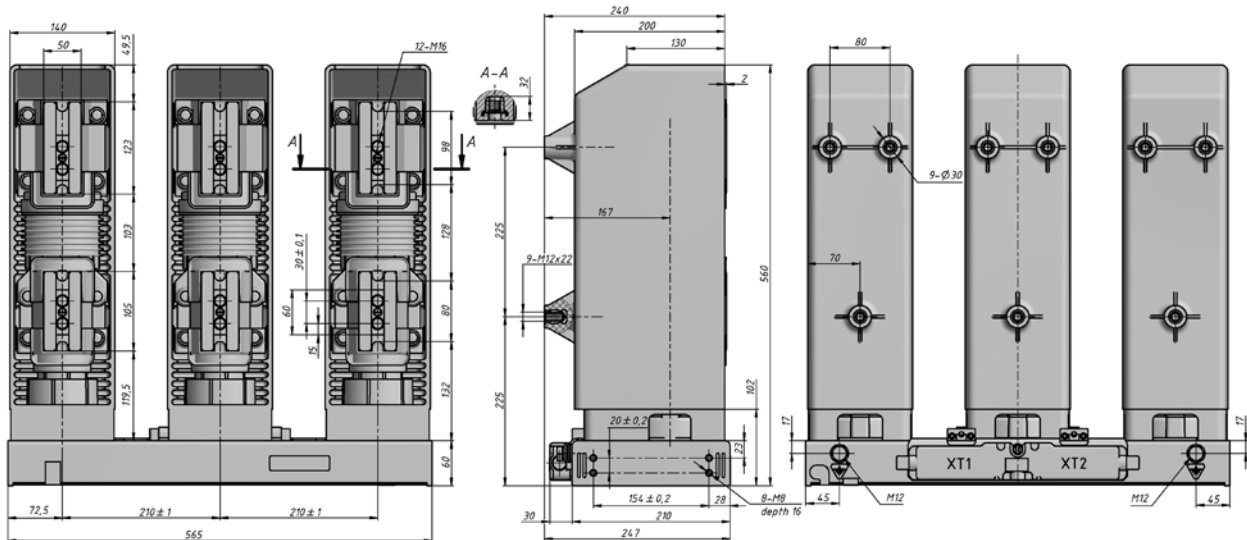


ISM15_Shell_2(150_L),
PCD 150 mm,
Weight: 51 kg

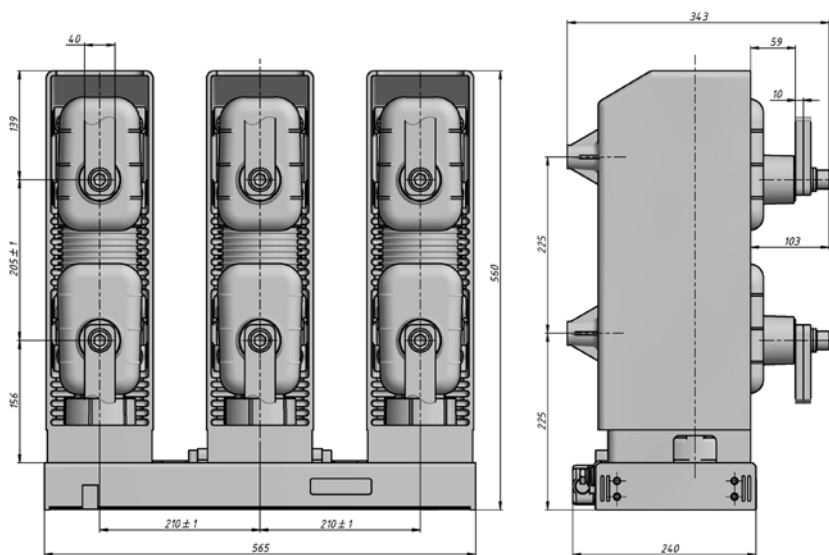


ISM15_Shell_2(150_L) with CBkit_Shell15_1(205) installed*,
PCD 150 mm,
Weight: 59,5 kg

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

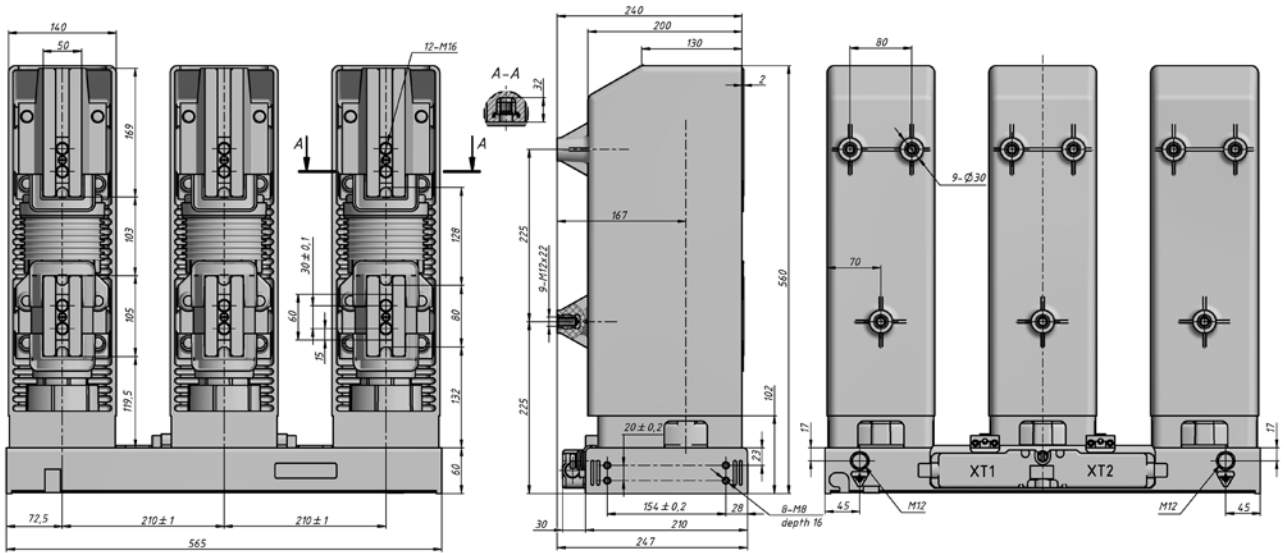


ISM15_Shell_2(210_L),
PCD 210 mm,
Weight: 52 kg

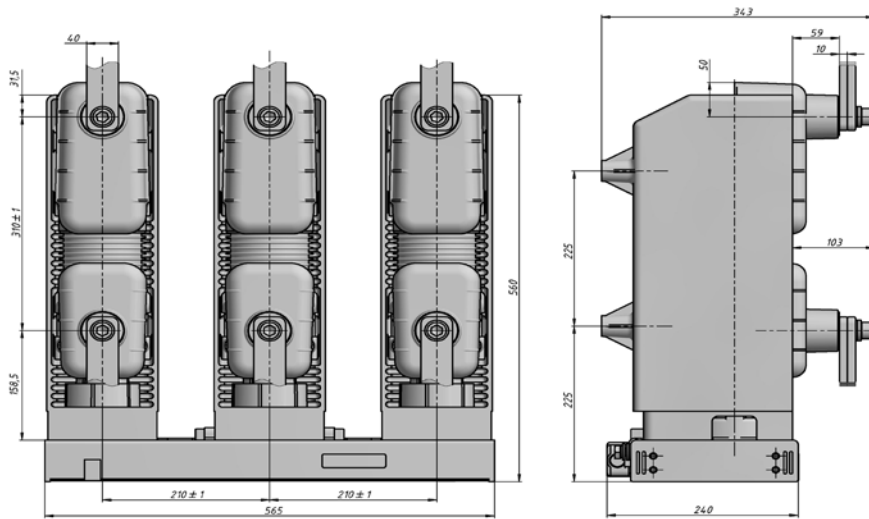


ISM15_Shell_2(210_L) with CBkit_Shell15_1(205) installed*,
PCD 210 mm,
Weight: 60,5 kg

