TAVRIDA ELECTRIC

# VCB

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

User Guide

# Contents

# 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 monstable 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)]<br>≤ 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<br>GB 1984- 2003 | IEC 62271-100<br>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)]<br>≤ 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)]<br>≤ 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 j >0.66.

7) At Cos j >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

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

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

# 1.5 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

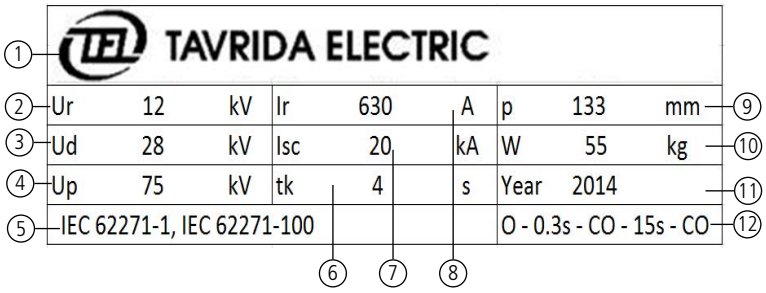



Figure 1

***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.

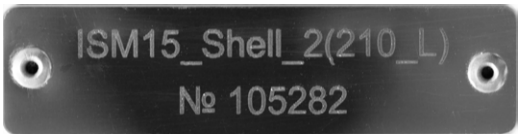



Figure 2

***Serial number plate***

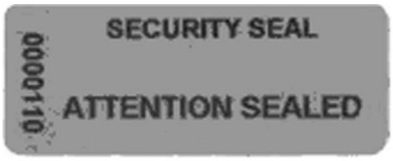
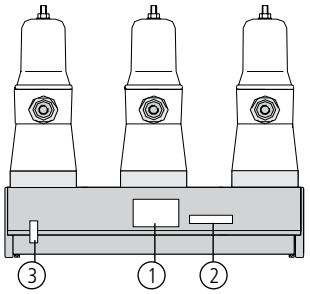


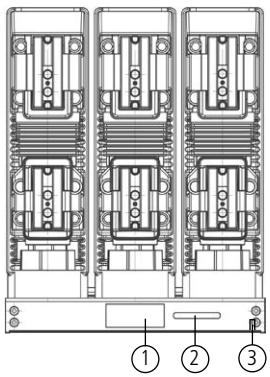

Figure 3

***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

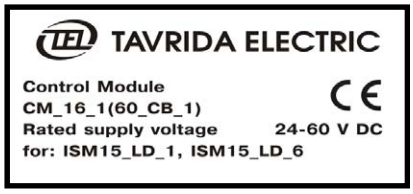



Figure 5

***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***

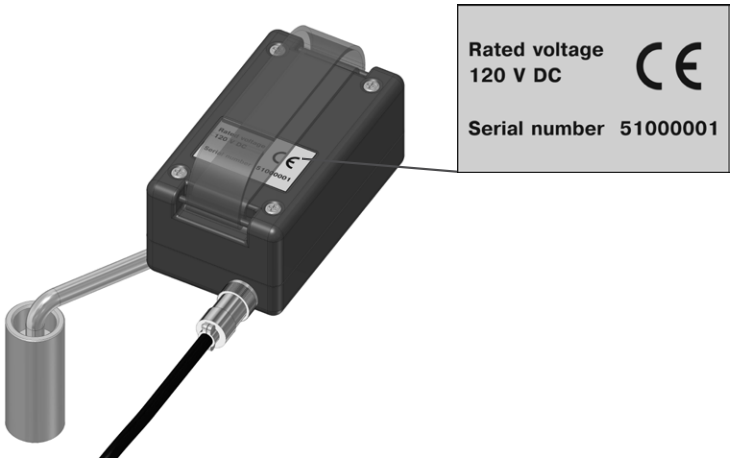



Figure 9

***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;
- dessicant must be placed in the packaging;
- storage must be dry, well ventilated and the room temperature should be between - 25°C and + 55°C.

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

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

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

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

# 3.3 Unpacking and inspection

## 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***

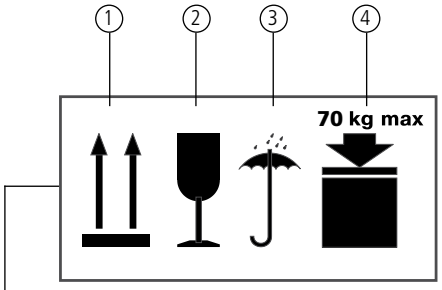
All items should be checked visually for:
- mechanical damage, scratches, discoloration, corrosion;
- damage to the seals (Figure 3, Figure 7).

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***

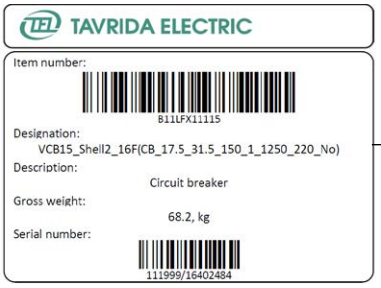

Figure 14
***Carton box***

TAVRIDA ELECTRIC

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

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

Figure 13
***Label 2 Logistics data***




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.

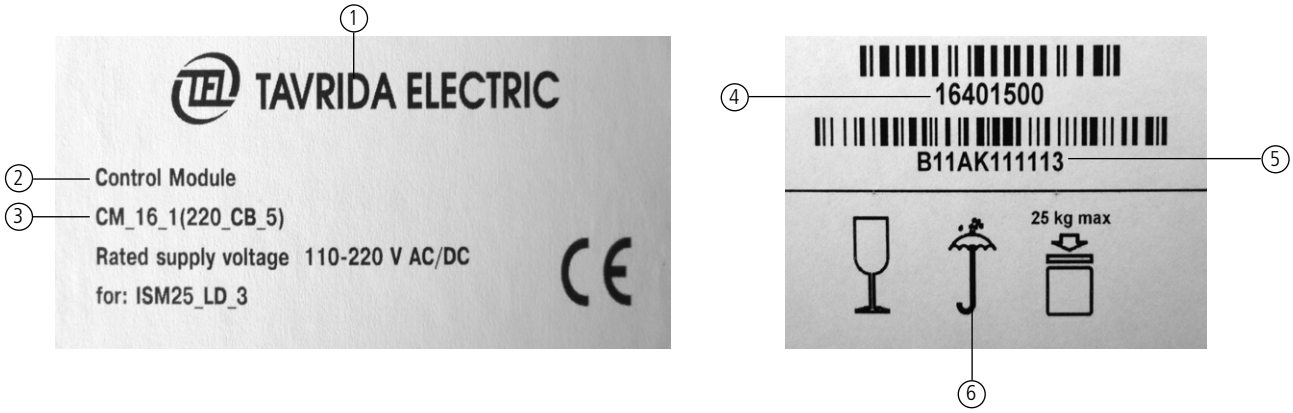
Figure 15
***Label 3 for manufacturers' and product information***

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 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
2. Product name
3. Type of device
4. Serial number
5. Product code
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

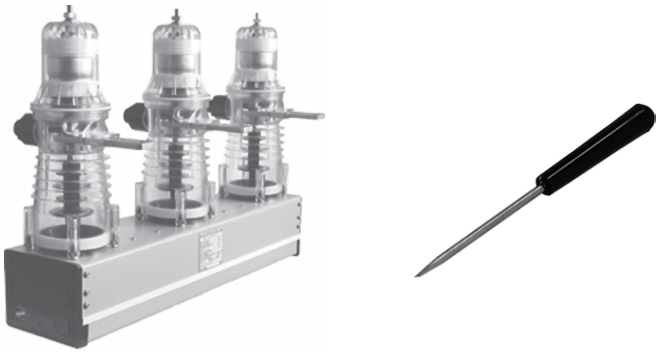
b) screwdriver
Unit_Screwdriver_1

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

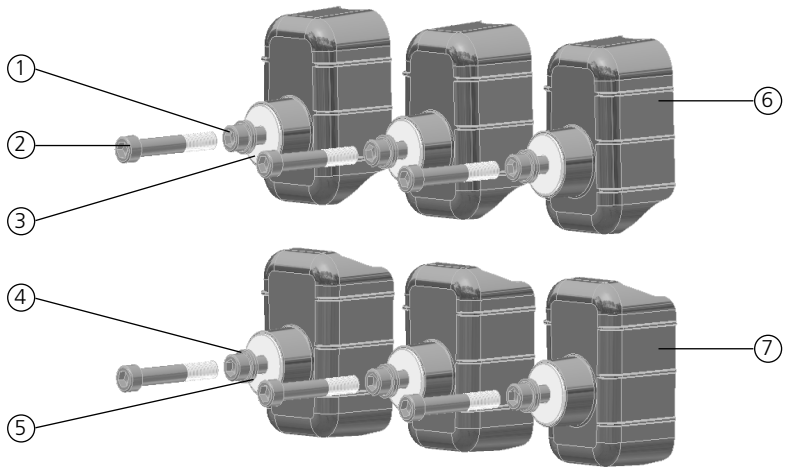
Plastic insulator
Det_PlastIns_49

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:

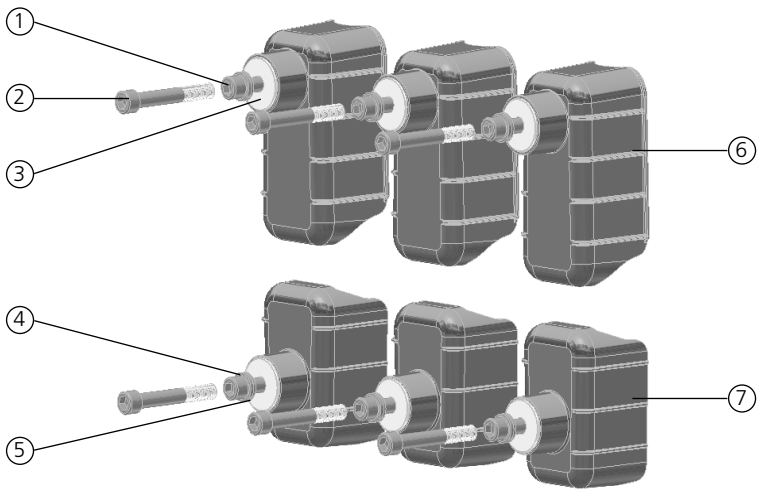



1. Screw StandDet_Screw_DIN912(M16_100_Fe88-Zn)
2. Screw StandDet_Screw_DIN912(M16_110_Fe88-Zn)
3. Terminal CBdet_Terminal_1
4. Washer StandDet_Washer_DIN125-1A(17_Fe-Zn)
5. Washer CBcomp_Washer_1
6. Plastic insulation CBdet_PlastIns_2(205_50_L)
7. Plastic insulation CBdet_PlastIns_1(50)

Figure 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:




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

Figure 23

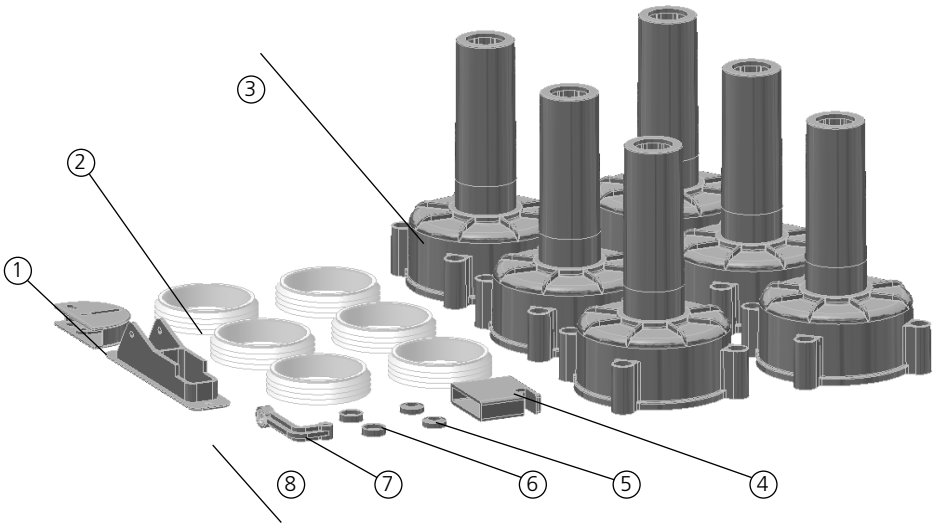
***CBkit_Shell15_1(310) delivery set***

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

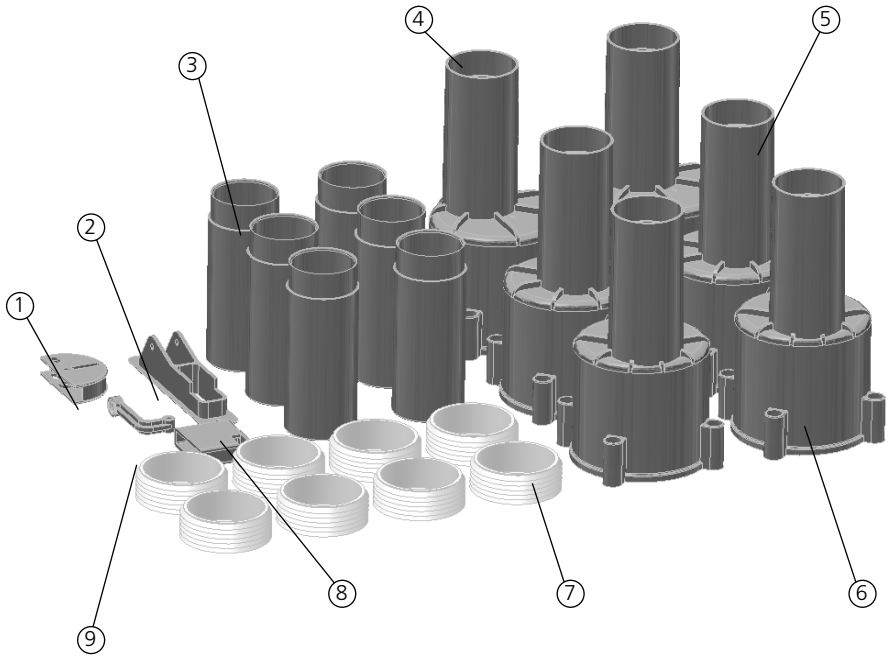
VCB15_LD6_16RD includes the plastic parts kit CBkit_LD15_2 for LMT Retrofit Draw-out type VCB or CBkit_LD15_3 for AG16 Retrofit Draw-out type VCB. As part of a VCB CBkit_LD15_2 and CBkit_LD15_3 are placed inside the VCB package. If the kits are delivered separately as a spare part of the VCB it is packed in a plastic bag.




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

Figure 24

***CBkit_LD15_2 delivery set***




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

Figure 25

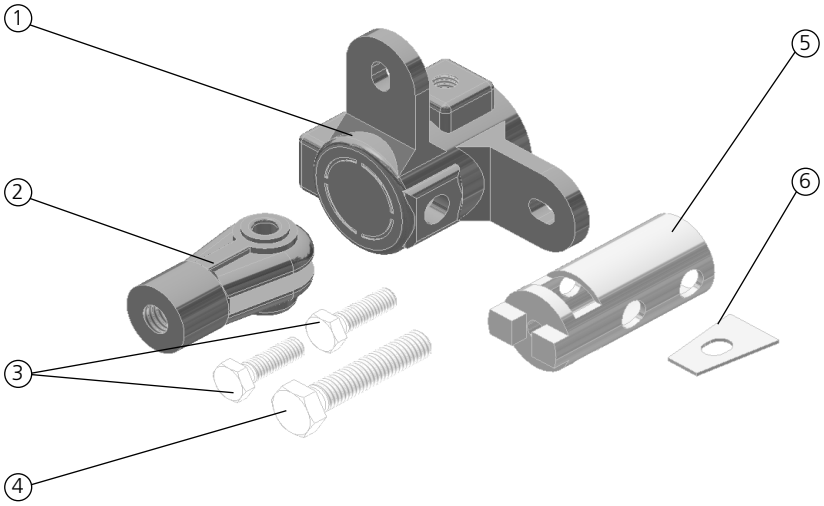
***CBkit_LD15_3 delivery set***

# 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:




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

Figure 26
***CBkit_Interlock_1 delivery set***

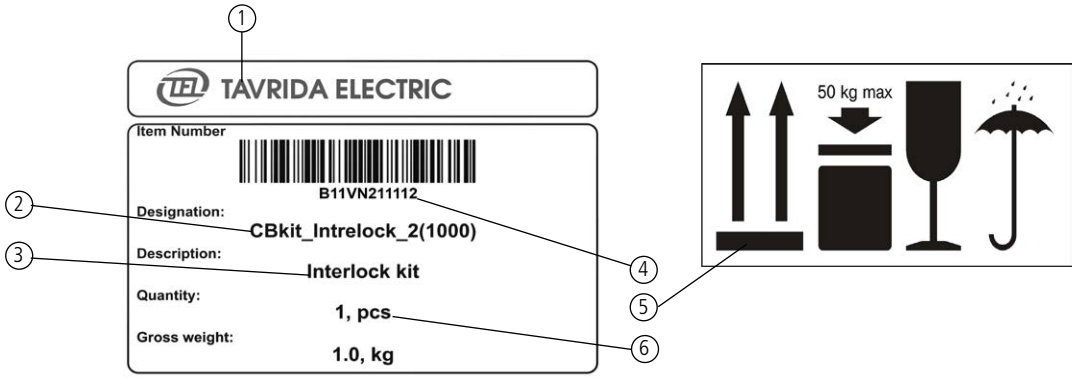
ISM15_LD_3 and ISM25_LD_3 are already equipped with the CBkit_Interlock_1 pre-installed.