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

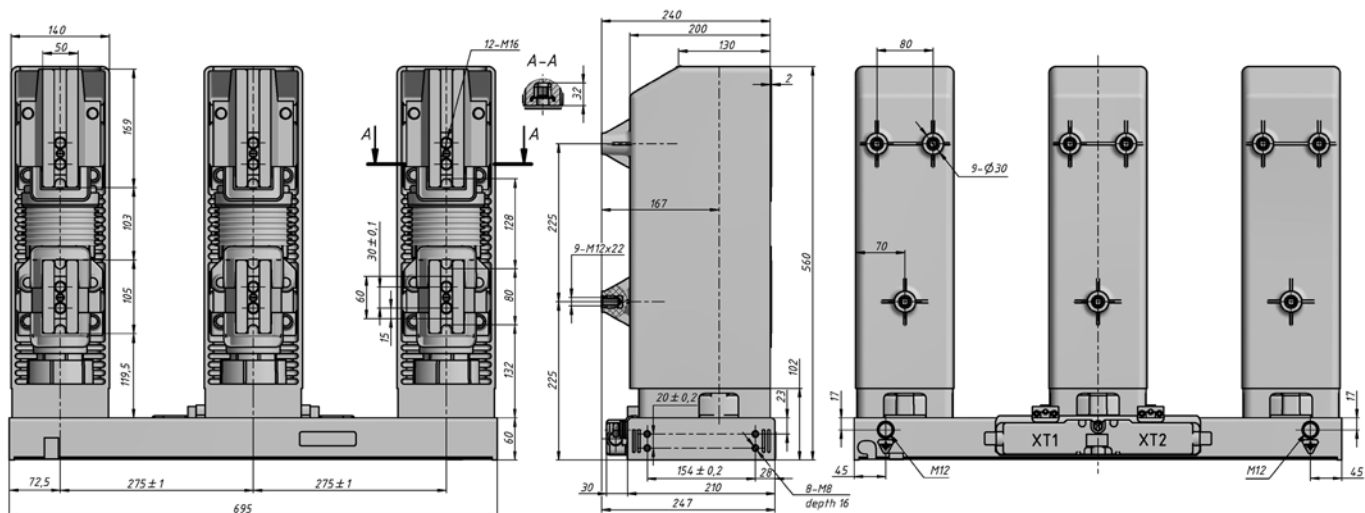


ISM15_Shell_2(210_H),
PCD 210 mm,
Weight: 53 kg

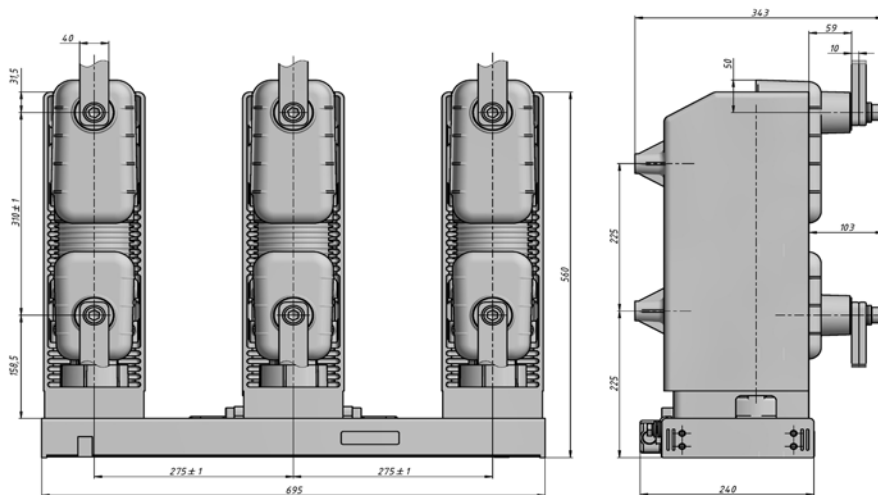


ISM15_Shell_2(210_H) with CBkit_Shell15_1(310) installed*,
PCD 210 mm,
Weight: 61,5 kg

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

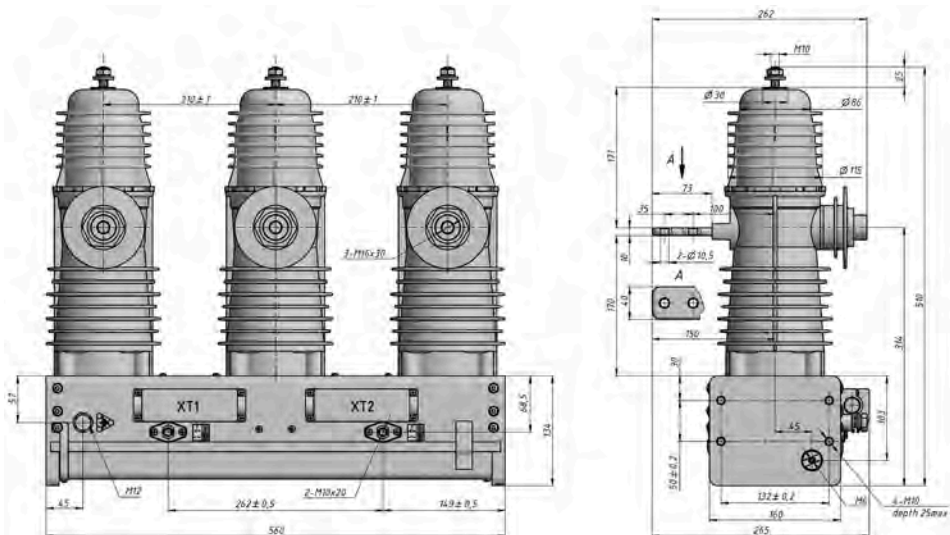


ISM15_Shell_2(275_H),
PCD 275 mm,
Weight: 55 kg

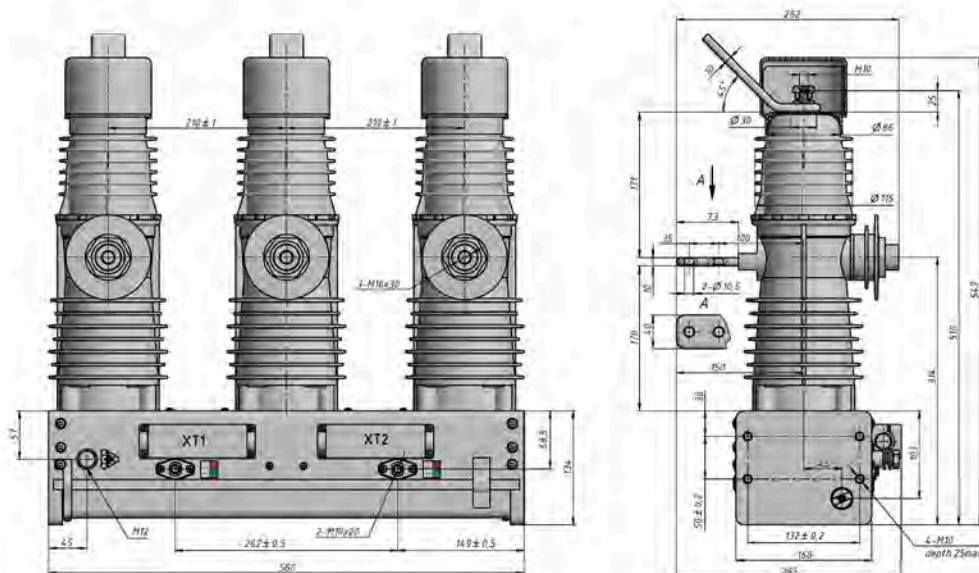


ISM15_Shell_2(275_H) with CBkit_Shell15_1(310) installed*,
PCD 275 mm,
Weight: 63,5 kg