## CBkit_Interlock_2 packaging and delivery set

CBkit_Interlock_2 can be used for VCB15_Shell2_16F as an acessory for manual trip / lockout of the ISM. The kit is packed in a cardboard box.

Figure 27

***CBkit_Interlock_2 packing***

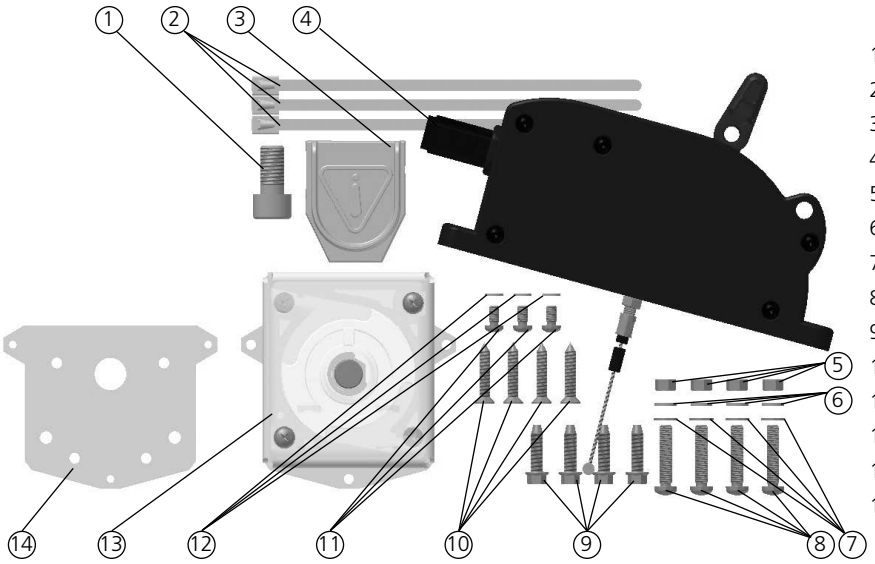



1. Manufacturer
2. Type of device
3. Product name
4. Product code
5. Handling symbols
6. Product quantity in the package

Figure 28

***CBkit_Interlock_2 package labeling***

The kit includes:




1. Screw StandDet_Screw_DIN912(M10_20_Fe88-Zn)
2. Cable tie StandDet_CableTie_LS(4.6_150_40)
3. Stopper CBdet_Stopper_2
4. Interlock unit CBunit_Interlock_1(1)
5. Nut StandDet_Nut_DIN555(M5_Fe-Zn)
6. Washer StandDet_Washer_DIN127-A(5_Fe-Zn)
7. Washer StandDet_Washer_DIN125-1A(5.3_Fe-Zn)
8. Screw StandDet_Screw_DIN7985-Ph(M5_25_Fe48-Zn)
9. Screw StandDet_Screw_DIN7504-K(4.8_19_Fe-Zn)
10. Screw StandDet_Screw_DIN7982(4.2_25_Fe-Zn)
11. Screw StandDet_Screw_DIN7985-Ph(M4_8_Fe48-Zn)
12. Wacher StandDet_Washer_DIN127-A(4_Fe-Zn)
13. Interlock unit CBunit_Interlock_3
14. Holder CBdet_Holder_14

Figure 29

***CBkit_Interlock_2 delivery set***

CBkit_Interlock_2 is used with the ISM15_Shell_2 only.

## 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.

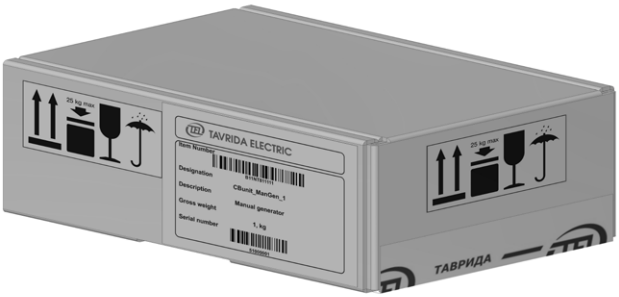
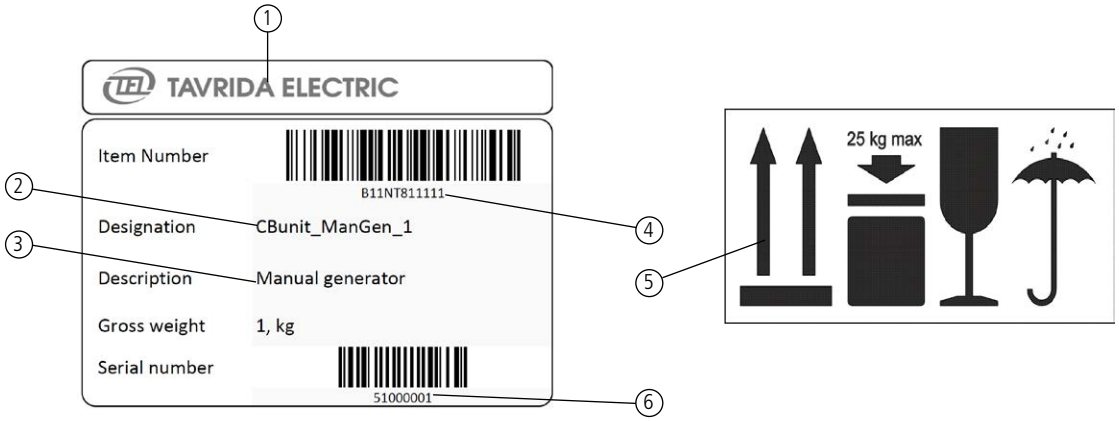



Figure 30

***CBunit_ ManGen_1 and CBunit_ ManGen_2 packing***




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

Figure 31

***CBunit_ ManGen_1 package labeling***

Figure 32

***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.

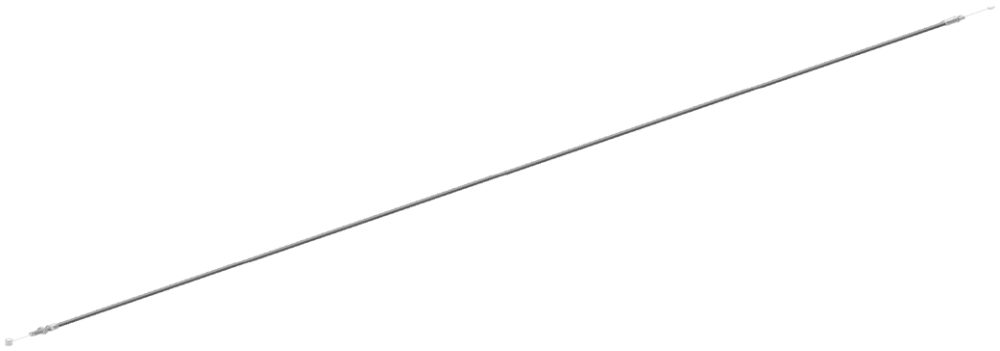


Figure 33
***CBcomp_RelCable_1 delivery set***

### 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.

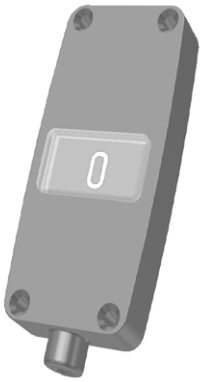



Figure 34
***Unit_PosInd_3 delivery set***

## 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/mm$^2$), nuts according to EN ISO 890 class 8 (880 N/mm$^2$), 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 35, Figure 36). The LD ISM can be installed in any position (Figure 37).

Figure 36
***Fixed compact installation of HD ISM, vertical arrangement, actuator up***

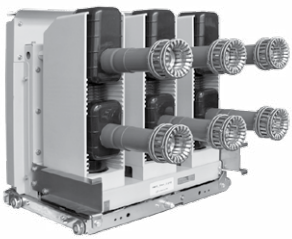


Figure 35
***Withdrawable unit with HD ISM, vertical arrangement, actuator down***

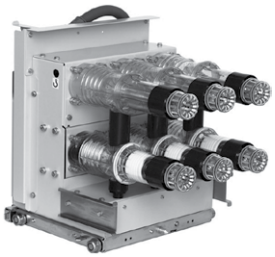


Figure 37
***Withdrawable unit with LD ISM, horizontal arrangement***

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 38).
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.

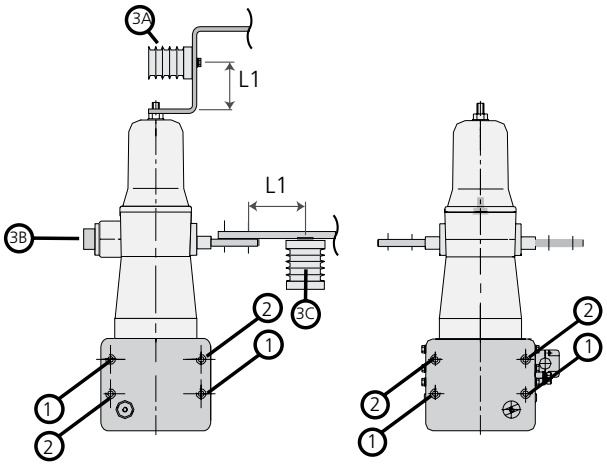



Figure 38
***LD ISM mounting points***

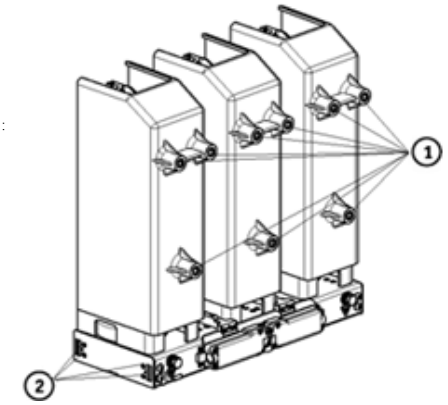



Figure 39
***HD ISM mounting points***

① Required mounting points

② Optional mounting points

③ Each two mounting points are required, either 3A+3B or 3A+3C

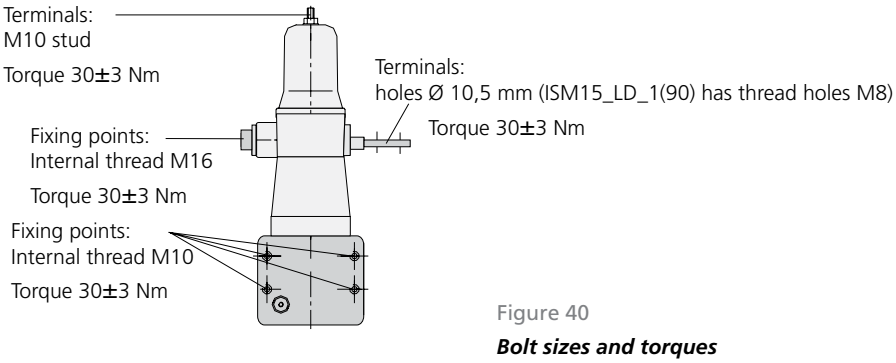
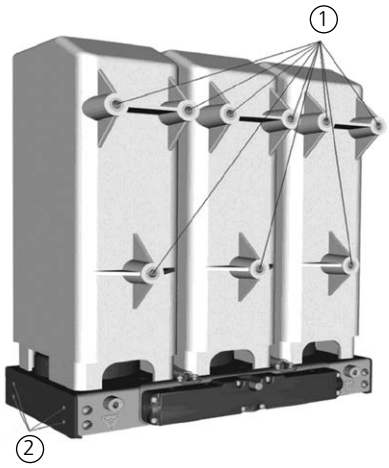



Figure 40
***Bolt sizes and torques***

**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 40) is not tightened.

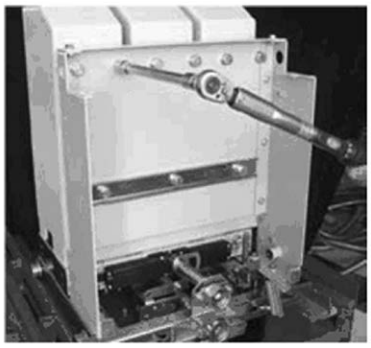



① Nine internal threads for obligatory ISM fixing which are formed in the module support insulator (M12, torque 40±2 Nm).

② Eight threads on both sides of the frame for optional ISM fixing (M8, torque is 10±1 Nm).

Figure 41

***HD ISM mounting diagram***



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 42; torque is 40±2 Nm).

Figure 42

***Example of HD ISM fixation***

## 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 magnetic field influences 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 43).

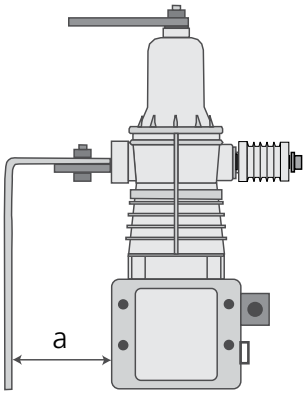



Figure 43

***Electromagnetic clearances limitations***

## Minimum clearances due to rated insulation voltage

The recommended minimum phase-to-phase and phase-to-ground air clearances 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 |

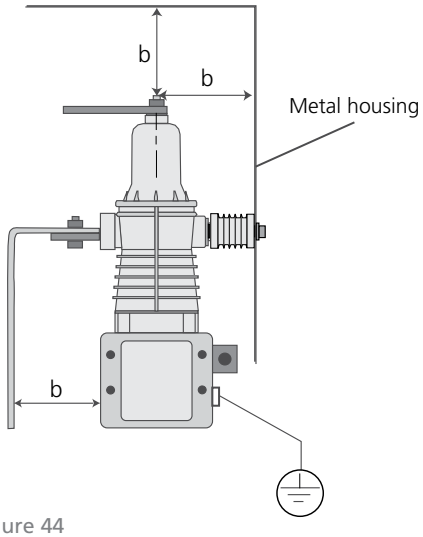



Figure 44

***LD ISM insulating clearances limitations***

### Coordination of minimum clearances

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

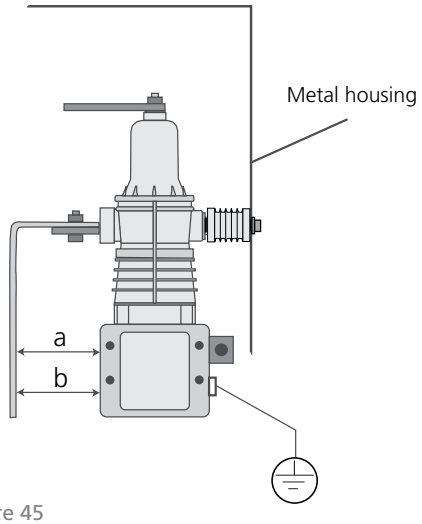



Figure 45

***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 46.

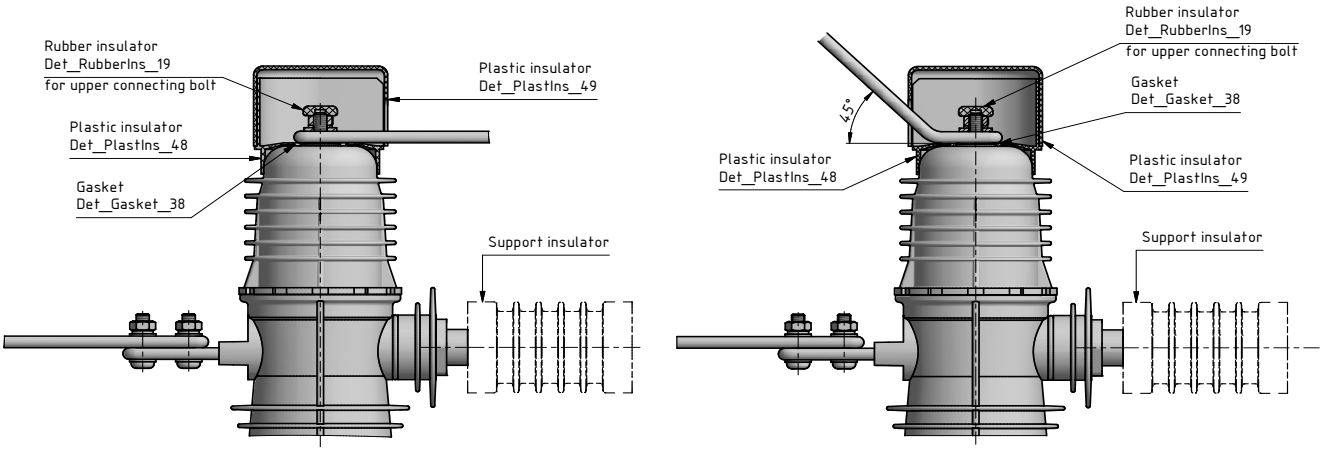



Figure 46

***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 47.

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.

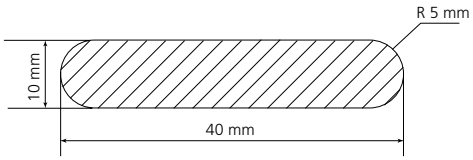



Figure 47

***Cross-section of the busbar connected to the pole***

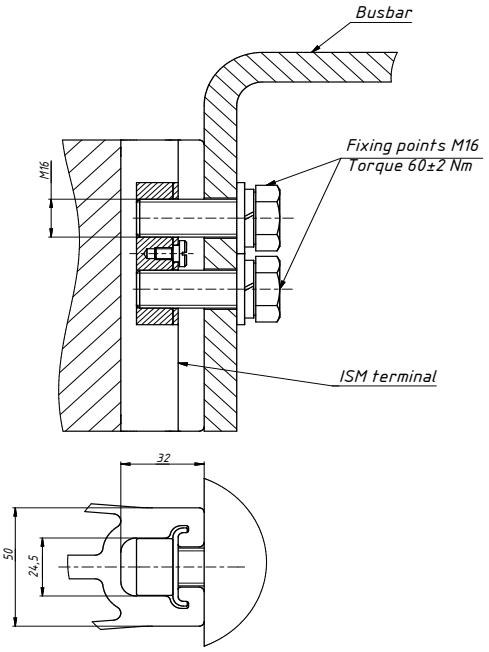
## 4.1.4 Main terminal connections of HD ISM

### Primary terminals connection

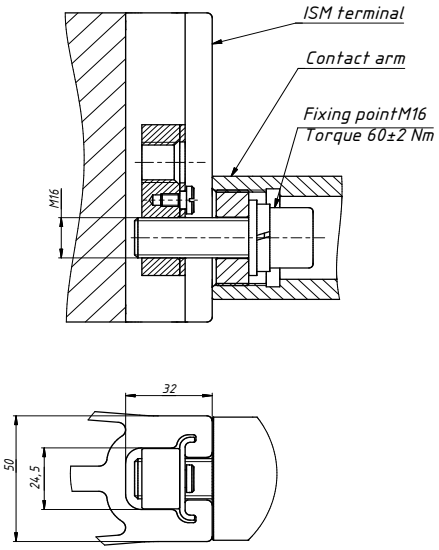
To comply with the rated impulse withstand voltage of 95 kV (75 kV for 150 mm PCD) according to IEC 62271-1 it is recommended to use CBkit_Shell15_1.
If CBkit_Ins_3 will not be used compliance with the rated insulation level shall be verified by a voltage test.
M16 bolts fixing busbars (or contact arms) 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.

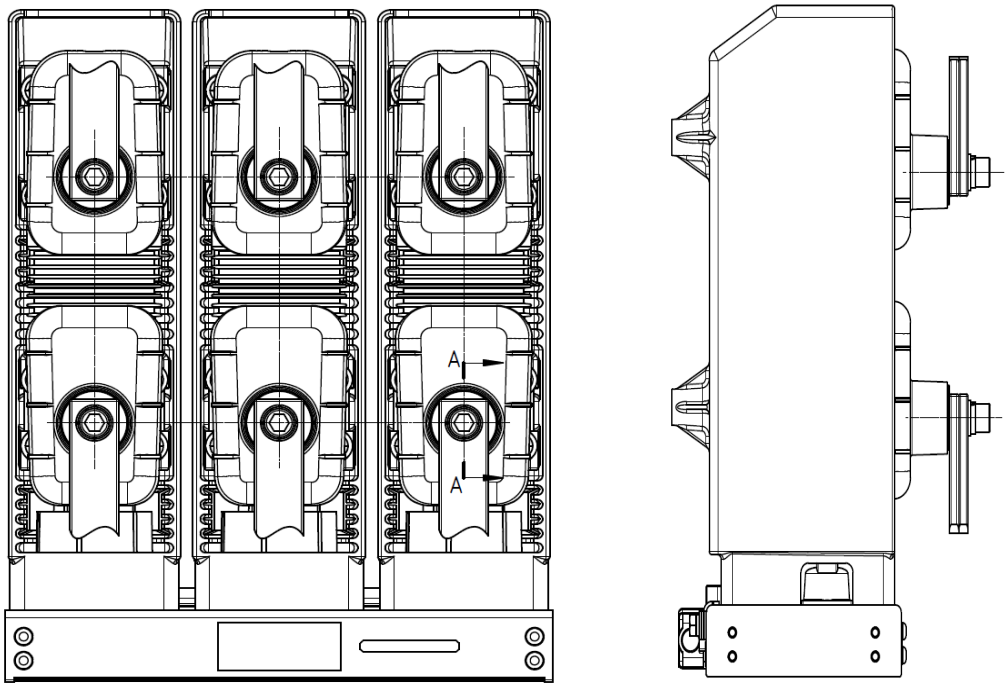
The gap between the busbar and the ISM terminal just before this fastening should be not more than one millimeter.




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

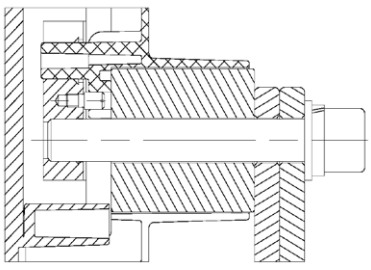



b) Details of HD ISM terminals connection to cylindrical cross-shaped busbars (withdrawable unit contact arm, for example)






A-A



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

Figure 48

***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.

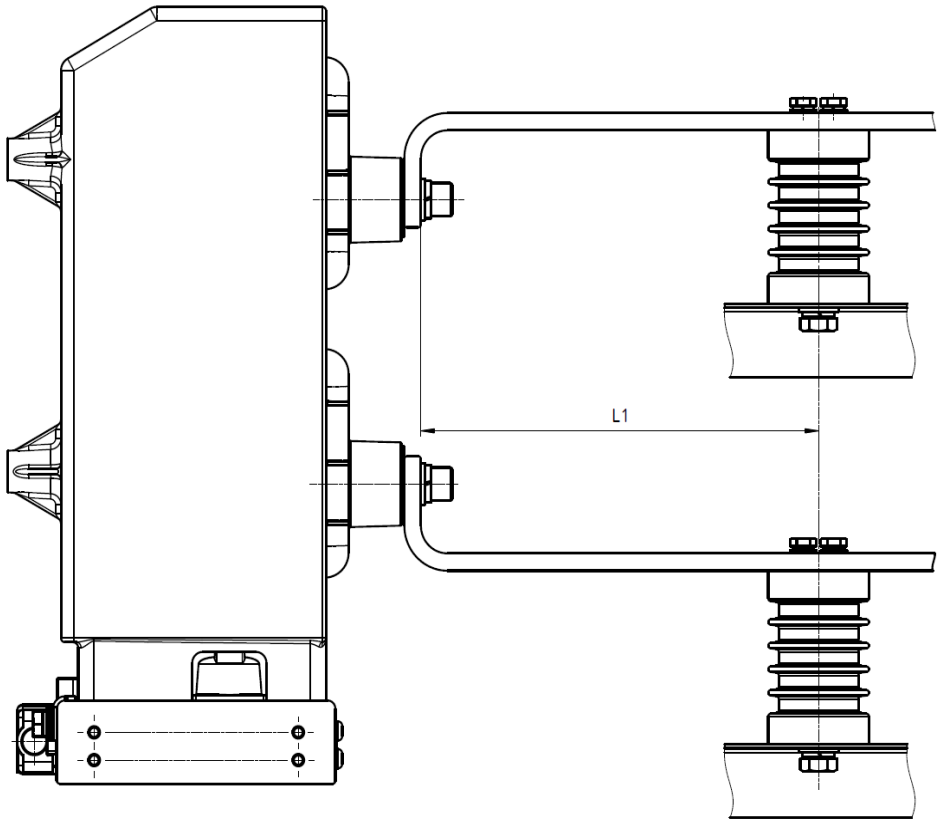



Figure 49

***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)<br>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 50) should be no less than stated in the Table 5.

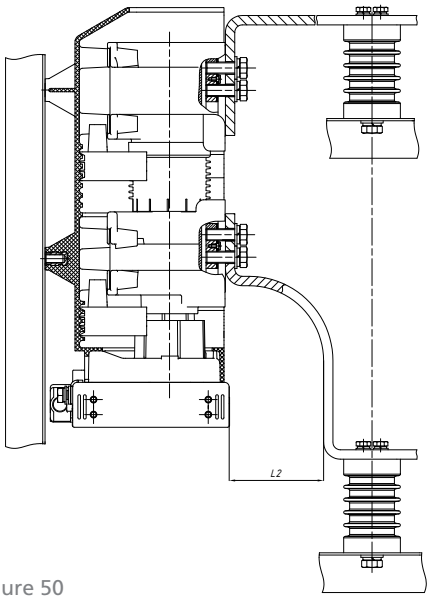



Figure 50

***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 phase-to-phase and phase-to-ground air clearances 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 |

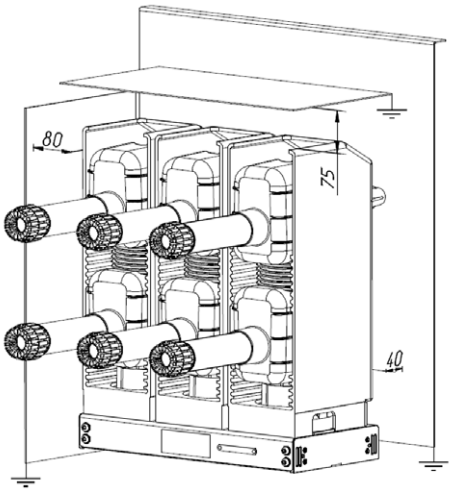



Figure 51

***Insulating clearance limitations of HD ISM with low upper terminal***

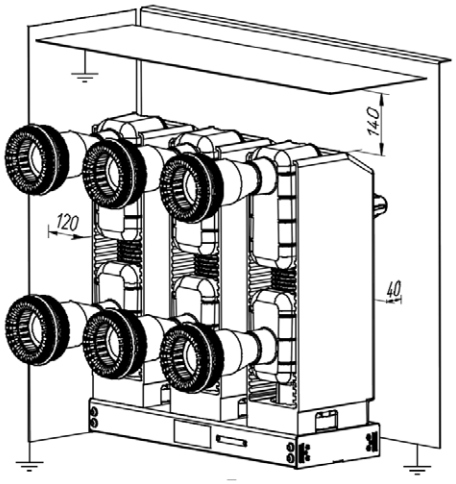



Figure 52

***Insulating clearance limitations of HD ISM with high upper terminal***

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 54):

- stub shafts at both sides with grooves and tapped holes (Figure 54, details 1 and 3);
- two interlocking pins with tapped holes (Figure 54, detail 2).

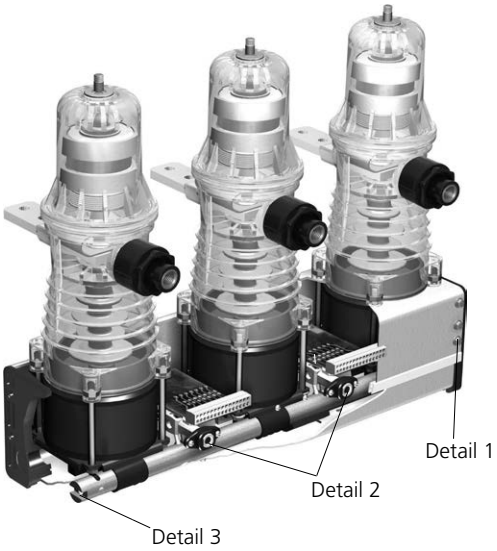
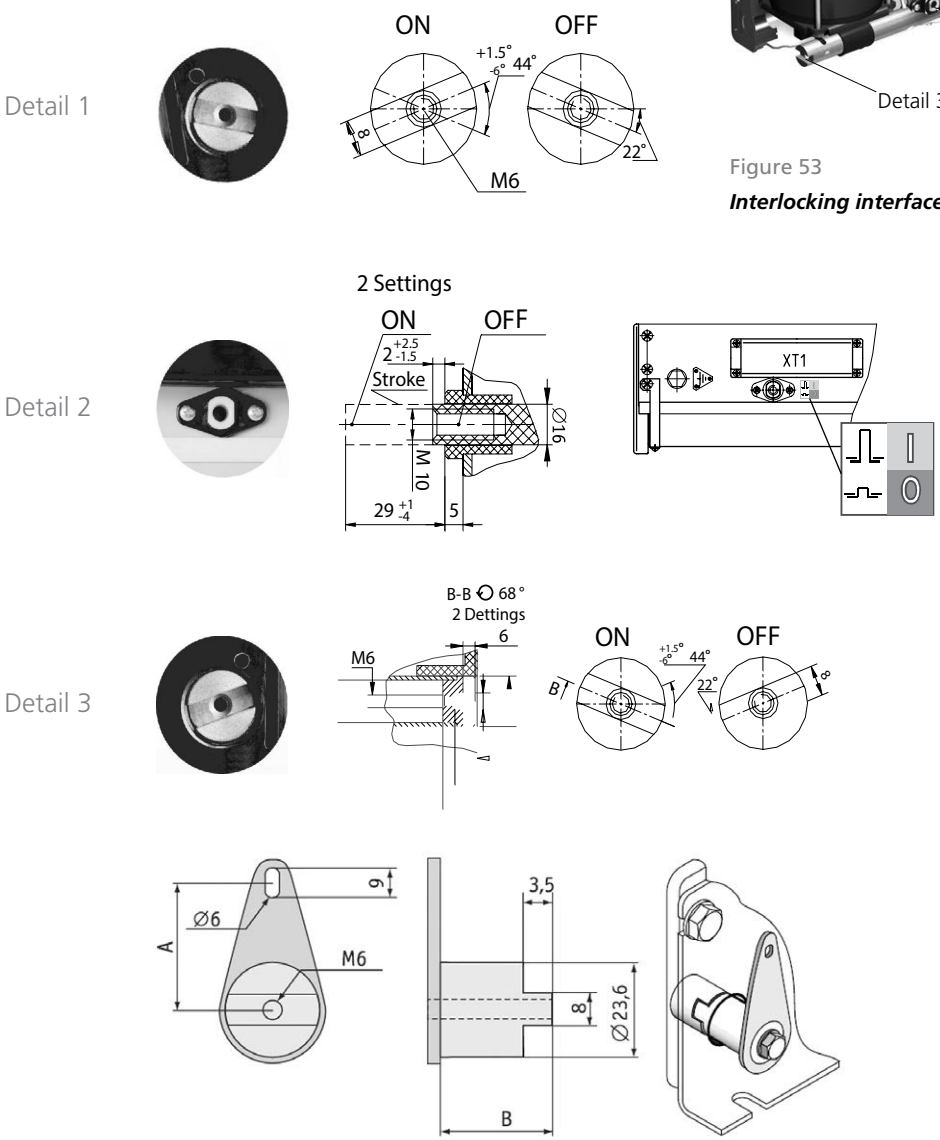



Figure 53

***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 54

***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 55).
- 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 56).
- If the interlocking mechanism is directly attached with the synchronizing shaft the moment of inertia of the attached mechanism shall not exceed 4.3 x $10^{-4}$ kg*$m^2$. If both stub shafts of the synchronizing shaft are used, the sum of the attached moments of inertia shall not exceed 4.3 x 10-4 kg*$m^2$ respectively 1.2 x $10^{-4}$ kg*$m^2$ (Figure 54).
- 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 55).
- It is not allowed to perform electrical trip/close commands while the interlocking pins or the synchronizing shaft are blocked mechanically.

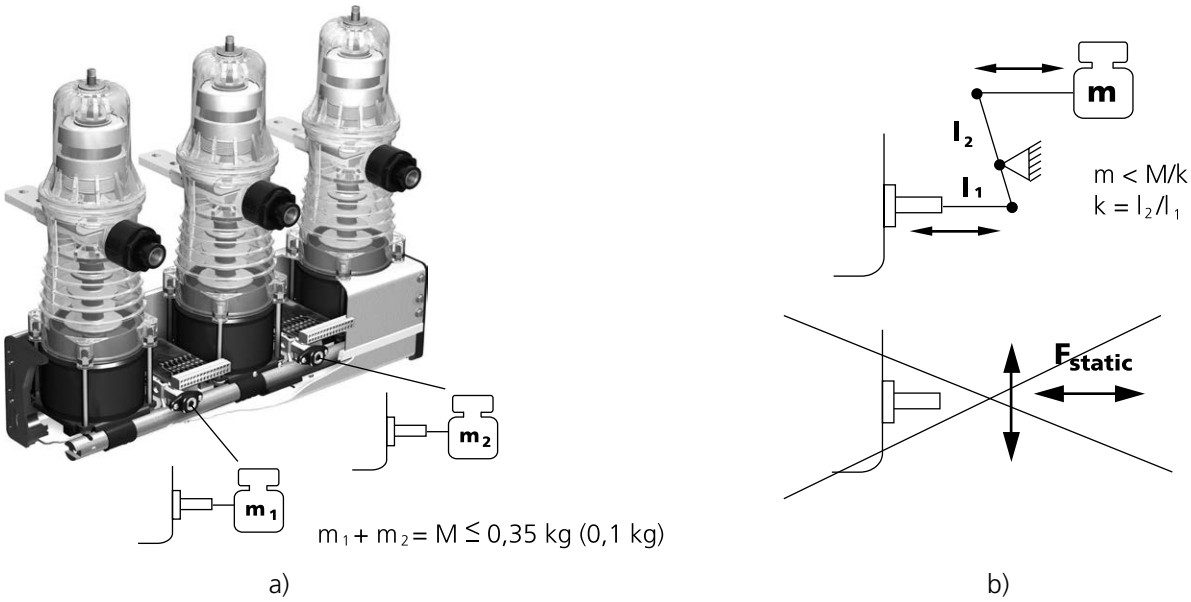
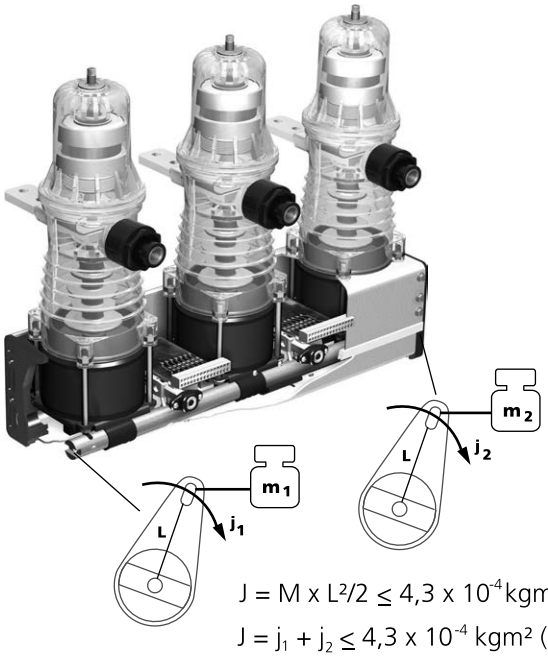