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

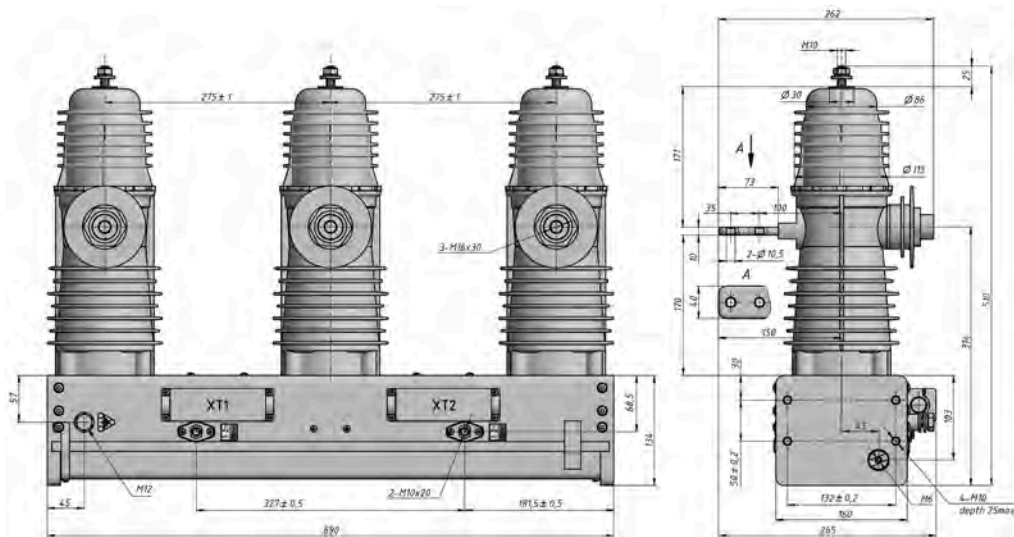


**ISM25_LD_1(210_Par2),
PCD 210 mm
Weight: 36 kg**

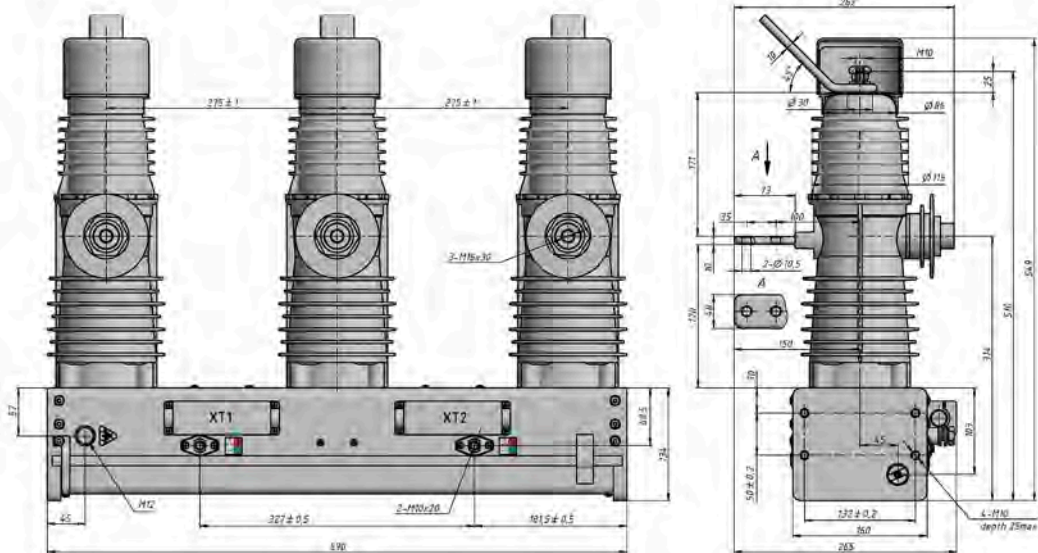


**ISM25_LD_1(210_Par2) with CBkit_Ins_3 installed*,
PCD 210 mm,
Weight: 36,5 kg**

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

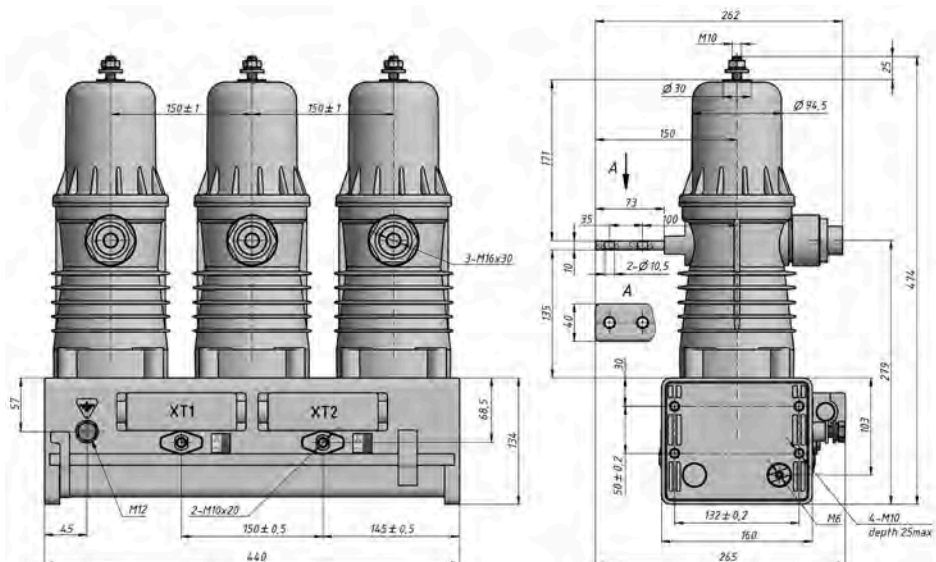


ISM25_LD_1(275_S),
PCD 275 mm
Weight: 38 kg

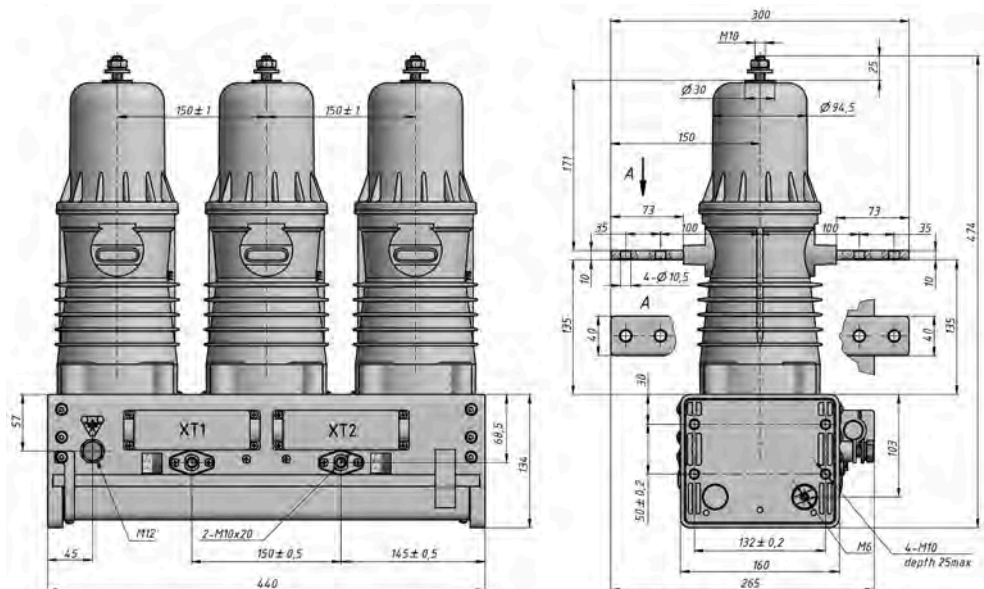


ISM25_LD_1(275_S) with CBkit_Ins_3 installed*,
PCD 275 mm,
Weight: 38,5 kg

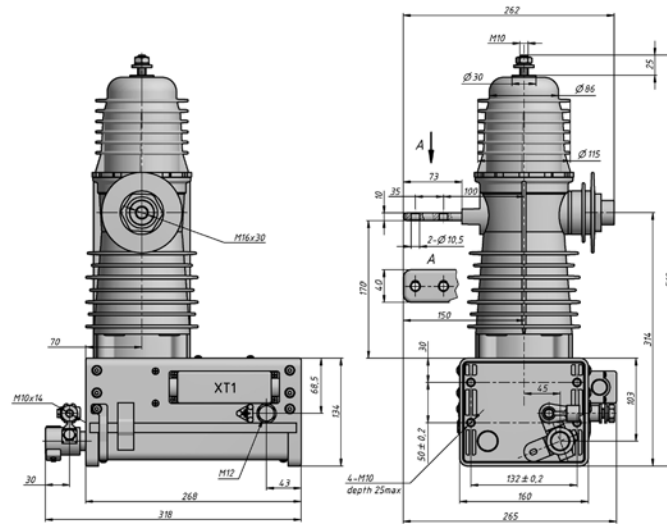
*- upper busbars shown for reference and are not supplied.