Figure 55

***Mechanical interlocking by interlocking pins***




J = M x L²/2 ≤ 4,3 x $10^{-4}$kgm²

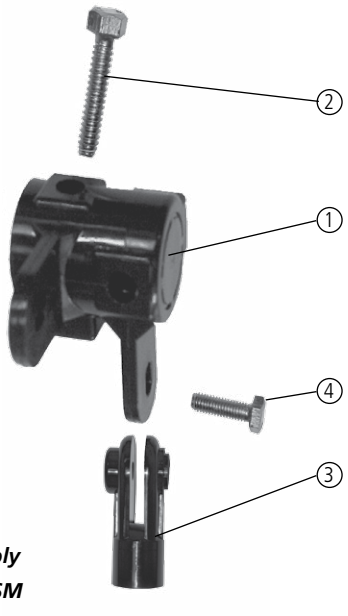
J = $j_1$ + $j_2$ ≤ 4,3 x $10^{-4}$ kgm² (1,2 x $10^{-4}$kgm²)

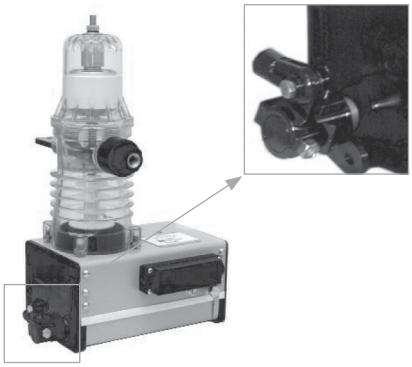
Figure 56

***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:

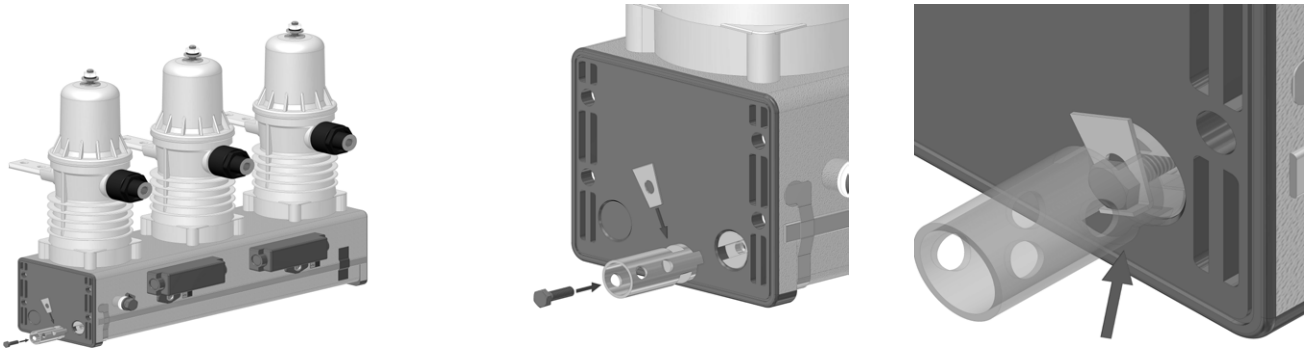


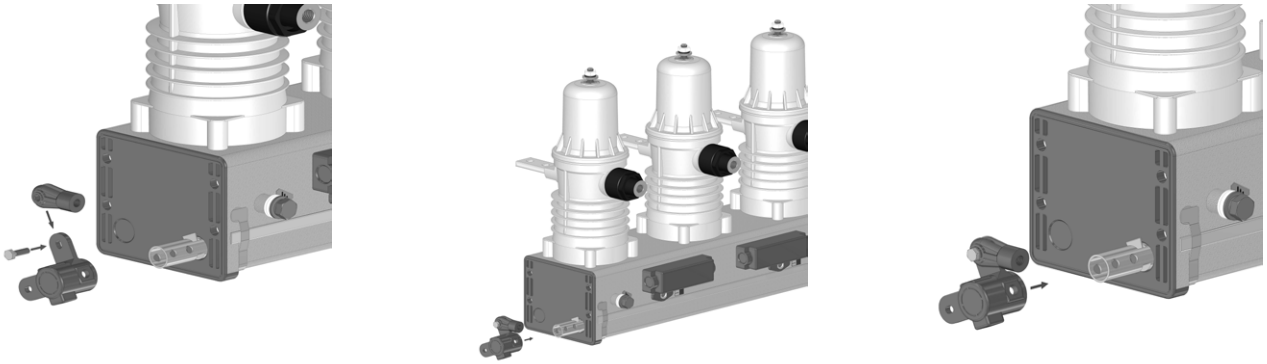
1. Holder Det_Holder_22;
2. Bolt StandDet_Bolt_DIN933(M8_40_Fe88-Zn) - bolt M8x40;
3. Holder Det_Holder_20;
4. Bolt StandDet_Bolt_DIN933(M6_20_Fe88-Zn) - bolt M6x20.

Figure 57
***Interlocking lever assembly design for single phase ISM***

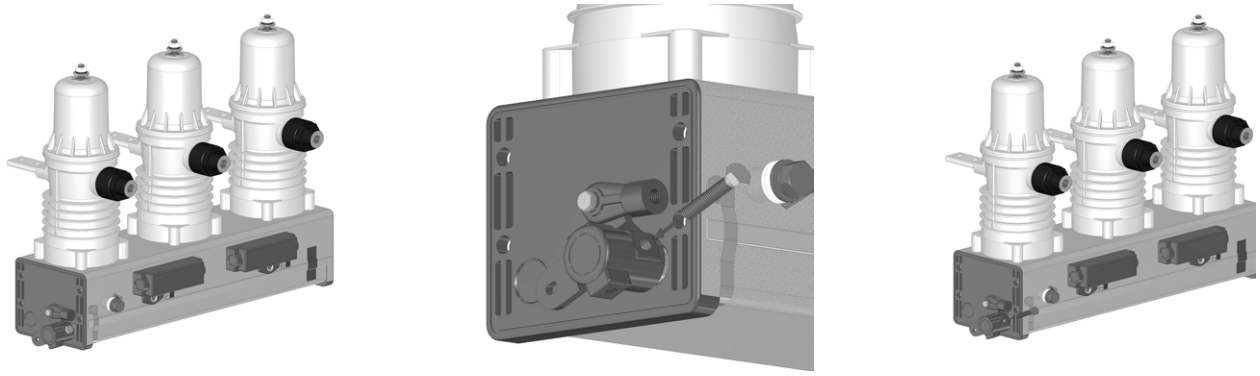
An interlocking lever can be installed on three phase ISM15_LD_1 and ISM25_LD_1 as shown below.



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



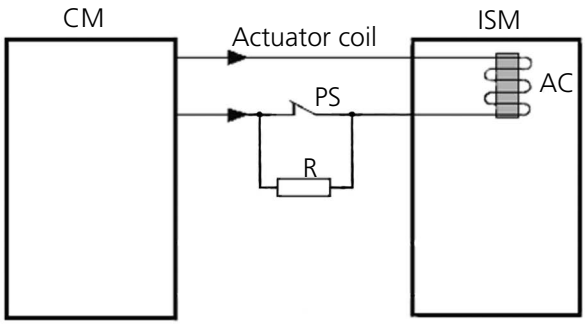
b) Attach Det_Holder_20 to the Det_Holder_22 and fix with StandDet_Bolt_DIN933(M6_20_Fe88-Zn). Then install Det_Holder_22 on CBdet_Shaft_1



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

Figure 58
***Interlocking lever assembly design for three phase ISM***

An electrical interlock can be provided by connecting the ISM actuator coil in series with the contacts of a position switch of the relevant device (disconnector or draw-out truck, etc.) as shown in the Figure 59.




AC — actuator coil;
PS — position switch with current not less than 10 A;
R — resistor 22 kOhm±5%, average power 0.15 W, peak power 8 W

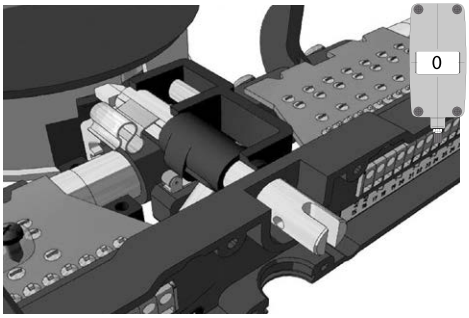
Figure 59
***Electrical interlock diagram***

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.

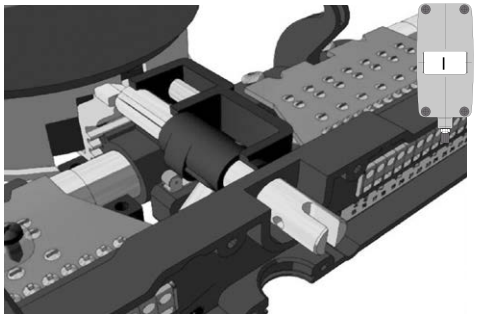
## 4.1.6 HD ISM interlocks

### Interlocking mechanism

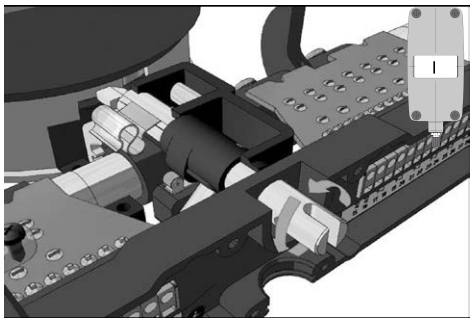
The HD ISM is equipped with an interlocking shaft that can be rotated clockwise to the "unlatched" position or counter-clockwise to the "open and locked" position. In the "unlatched" position the HD ISM can perform "close" and "open" operations.
In the "open and locked" position the ISM the interlocking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



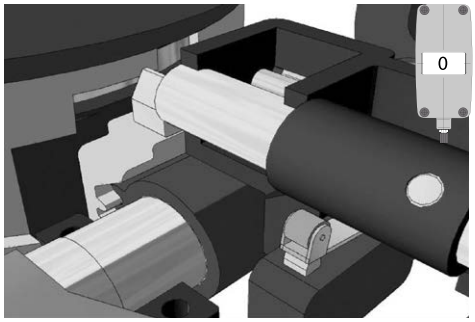

a) Interlocking shaft in unlatched position. ISM is open



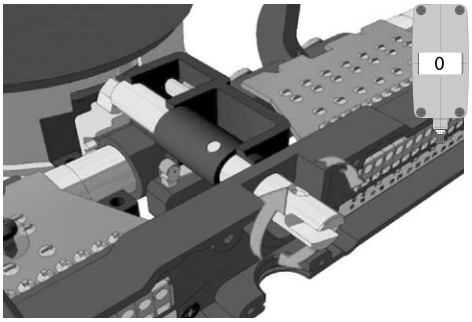

b) Interlocking shaft in unlatched position. ISM is closed




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




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




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

Figure 60

***HD ISM interlock operating principle***

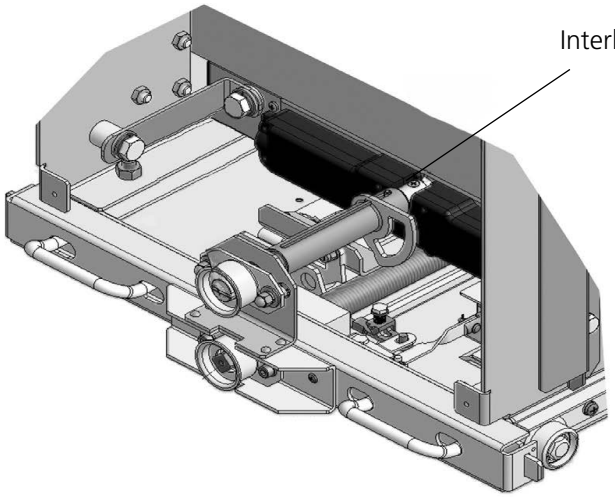
## Load capacity of HD ISM interlocking shaft

- 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 61

***Examples of HD ISM mechanical interlock connection***

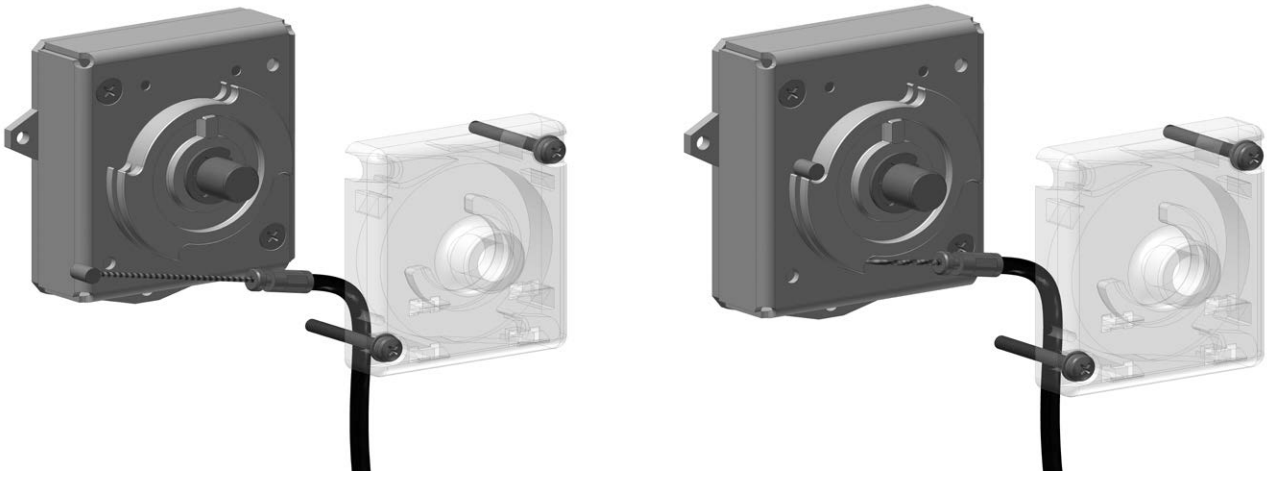
## Connection of CBkit_Interlock_2 to HD ISM interlocking shaft

CBkit_Interlock_2 can be used for HD ISM as an acessory for manual trip / lockout of the ISM.

The installation of the CBkit_Interlock_2 is shown below. (Figure 62 - Figure 72). The ISM15_Shell_2 shall be in Unlocked position.

Notes:

- The bending radius of the flexible release cable shall be not less than 150 mm;
- It is recommended to install ISM in the Switchgear and connect its auxlliary circuits prior interlock connection to simplify the connection and adjustment process;
- If the flexible release cable passes through the Switchgear segregations according to the design solution it is recommended to pass it through these segregation prior interlock connection.



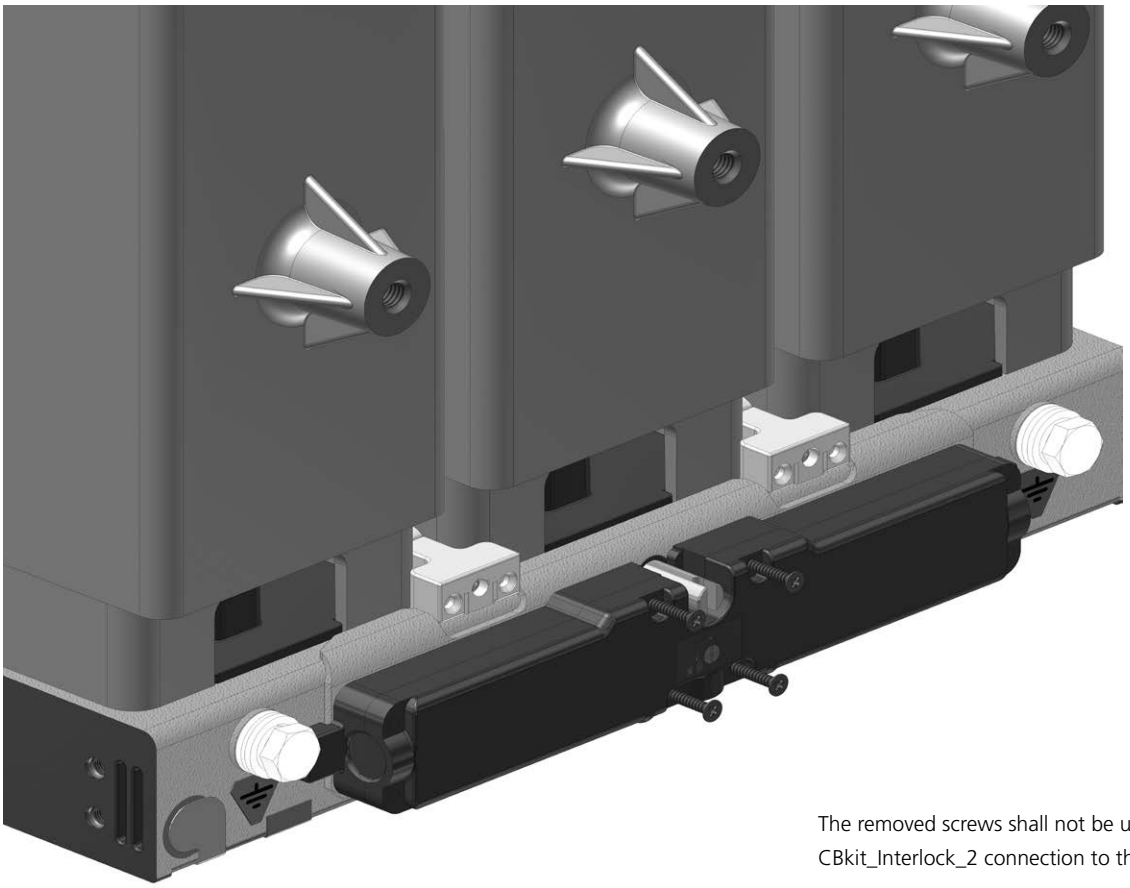
a) b)

c)

a) Unscrew the screws that fix plastic cover of the CBunit_Interlock_3;
b) Install the flexible release cable as shown in the Figure 62;
c) Install the cover back and fix it by screws. The cover should fix the fliexible release cable cover.

Figure 62

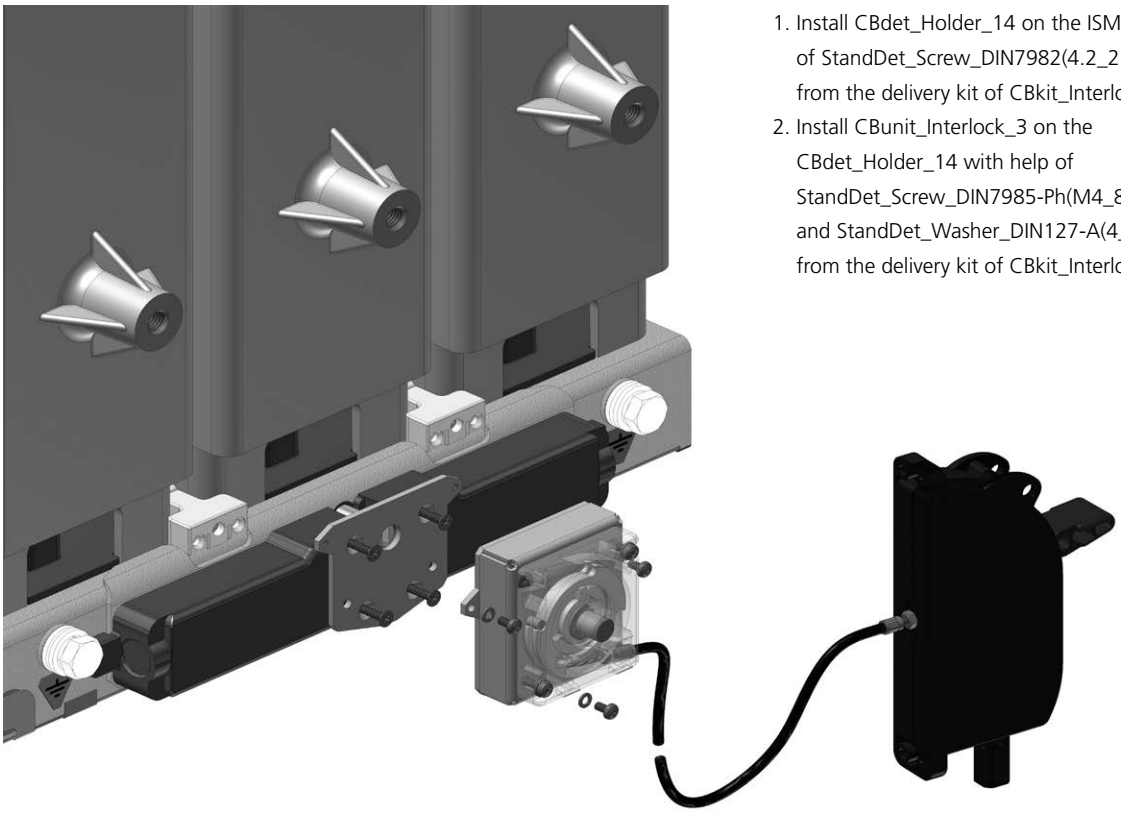
***Flexible release cable connection to CBunit_Interlock_3***



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

Figure 63

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



1. Install CBdet_Holder_14 on the ISM with help of StandDet_Screw_DIN7982(4.2_25_Fe-Zn) from the delivery kit of CBkit_Interlock_2;
2. Install CBunit_Interlock_3 on the CBdet_Holder_14 with help of StandDet_Screw_DIN7985-Ph(M4_8_Fe48-Zn) and StandDet_Washer_DIN127-A(4_Fe-Zn) from the delivery kit of CBkit_Interlock_2.

Figure 64

***Installation of CBunit_Interlock_3 with connected flexible release cable on the ISM***

Install CBdet_Stopper_2 on the CBunit_Interlock_1(1) with help of StandDet_Screw_DIN912(M10_20_Fe88-Zn) from the delivery kit of CBkit_Interlock_2. The orientation of CBdet_Stopper_2 depends on the way of next installation of CBunit_Interlock_1(1).
During fixation of StandDet_Screw_DIN912(M10_20_Fe88-Zn) the rod of CBunit_Interlock_1(1) shall not be loaded by torque, the wrench shall be used for rod unloading.

Figure 65
***Installation of CBdet_Stopper_2 on the CBunit_Interlock_1(1)***

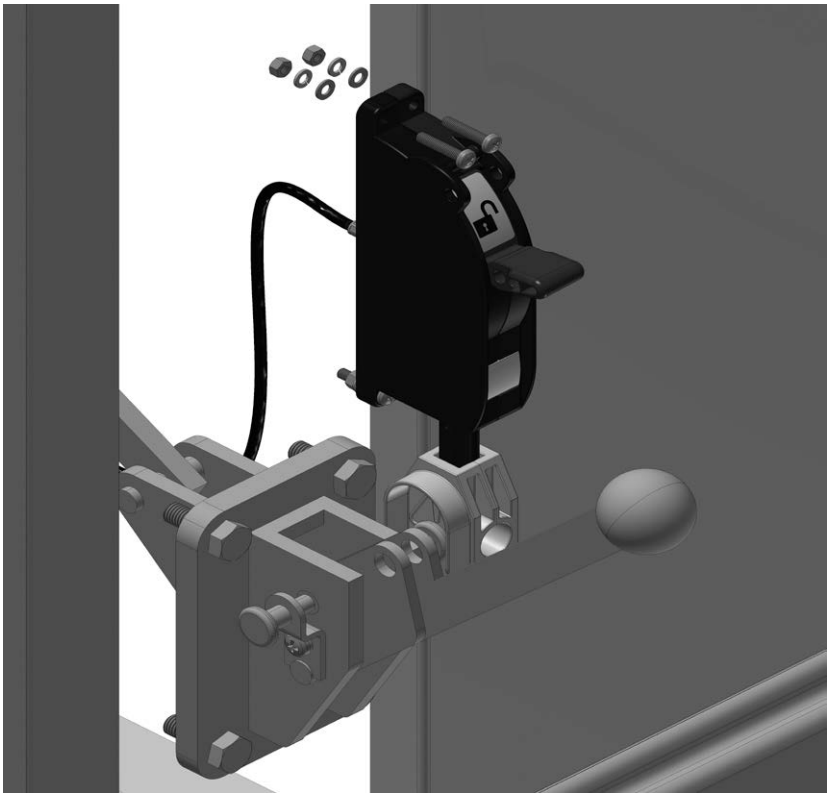


Figure 66
***Installation of CBunit_Interlock_1(1) for varinat with one or with two straddling disconnectors***

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

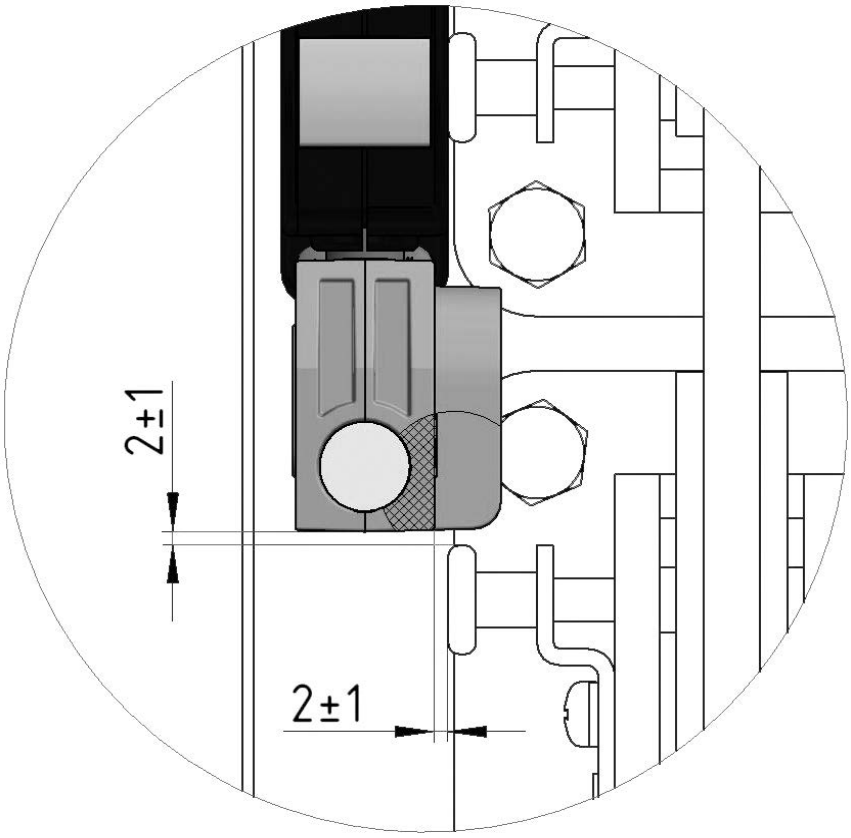



Figure 67

***Adjustment of CBunit_Interlock_1(1) nstallation for varinat with one or with two straddling disconnectors***

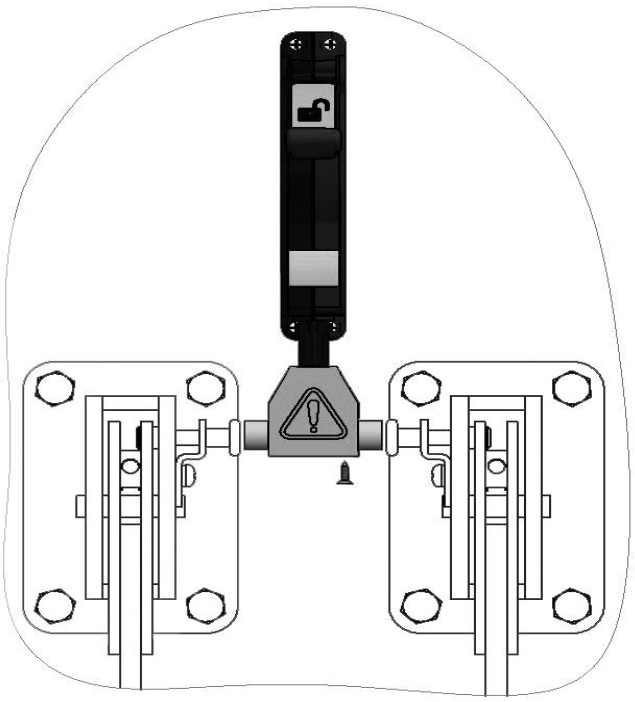


Figure 68

***Installation of CBunit_Interlock_1(1) for varinat with two disconnectors***

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

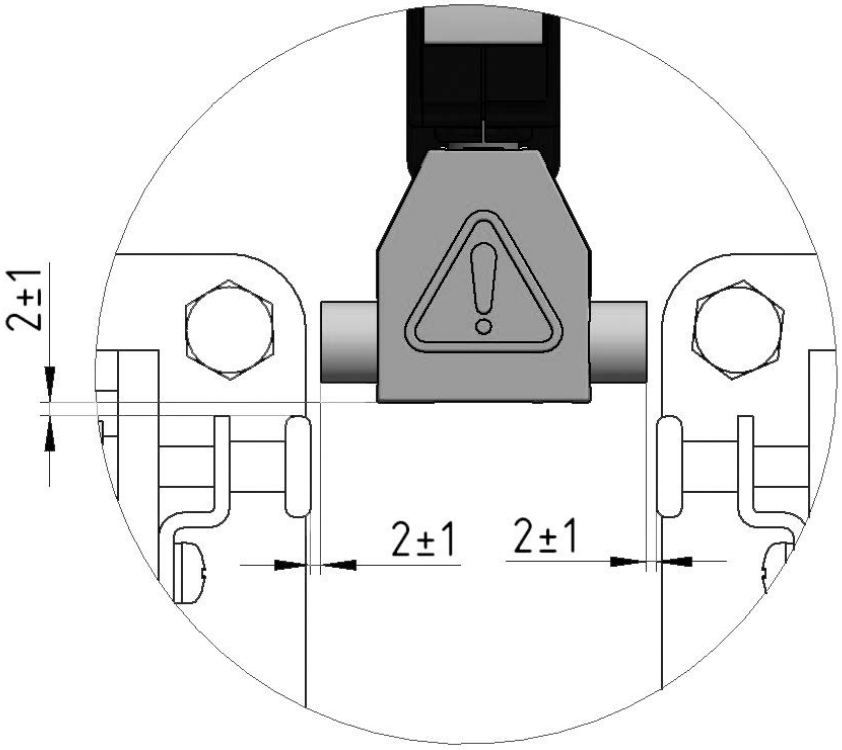
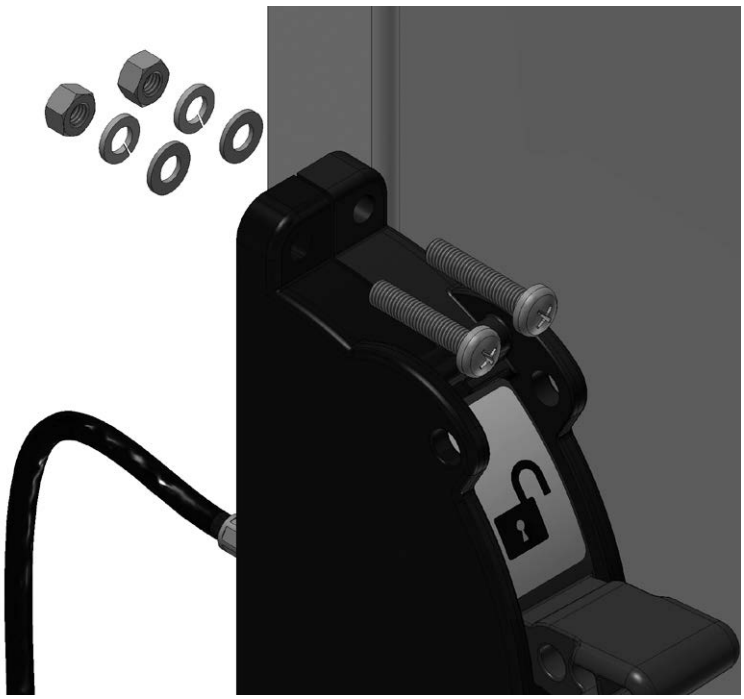



Figure 69

***Adjustment of CBunit_Interlock_1(1) nstallation for varinat with two disconnectors***



CBunit_Interlock_1(1) sahll be fixed with help of:
- StandDet_Screw_DIN7985-Ph(M5_25_Fe48-Zn);
- StandDet_Washer_DIN125-1A(5.3_Fe-Zn);
- StandDet_Washer_DIN127-A(5_Fe-Zn);
- StandDet_Nut_DIN555(M5_Fe-Zn)

from the delivery kit of CBkit_Interlock_2.
Alternatively StandDet_Screw_DIN7504-K(4.8_19_Fe-Zn) from the delivery kit of CBkit_Interlock_2 can be used.

Figure 70

***Fixation of CBunit_Interlock_1(1)***

The flexible release cable shall be fixed in the Switchgear with help of StandDet_CableTie_LS(4.6_150_40) from the delivery kit of CBkit_Interlock_2. If necessary the stroke of flexible release cable can be adjusted as shown in the Figure 71.