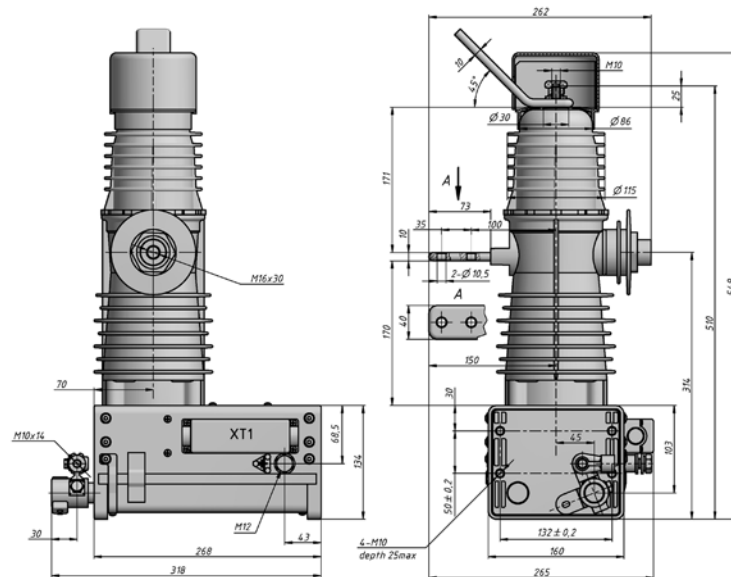
ISM25_LD_2(1),
PCD 150 mm
Weight: 35 kg



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



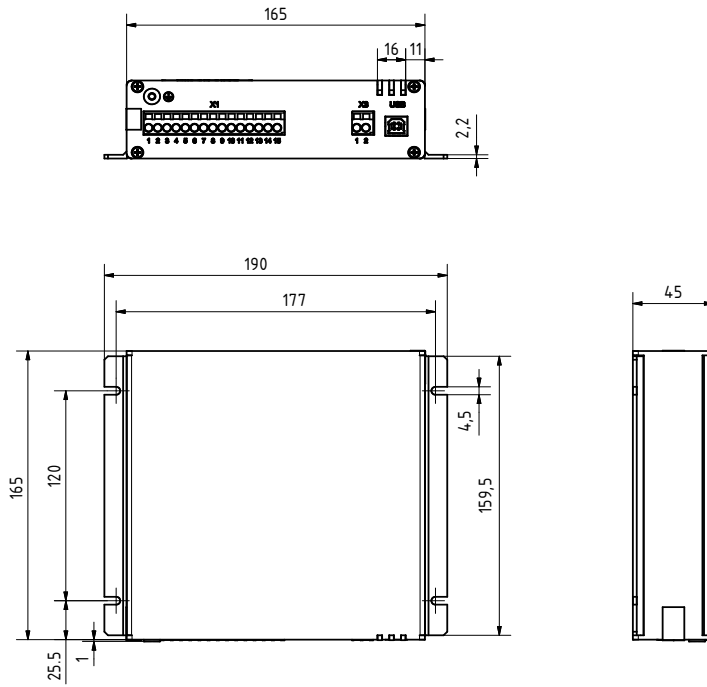
ISM25_LD_3,
Weight: 14 kg



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

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

Dimensions of Control Module



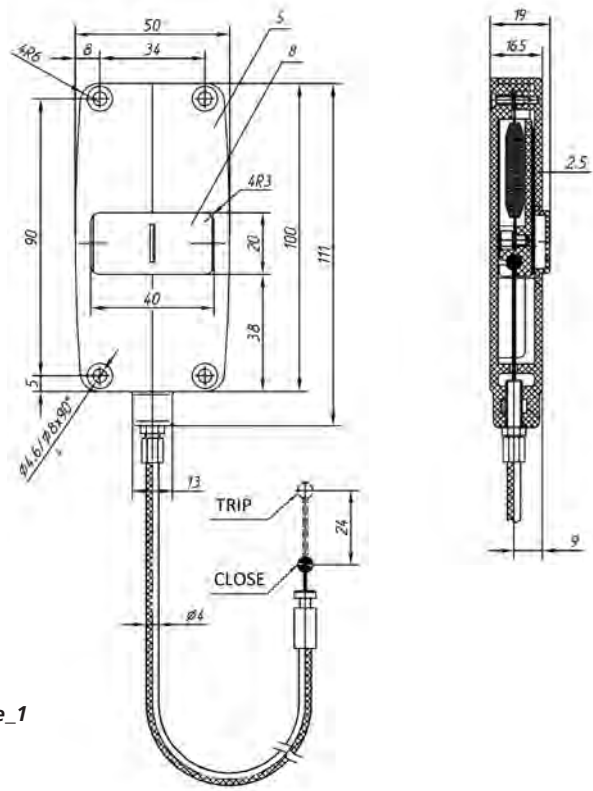
CM_16_1(Par1_CB_Par3)
Weight: 1 kg