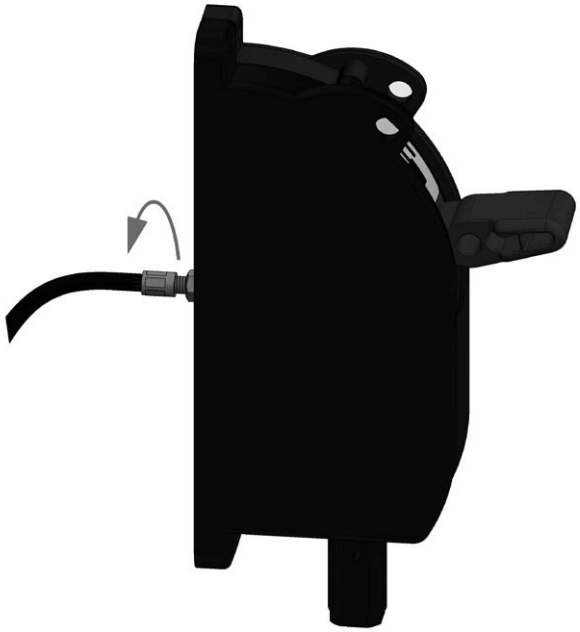
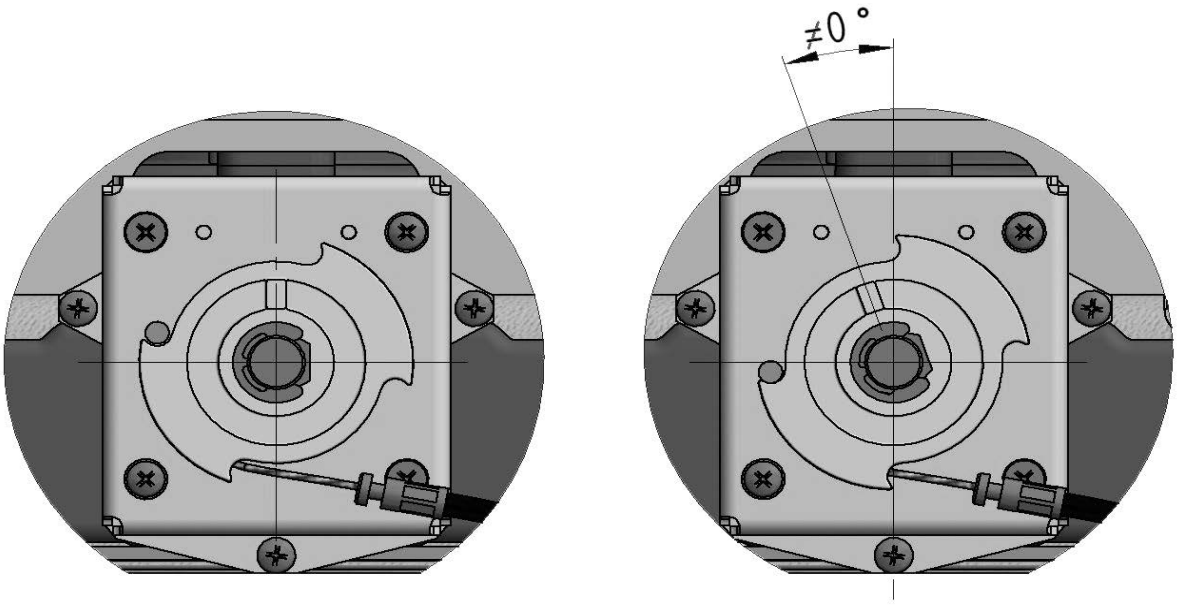


Figure 71

***Adjustment of stroke of flexible release cable***




Correct

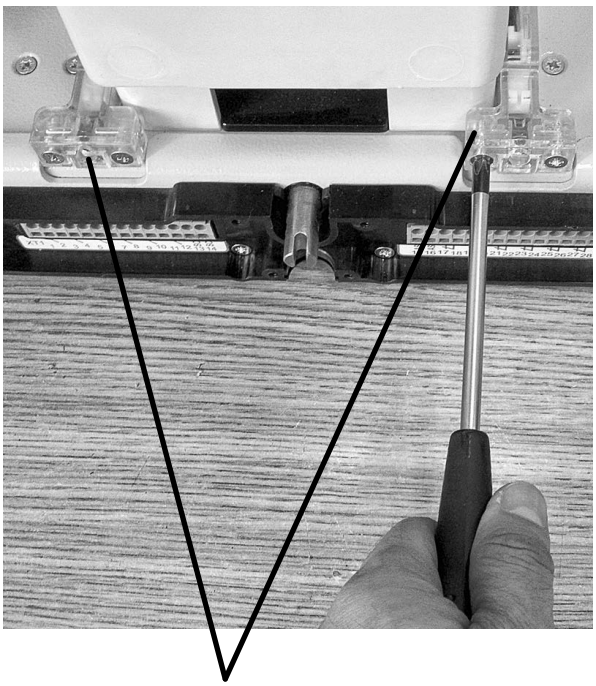
Wrong

Figure 72

***Position of interlocking shaft of the ISM with connected CBkit_Interlock_2***

## 4.1.7 Installation of HD ISM main contacts position indicator

The installation of the main contacts position indicator is shown below. (Figure 73 - Figure 76). The ISM shall be in the Closed position.
Note: The bending radius of the flexible release cable shall be not less than 40 mm.



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

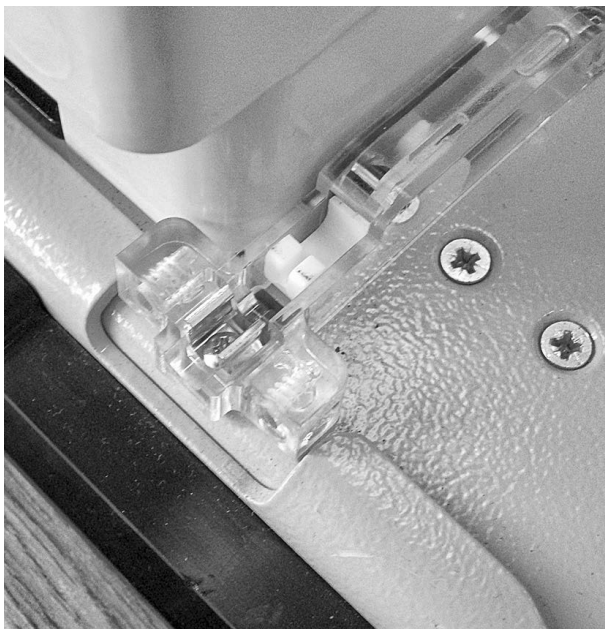


Figure 73

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

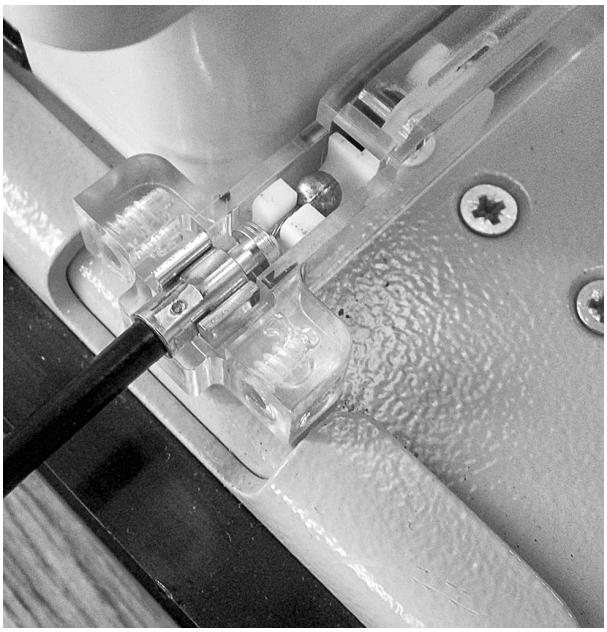


Figure 74

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

Figure 75

***Return the cover and fasten it to the ISM.***

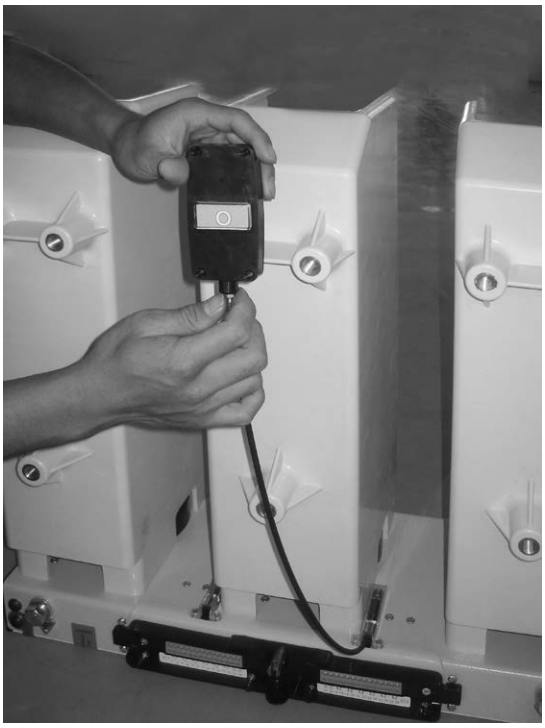


Figure 76
***Adjust the indicator for both closed and opened states of the switching module.***

Figure 77
***Position indicator shows that main contacts are open***

Figure 78
***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 mm² |
| 20 kA | 300 °C | 70-120 mm² |
| 25 kA | 300 °C | 95-140 mm² |
| 31.5 kA | 300 °C | 120-190 mm² |

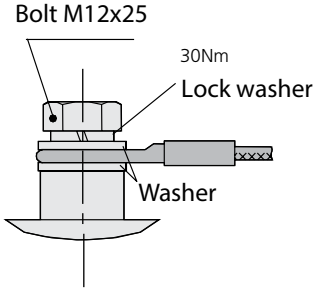



Figure 79
***ISM protective earthing connection***

The method of LD ISM earthing is shown in the Figure 80.

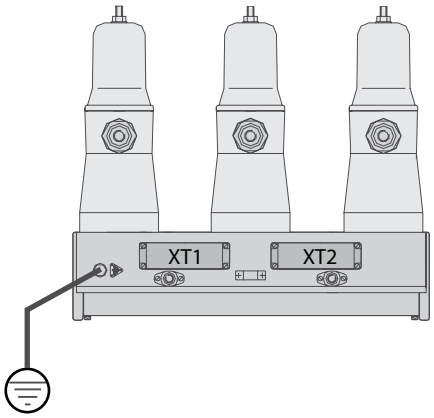



Figure 80
***LD ISM earthing***

An example of one side copper bar earthing is represented in Figure 81.

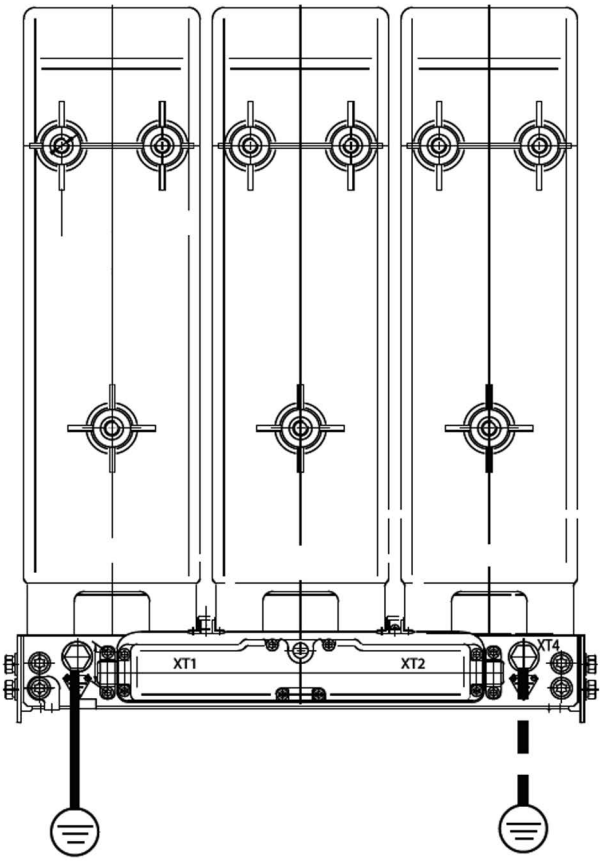



Figure 81
***HD ISM earthing***

Figure 82
***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.

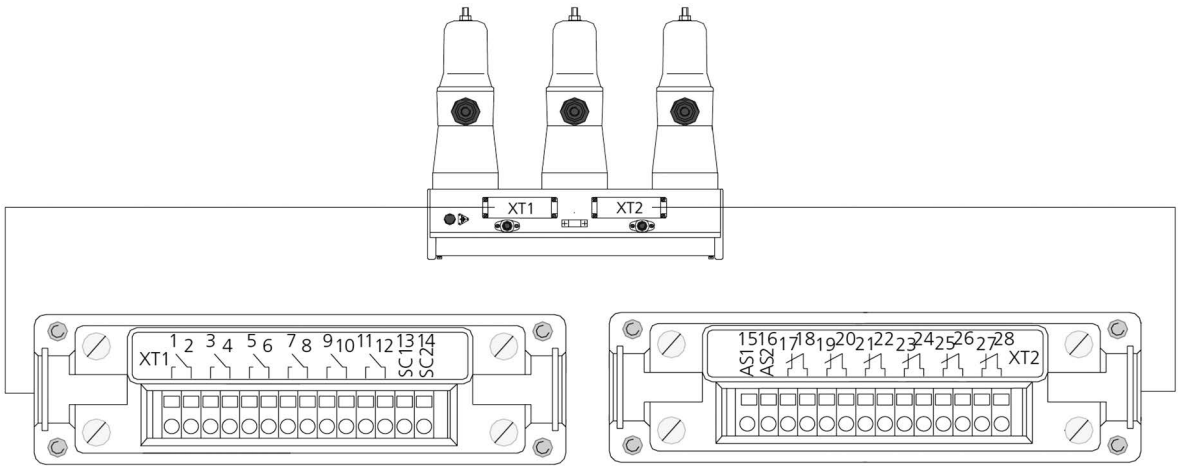



Figure 83

***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.

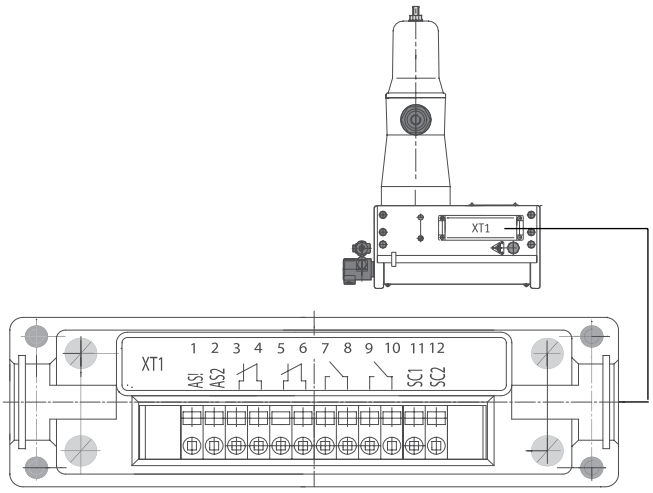



Figure 84

***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.

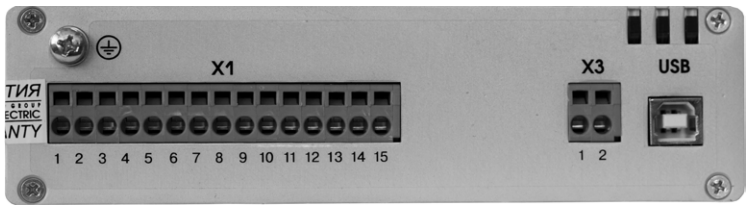



Figure 85

***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 NC | | |
| 4 | Relay output 1 Com | | |
| 5 | Relay output 1 NO | | |
| 6 | Relay output 2 NC | | |
| 7 | Relay output 2 Com | | |
| 8 | Relay output 2 NO | | |
| 9 | Relay output 3 NC | | |
| 10 | Relay output 3 Com | | |
| 11 | Relay output 3 NO | | |
| 12 | Close input | | |
| 13 | Close input | | |
| 14 | Trip input | | |
| 15 | Trip input | | |

CM relay functionality:

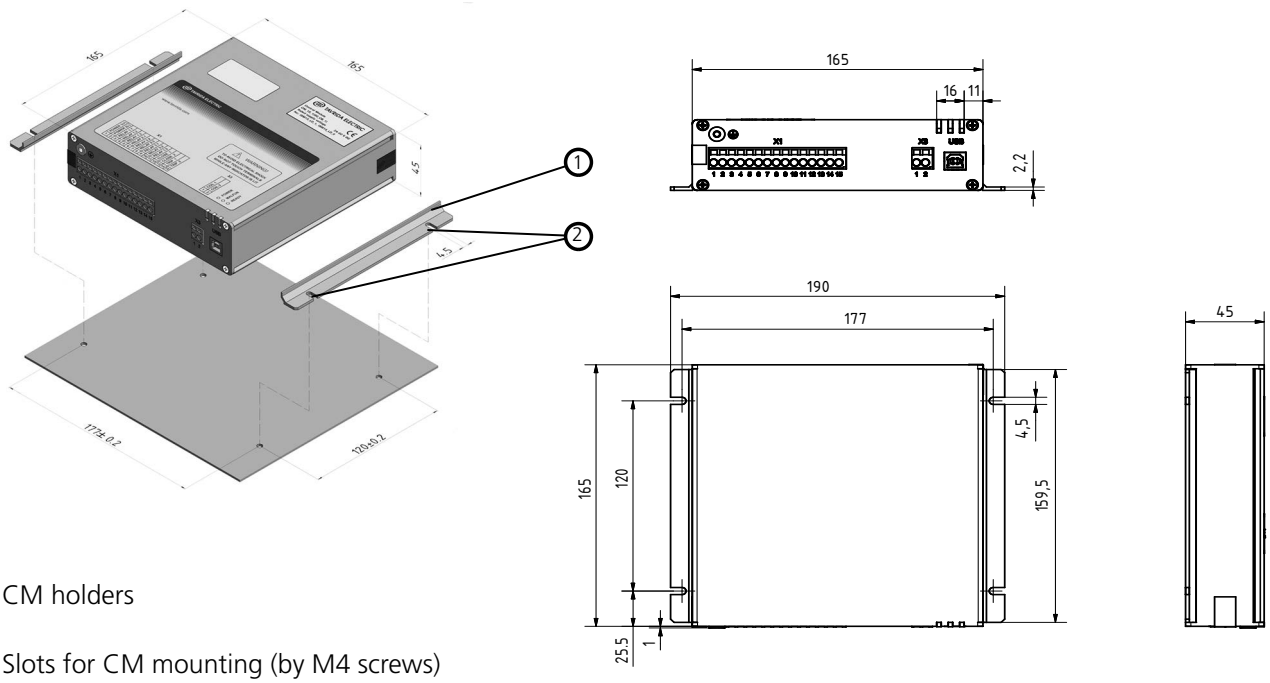
- Relay 1 - "ISM main contact position" relay;
- Relay 2 - "Ready" relay;
- Relay 3 - "Malfunction of Loss of auxiliary supply" relay.

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

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

## 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 86

***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 $mm^2$. The insulation stripping length shall be 6–10 mm. Insulated auxiliary circuits shall provide 2 kV power frequency dielectric strength.

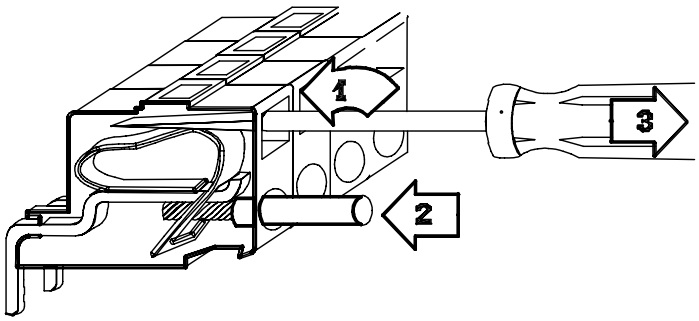



Figure 87

***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 packinig 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 88, Figure 89, Figure 90). 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.

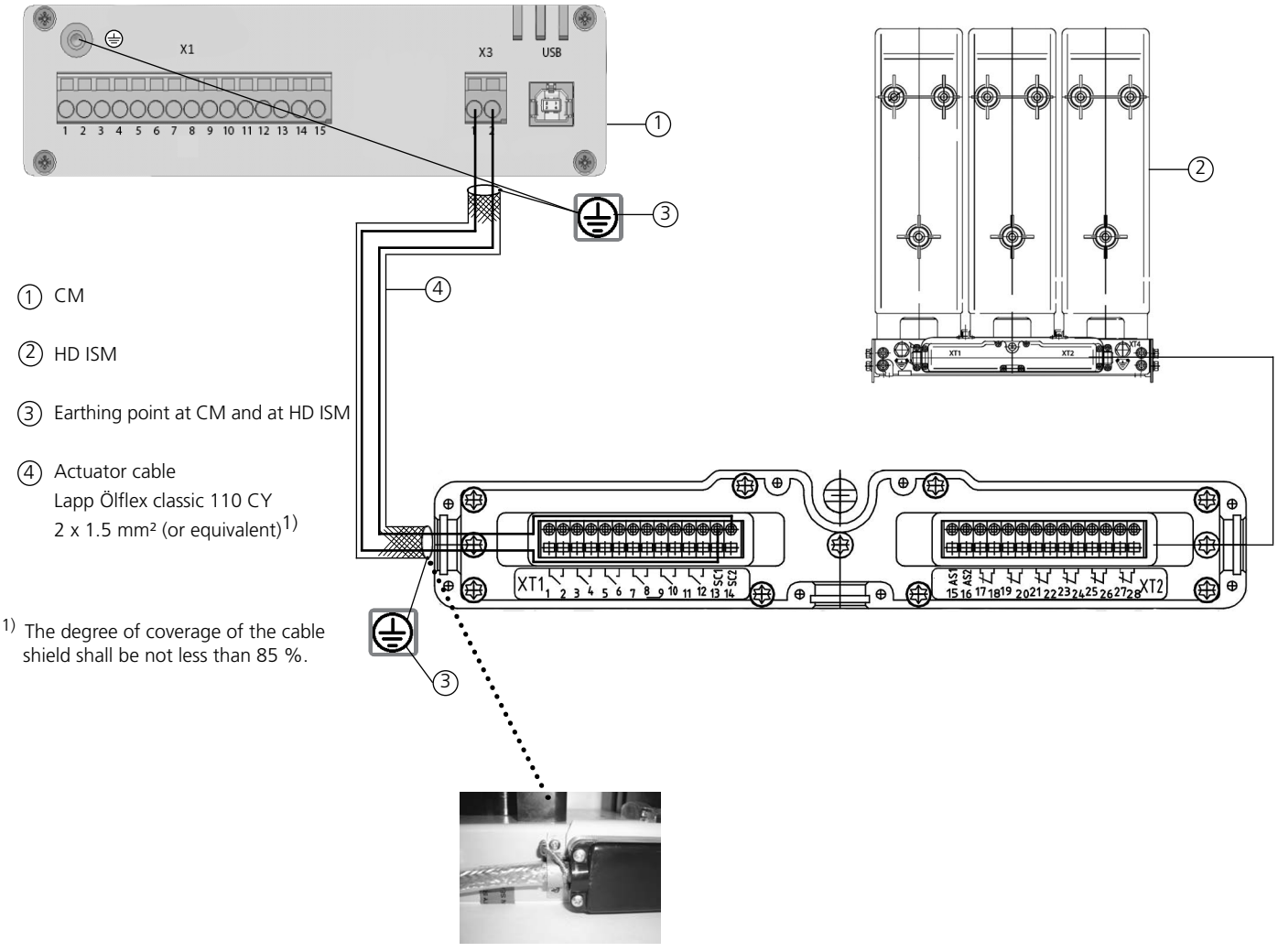
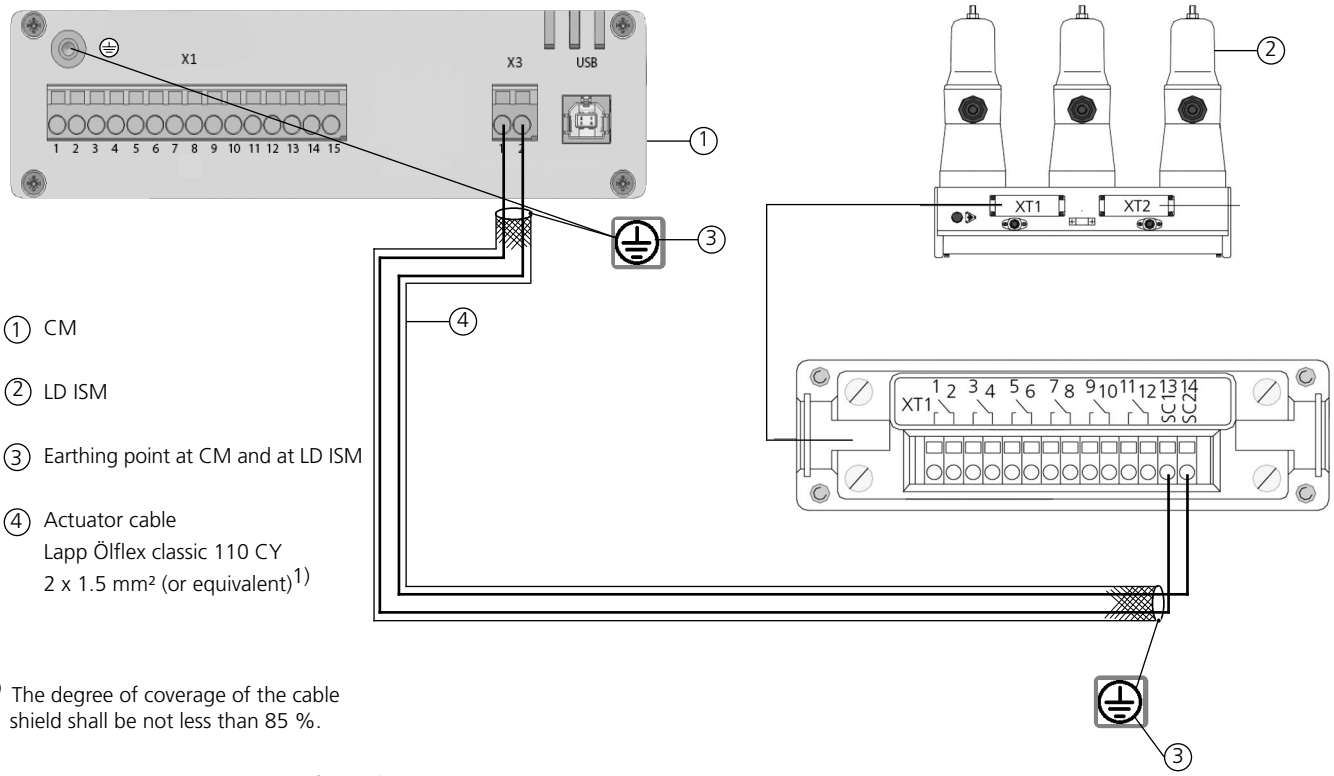



Figure 88

***Secondary cables between HD ISM and CM***




① CM

② LD ISM

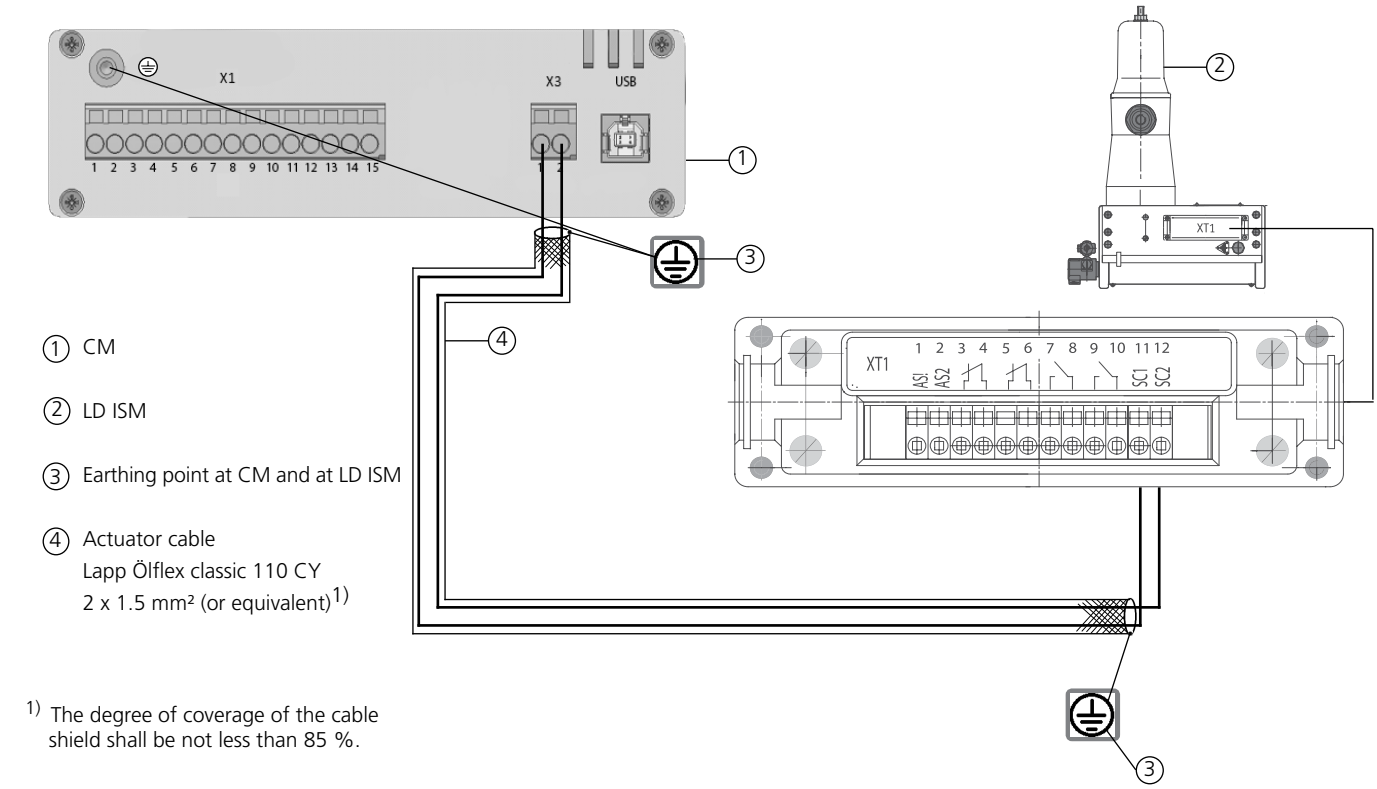
③ Earthing point at CM and at LD ISM

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

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

Figure 89

***Secondary cables between three phases LD ISM and CM***




① CM

② LD ISM

③ Earthing point at CM and at LD ISM

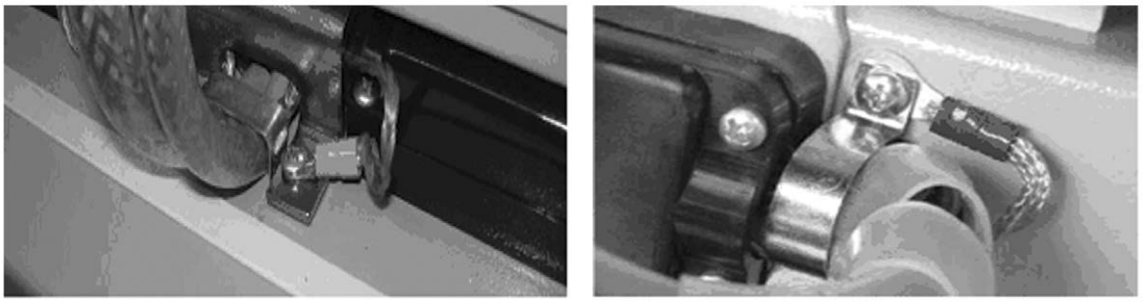
④ Actuator cable
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[1)]

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

Figure 90

***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 91

***Sample of earthed cable shielding on ISM side***

## 4.2.6 Auxiliary supply

Connection of CM_16_1 to power supply is shown below.

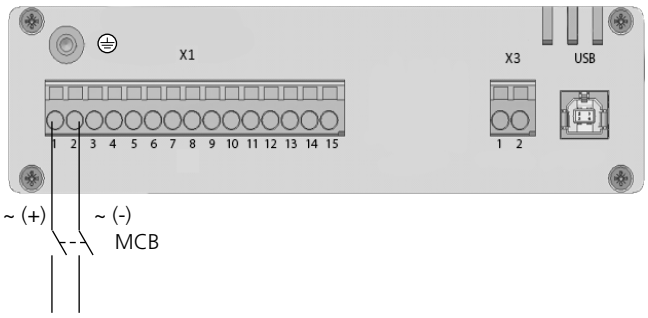



Figure 92

***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:

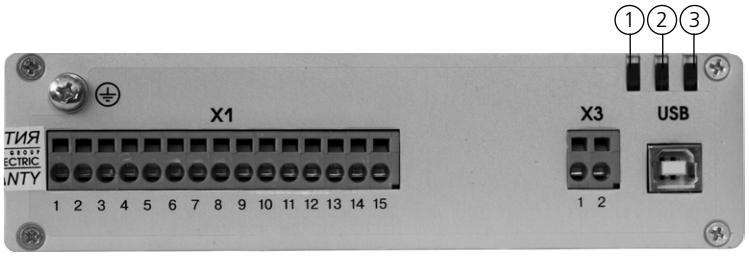
- red colour wire - positive polarity output wire;
- black colour wire - negative polarity output wire;
- yellow-green clour wire - manual generator earting wire.

## 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 inicators are shown in Figure 93. The LED indicators are visible from two directions.




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

Figure 93

***CM_16 LED indicators***

The self-diagnostic system inside the CM detects possible malfunctions and reports them via the Malfunction LED blink signals and Malfunction or Loss of auxiliary supply Relay state. The explanation of the LED blink codes is given in Table 11.

**Table 11 - CM self-diagnostic 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 |
| Exessive 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. Exessive 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 |

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

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

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

**Table 14 - CM relay "Malfunction or Loss of auxiliary supply" contacts operation**

| CM state | Relay "Malfunction or Loss of auxiliary supply" contacts state | |
|---|---|---|
| | NO | NC |
| Power supply voltage is absent for more than 1.5 seconds (1 blink of LED Malfunction) | Open | Closed |
| Exessive 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, contamination or moisture | 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 38 - Figure 41 | Visual check, no tool is required | 1 minute |
| Bolts and torques shall be according to Figure 38 - Figure 41 | 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.<br>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.<br>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:<br>- The "Power" LED must light up immediately;<br>- The "Ready" LED must light up continuously within 15 s after switching on;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must close within 15 s.;<br>- The "Malfunction or Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay contact must not change its state;<br>- 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:<br>- The "Power" LED must light continuously;<br>- The "Ready" LED must light continuously;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must not change its state;<br>- The "Malfunction or Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay contact must change its state;<br>- 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:<br>- The "Power" LED must light continuously;<br>- The "Ready" LED must light continuously;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must not change its state;<br>- The "Malfunction of Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay contact must change its state;<br>- 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 |
|---|---|---|
| Do not remove trip command and apply close command to the CM then check the following:<br>- The "Power" LED must light continuously;<br>- The "Ready" LED must light continuously;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must not change its state;<br>- The "Malfunction or Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay contact must not change its state;<br>- ISM main contacts must not change their state (ISM shall remain open). | Visual check, no tool is required | 1 minute |
| Remove close and trip commands to the CM then check the following:<br>- The "Power" LED must light continuously;<br>- The "Ready" LED must light continuously;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must not change its state;<br>- The "Malfunction or Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay must change its state;<br>- ISM main contacts must change their state (ISM shall remain open). | Visual check, no tool is required | 1 minute |
| Apply and keep close command and then apply trip command to the CM then check the following:<br>- The "Power" LED must light continuously;<br>- The "Ready" LED must go out after the trip of the ISM and then light up continuously within 10 s.;<br>- The "Malfunction" LED must not light up;<br>- The "Ready" relay contact must change its state after the trip of the ISM and then change its state again within 10 s.;<br>- The "Malfunction or Loss of auxiliary supply" relay contact must not change its state;<br>- The "ISM main contact position" relay contact must change its state each time when ISM is closed and open;<br>- ISM main contacts must change their state each time when ISM is closed and open. | Visual check, no tool is required | 1 minute |

| Operation description | Required tool | Approximate timing |
|---|---|---|
| **Primary circuits insulation check**[1] | | |
| Observe safety precautions listed in the danger and warning advisories. Construct proper barriers and warning light systems | Equipment to provide safety in the test area | 10 minutes |
| Ground each pole of ISM that is not under test[2] | Wires | 2 minutes |
| Apply slowly rising 100%[3] of test voltage[4] (50 or 60 Hz) across each pole for one minute[5]. (ISM is open) | Power frequency withstand voltage test set | 2 minutes |
| If the pole sustains the test voltage for that period, its vacuum integrity has been 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 94 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 95 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 mesurement 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.