Dimensions of accessories

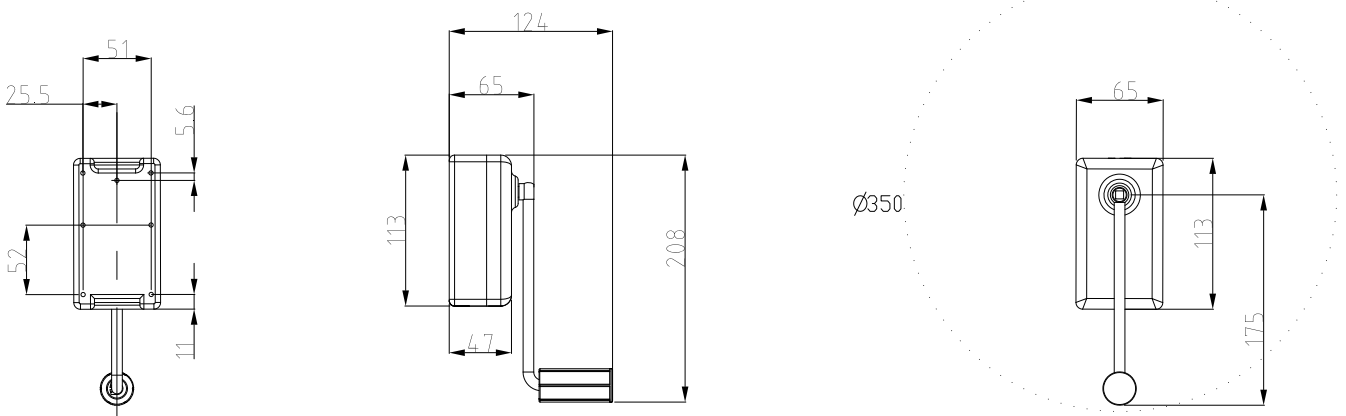
Dimensions of Position Indicator

Rope length L=1m

Unit_PosInd_3 with connected CBcomp_RelCable_1



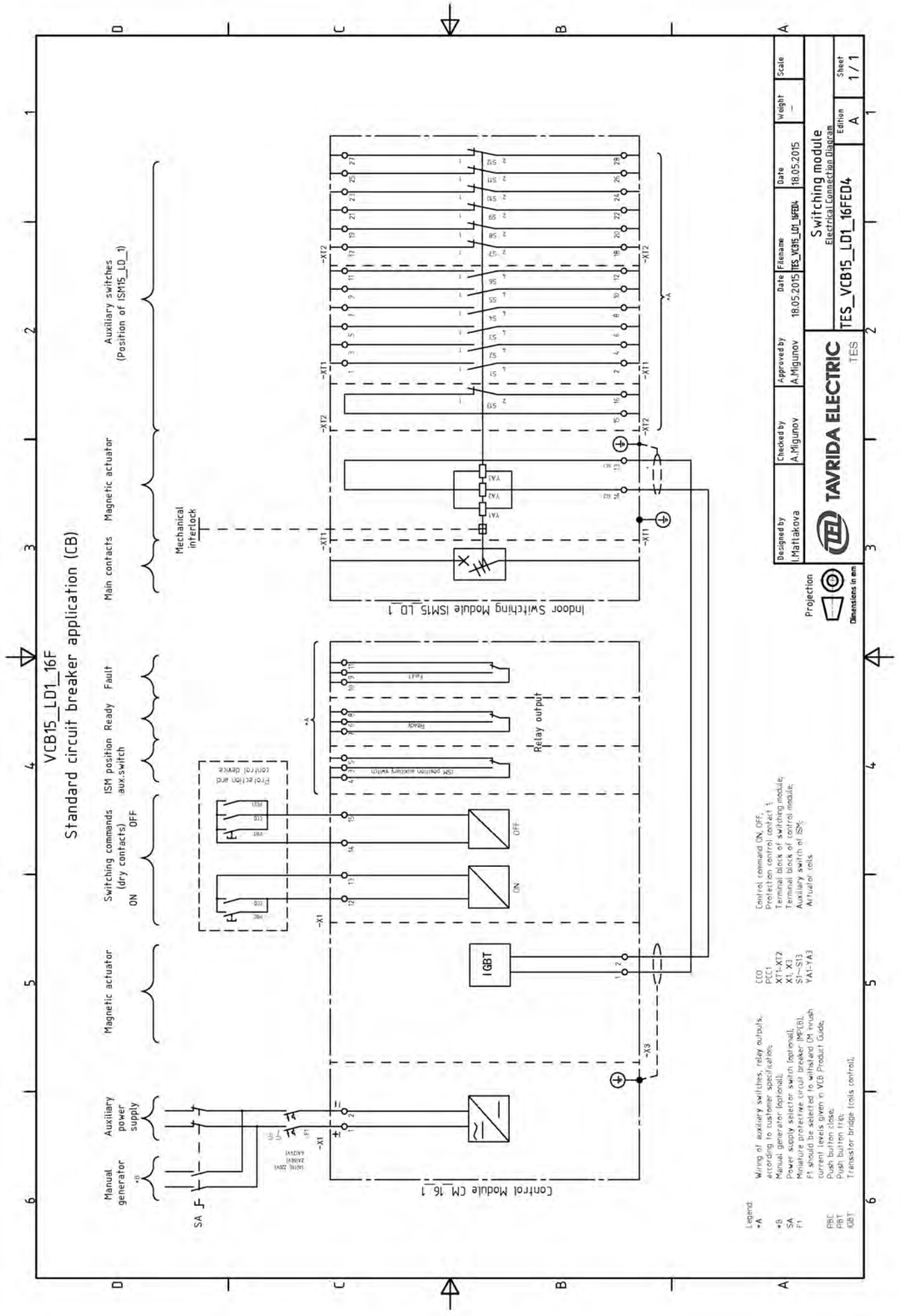
Dimensions of Manual Generator



CBunit_ManGen_1, CBunit_ManGen_2

Appendix 3.

Secondary schemes



VCB15_LD1_16F
Standard circuit breaker application (CB)

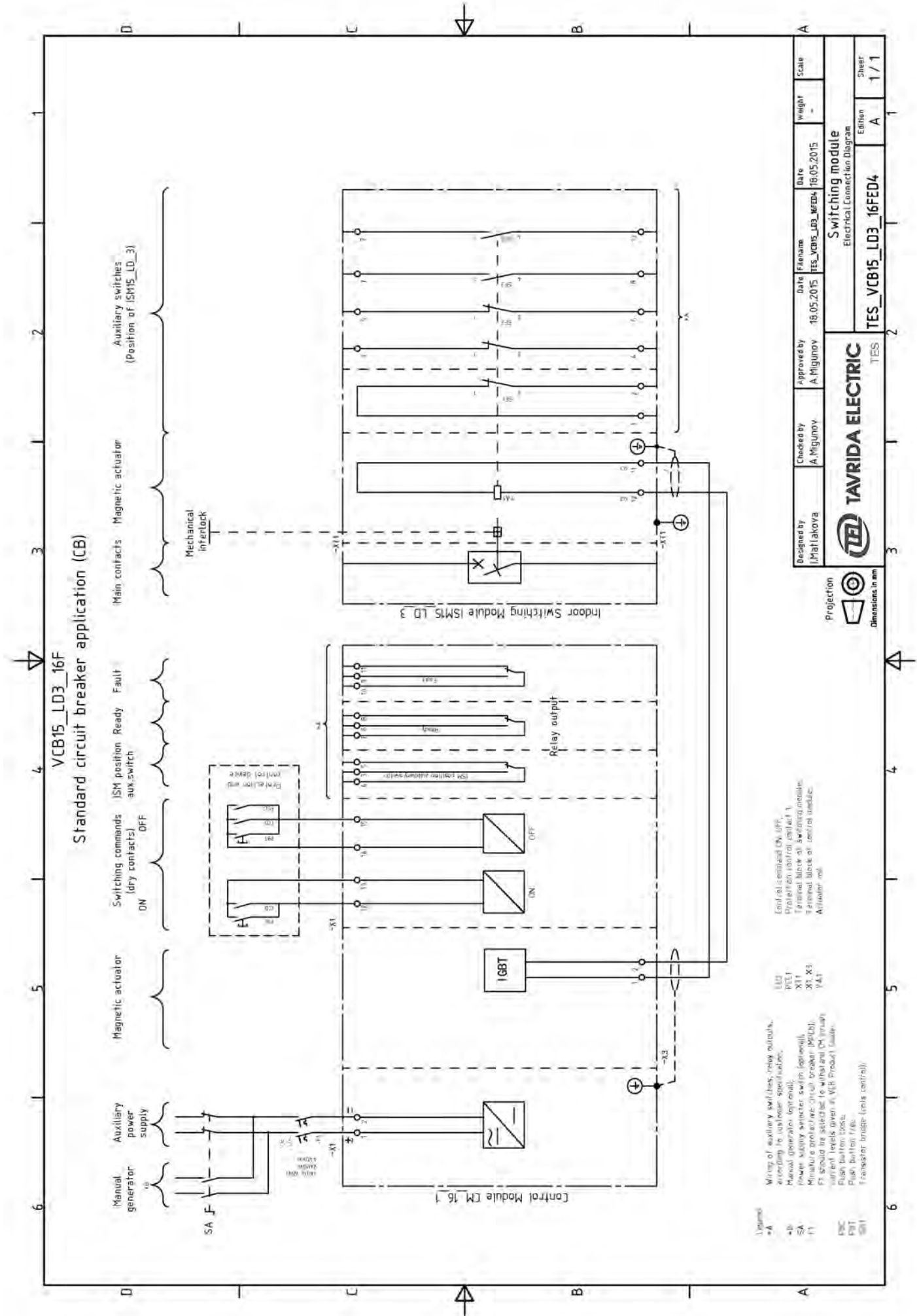
Legend:

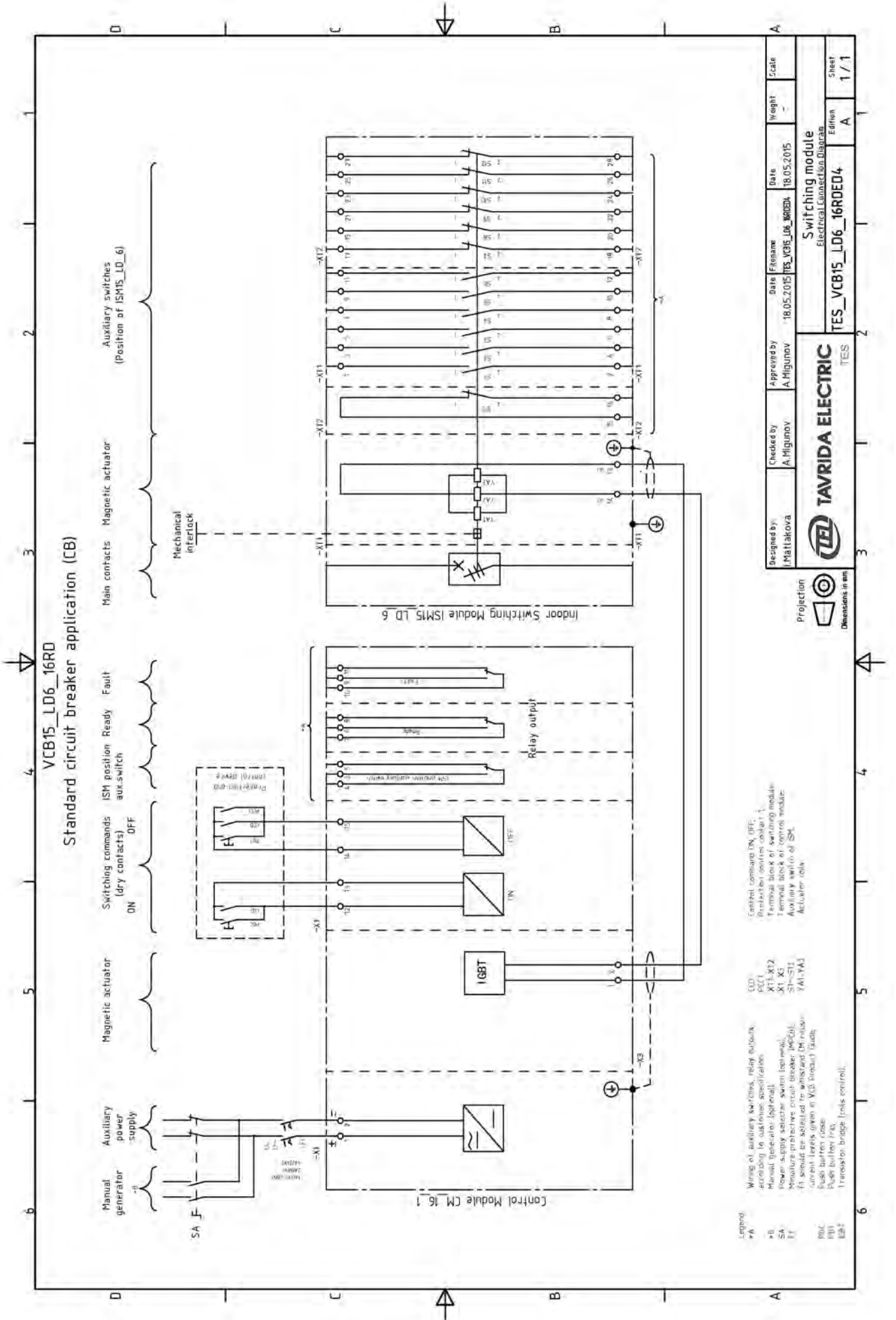
- A Winding of auxiliary switches, relay outputs, according to customer specifications.
- +B Manual generator (optional).
- SA Power supply selector switch (optional).
- F1 Miniature protective circuit breaker (MPCB).
- F1 should be selected to withstand DM brush current levels given in VCB Product Guide.
- PRT Push button trace.
- IGBT Transistor bridge (foils control).

Legend:

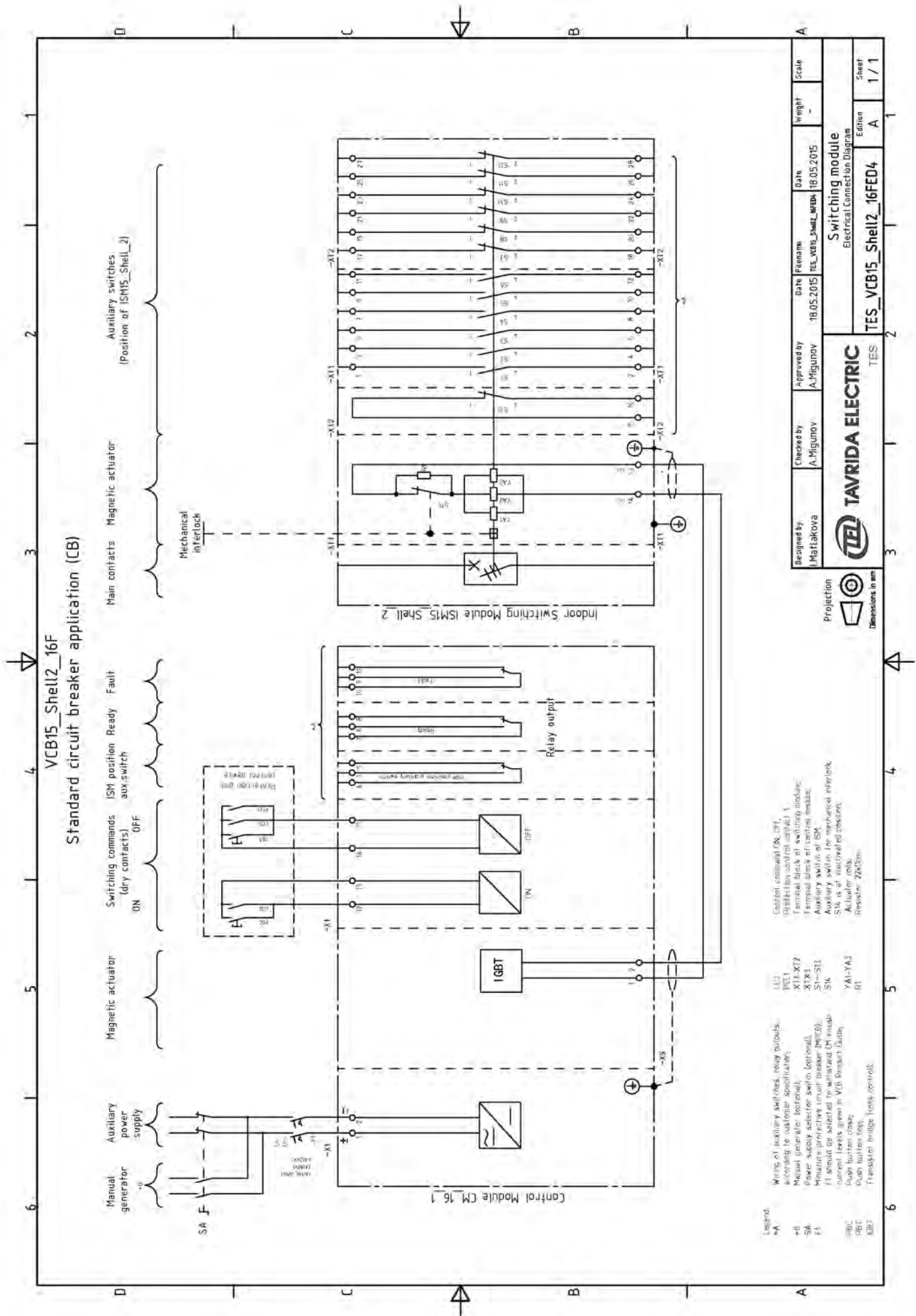
- CC0 Control command ON, OFF.
- PIC1 Protection control contact 1.
- XT1-XT2 Terminal block of switching module.
- X1, X3 Terminal block of control module.
- S1-S13 Auxiliary switch of ISM.
- VA1-VA3 Actuator coils.

Designed by I. Matlakova	Checked by A. Migunov	Approved by A. Migunov	Date 18.05.2015	Filename TES_VCB15_LD1_WB04	Date 18.05.2015	Scale -	Weight -	Sheet 1 / 1
TAVRIDA ELECTRIC TES						Switching module Electrical Connection Diagram		
Projection						TES_VCB15_LD1_16FED4		
Dimensions in mm						Edition A		





Designed by: Mattakova	Checked by: A. Migunov	Approved by: A. Migunov	Date: 18.05.2015	Filename: TES_VCB15_LD6_16RD.A	Date: 18.05.2015	Weight: -	Scale: -
TEL TAVRIDA ELECTRIC			Switching module Electrical Connection Diagram				
Projection 			TES		A		Sheet 1 / 1



Legend

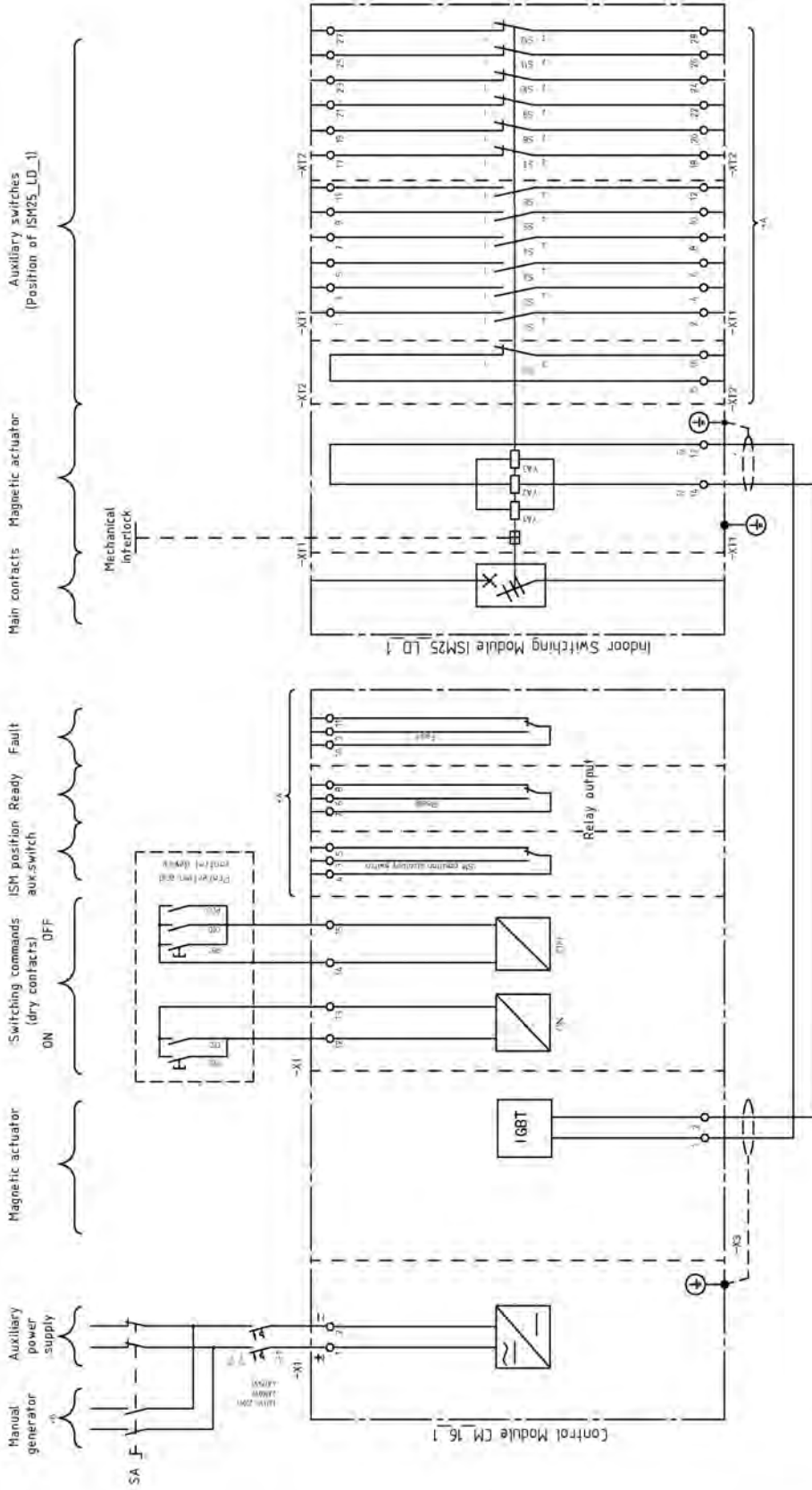
- A Wiring of auxiliary switches, ready outputs, according to customer specification.
- B Manual generator, optional.
- S6 Power supply selector switch, optional.
- E1 Minimum protective circuit breaker (MPCB).
- E1 should be selected to withstand CM break current levels given in VCB Breakout Study.
- BPC Single barrier class.
- BPT Single barrier type.
- CBT Transmission bridge type control.
- LUU
- PEL1
- X11-X12
- X1X3
- S1-S11
- S16
- YAI-YA3
- RT

Condition command ON, OFF, (projection control output 1).
Terminal block of switching module.
Terminal block of control module.
Auxiliary switch in ISM.
Auxiliary switch for mechanical interlock.
S16 is of inactivated position.
Actuator rolls.
Resistor ZK20m.

Designed by	Checked by	Approved by	Date	Filename	Date
I.MafLakova	A.Migunov	A.Migunov	18.05.2015	tes_vcb15_shell_16f	18.05.2015
TAVRIDA ELECTRIC					
Projection					
Dimensions in mm					
Switching module					
Electrical Connection Diagram					
TES_VCB15_Shell2_16FED4				Edition	Scale
A				A	1 / 1

VCB25_LD1_16F

Standard circuit breaker application (CB)



Legend

- A Wiring of auxiliary switches, relay outputs according to customer specification
- A Power generation terminal
- SA Manual generator supply
- SA F Manual generator supply fuse
- A Power supply auxiliary switch (optional)
- A ET should be selected to wireless DM through terminal relays (only in VCB Product Group)
- A Push button fuse
- A Transistor bridge (optional)

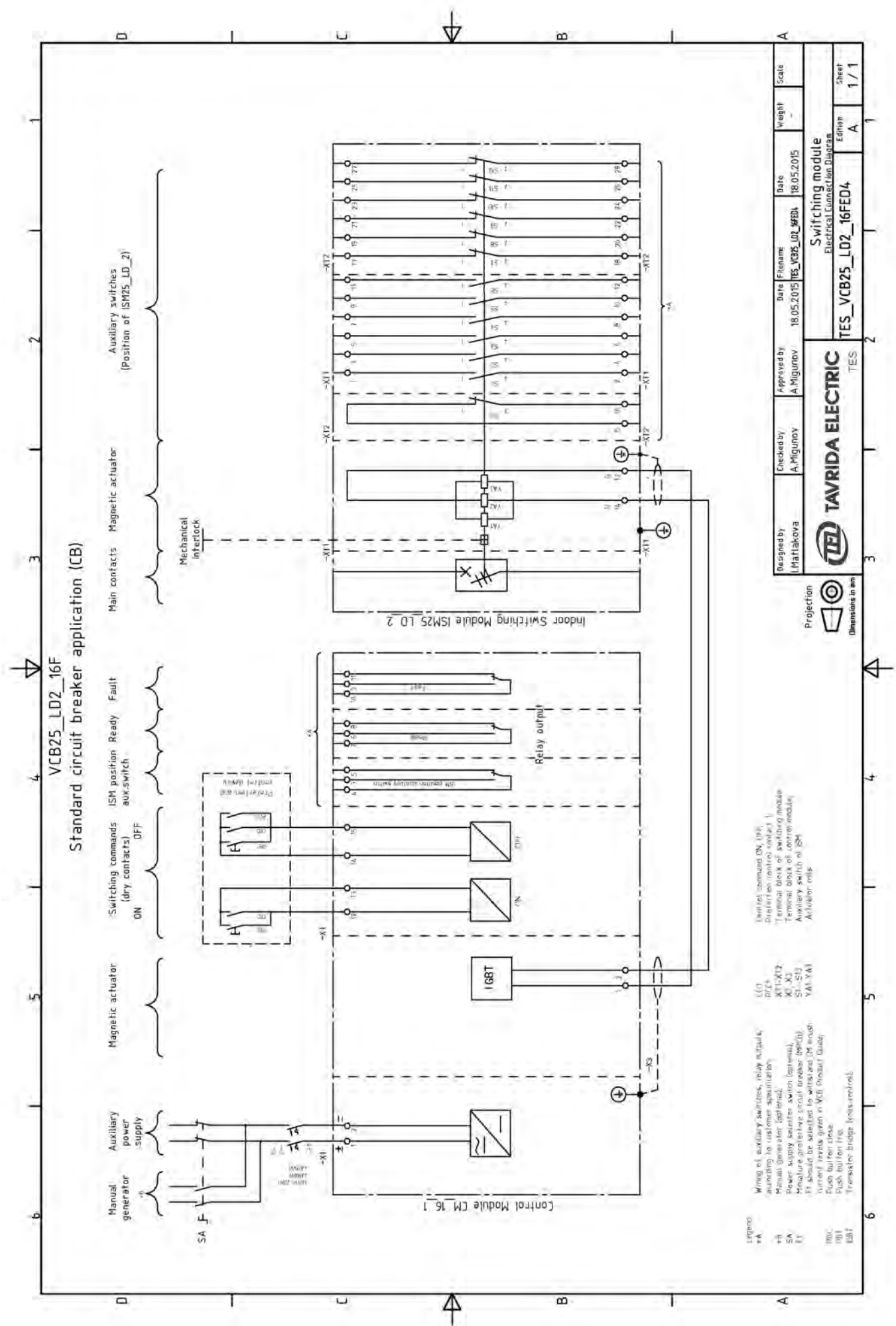
Legend

- (/N) Control command ON, OFF
- (/N) Reference terminal contact 1
- Terminal block of switching module
- Terminal block of switching module
- Auxiliary switch of ISM
- Actuator coils

Legend

- (/N) Control command ON, OFF
- (/N) Reference terminal contact 1
- Terminal block of switching module
- Terminal block of switching module
- Auxiliary switch of ISM
- Actuator coils

Designed by	Checked by	Approved by	Date	Filename	Date	Scale	
(M) Matlakova	A. Migunov	A. Migunov	18.05.2015	TES_VCB25_LD1_16FEN	18.05.2015	-	
TAVRIDA ELECTRIC						Weight	1 / 1
Projection						Edition	A
Dimensions in mm						Sheet	1 / 1
TES_VCB25_LD1_16FED4						Scale	-
Switching module						Weight	-
Electrical Connection Diagram						Scale	-



VCB25_LD2_16F
Standard circuit breaker application (CB)

Legend

YA	Wiring of auxiliary switches, with outputs according to customer specification
YA	Manual generator (optional)
SA	Power supply selector switch (optional)
FT	Minimature protective circuit breaker (PPC(d))
PPC	Turnoff device given in VCB Product Guide
IBI	Push button stop
IBT	Transistor bridge (with control)

U10	IGBT
IBT4	Transistor bridge (with control)
X1-X12	Terminal block of switching module
X1-X3	Terminal block of control module
S1-S3	Auxiliary switch of ISM
YA1-YA1	Actuator rolls

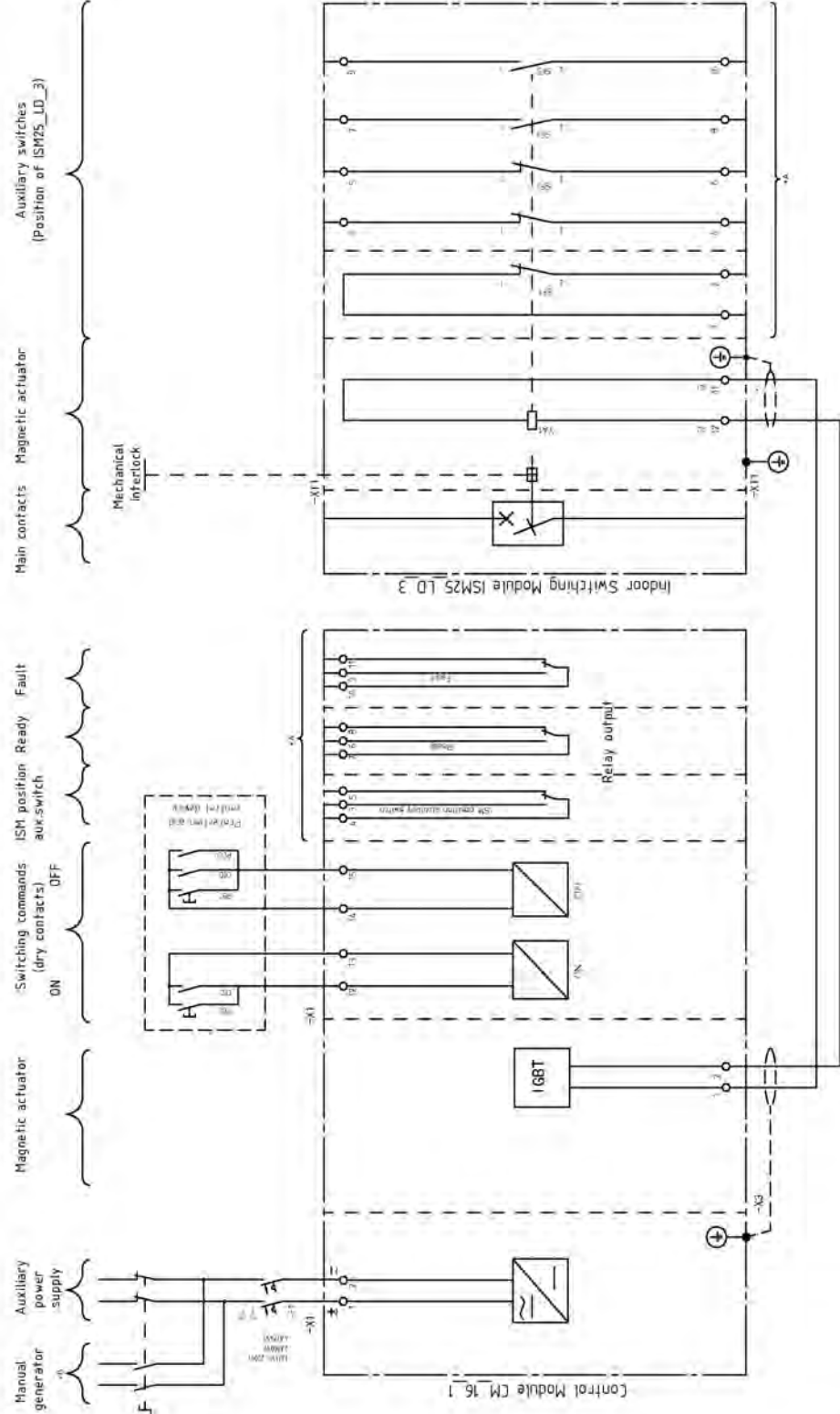
U10	IGBT
IBT4	Transistor bridge (with control)
X1-X12	Terminal block of switching module
X1-X3	Terminal block of control module
S1-S3	Auxiliary switch of ISM
YA1-YA1	Actuator rolls

Projection

Dimensions in mm

Designed by	I. Matlakova	Checked by	A. Migunov	Approved by	A. Migunov	Date	18.05.2015	File name	TES_VCB25_LD2_16F04	Date	18.05.2015	Scale	-	Sheet	1 / 1
TAVRIDA ELECTRIC										Switching module Electrical Connection Diagram					
TES										TES_VCB25_LD2_16FED4					
Edition										A					

VCB25_LD3_16F Standard circuit breaker application (CB)



- Legend:**
- A: Wiring of auxiliary switches, relay outputs, according to customer specification.
 - B: Manual generator terminal.
 - C: Power supply wire for switch terminal.
 - D: Main circuit breaker terminal (MCR).
 - E: It should be selected for withdrawal (to avoid) current levels given at VCB Product Label.
 - F: Page number.
 - G: Page number.
 - H: Transistor bridge (look terminal).

Derives command ON, OFF, position control contact (position control contact) Terminal block of switching module Terminal block of control module (location rail)

Designed by	I.Mahakova	Checked by	A.Migunov	Approved by	A.Migunov	Date	18.05.2015	File name	TES_VCB25_LD3_16FEDA	Date	18.05.2015	Weight	-	Scale	-				
TAVRIDA ELECTRIC										Switching module Electrical Connection Diagram									
Projection										TES		Edition		A		Sheet		1 / 1	

Dimensions in mm

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