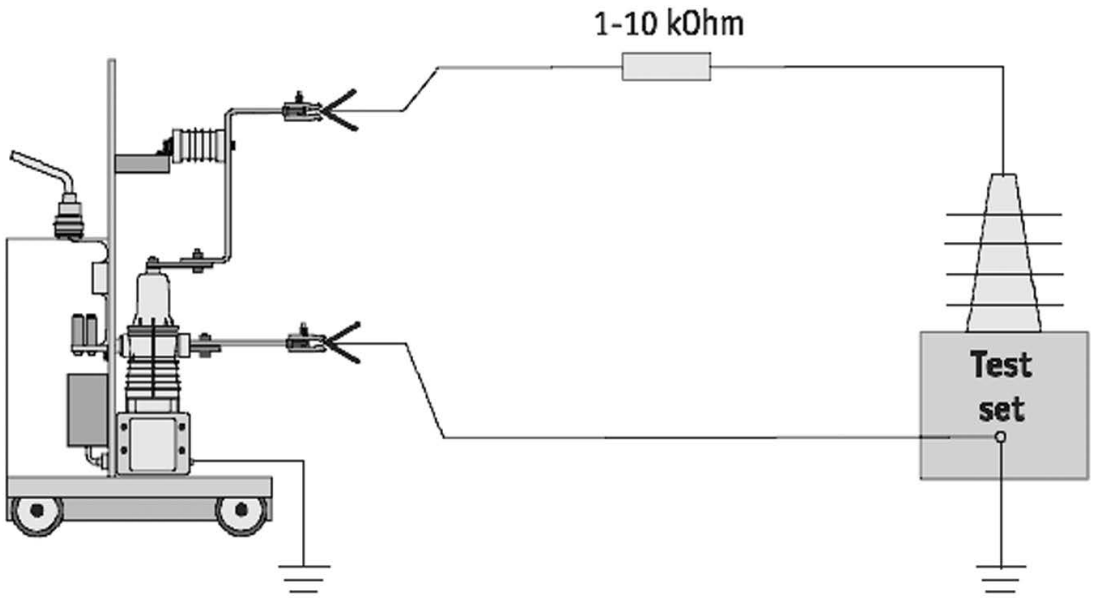



Figure 94

***The Vacuum integrity and solid insulation test installation***

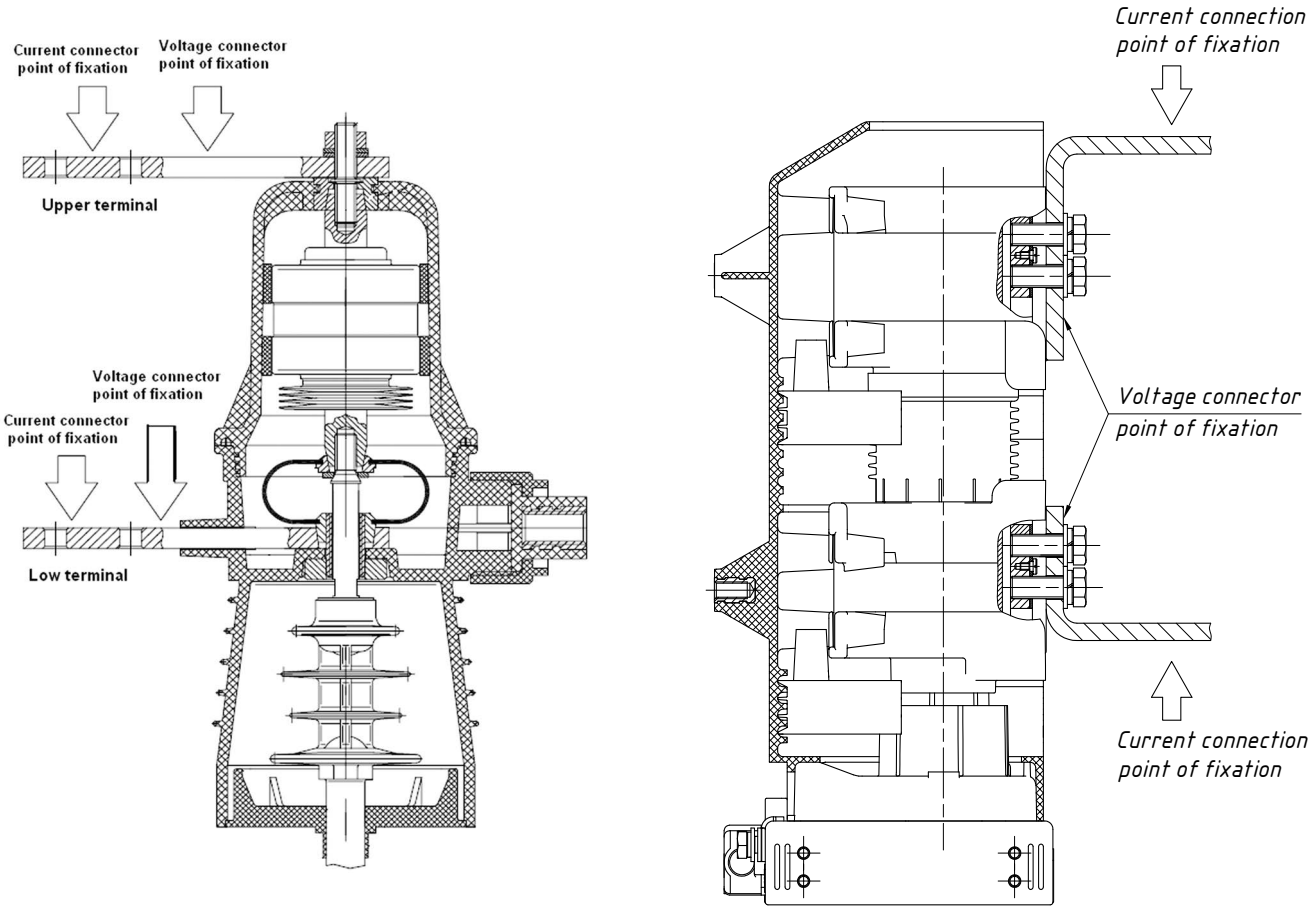



Figure 95

***The connection points of the contact resistance meter***

# 6. Operation

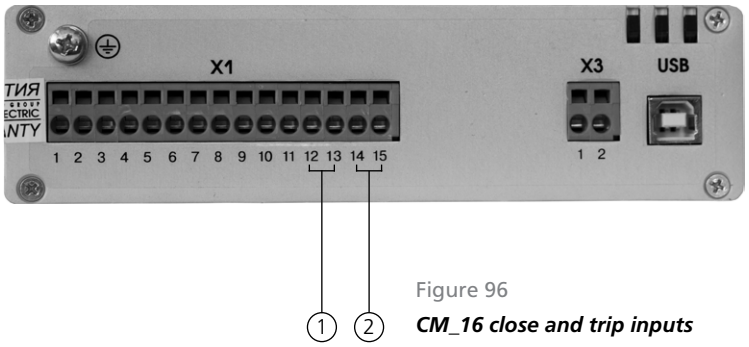
# 6.1 Switching

## 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 96
***CM_16 close and trip inputs***

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

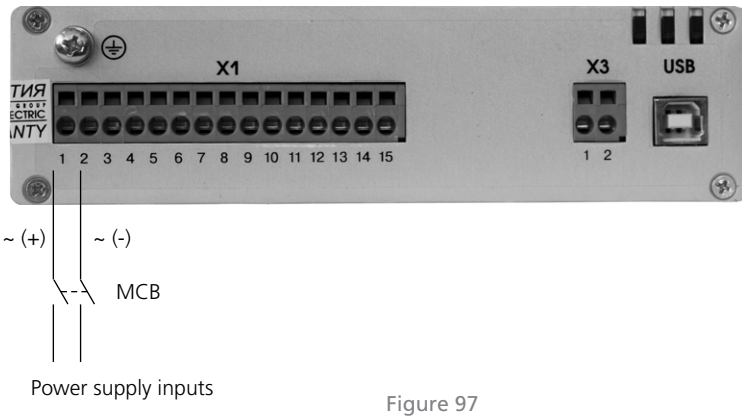



Figure 97
***CM_16 power supply connection***

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 97) 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 evenly during their movement - see Figure 98. 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.

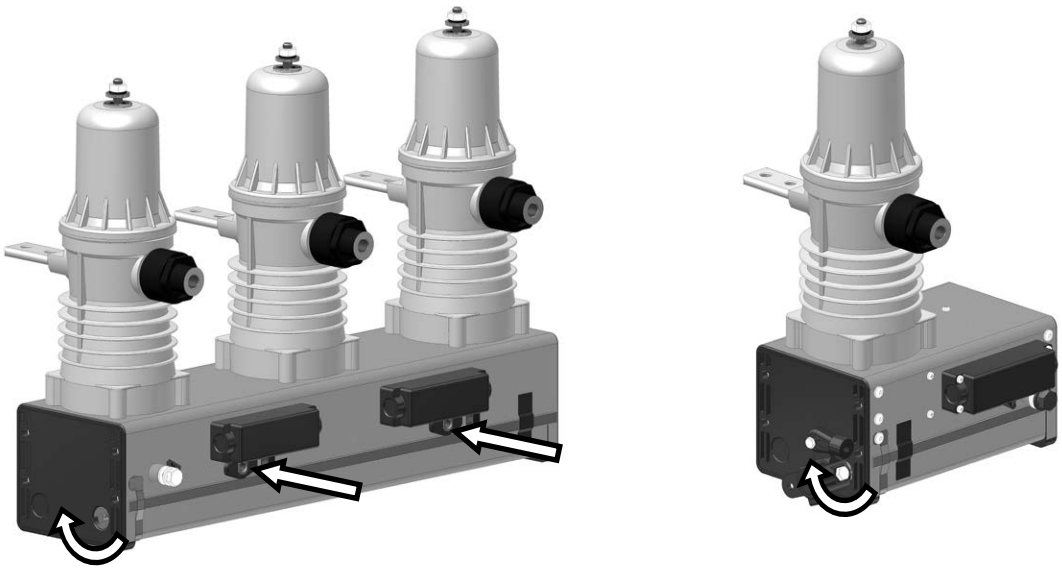


Figure 98

***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 evenly during its movement - see Figure 99. 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.

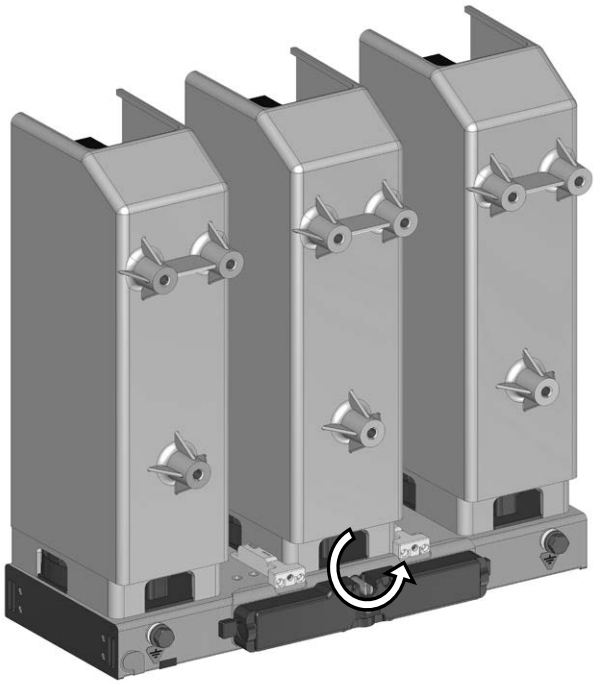


Figure 99

***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, contamination or moisture | Dry napless cloth or a napless cloth soaked in alcohol to clean the insulation | 5 minutes |
| Bolts and torques shall be according to Figure 38 - Figure 41 | 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 check**[1)] | | |
| Observe safety precautions listed in the danger and warning advisories. Construct the proper barrier and warning light system | Equipment to provide safety in test area | 10 minutes |
| Ground each pole not under test | Wires | 2 minutes |
| Apply slowly rising 100%[2)] of test voltage[3)] (50 or 60 Hz) across each pole for one minute[4)]. (ISM is open) | Power frequency withstand voltage test set | 2 minutes |
| If the pole sustains the test voltage for that period, its vacuum integrity has been 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 accroding 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 94 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 check**[1)] | | |
| ISM shall be closed before the test, there should not be any external circuits connected to ISM main terminals that provide parallel circuit with the ISM main circuits otherwise tests will be invalid. | Visual check, no tool is required | 1 minute |
| Test equipment shall be connected to ISM main circuits terminals according to Figure 95 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:

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

where:
Ia, Ra — actual current and corresponding contact resistance,
Ir, Rr — rated values (Table 1).
If the contact resistance is at least twice as high as the specified limit, the ISM must be replaced.

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

# 7.2 Secondary circuits

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

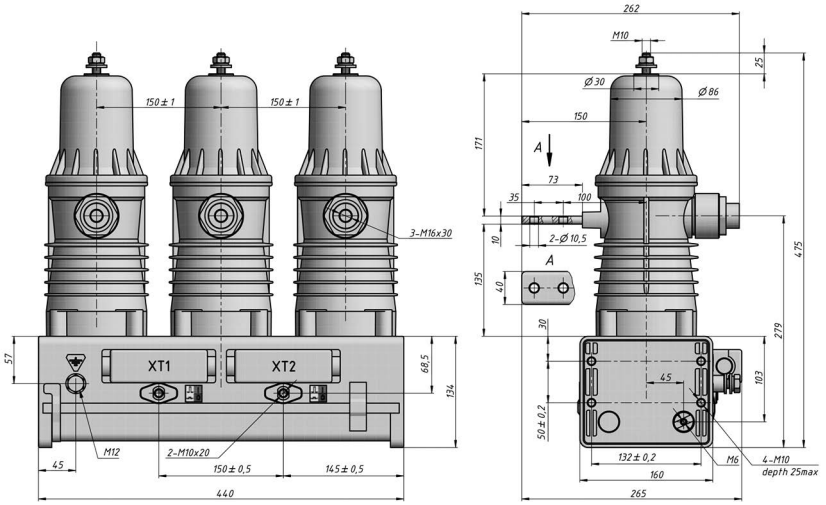
# VCB Product range, delivery sets and package parameters

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

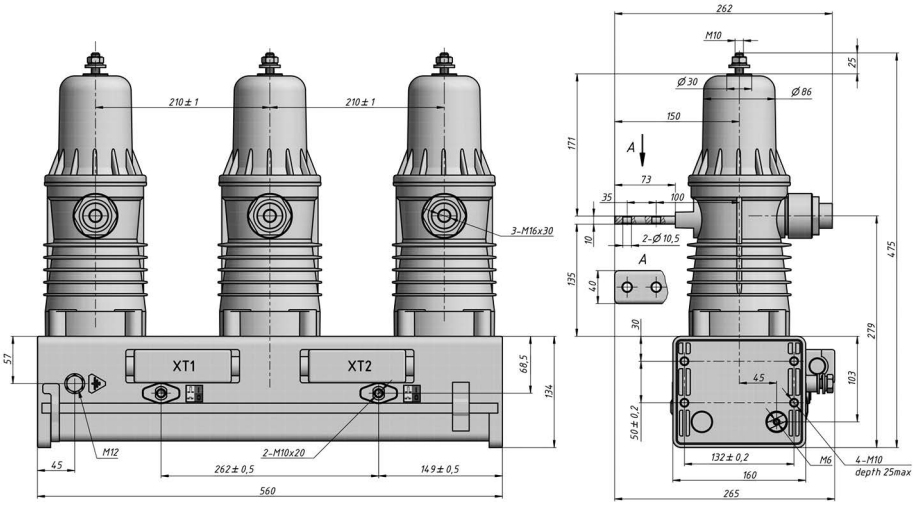
| VCB designation | Item | Quantity | Package dimensions (LxWxH), mm | Gross weight, kg | Net weight, kg |
|---|---|---|---|---|---|
| VCB15_Shell2_16F(CB_12_31.5_2000_210_1_60_No) | ISM15_Shell_2(210_H)<br>CM_16_1(60_CB_3) | 1<br>1 | 790x275x600 | 58.6 | 62.5 |
| VCB15_Shell2_16F(CB_12_31.5_2000_210_1_220_No) | ISM15_Shell_2(210_H)<br>CM_16_1(220_CB_3) | 1<br>1 | 790x275x600 | 58.6 | 62.5 |
| VCB15_Shell2_16F(CB_17.5_31.5_2000_210_1_60_No) | ISM15_Shell_2(210_H)<br>CM_16_1(60_CB_3)<br>CBkit_Shell15_1(310) | 1<br>1<br>1 | 790x275x800 | 67.4 | 62.9 |
| VCB15_Shell2_16F(CB_17.5_31.5_2000_210_1_220_No) | ISM15_Shell_2(210_H)<br>CM_16_1(220_CB_3)<br>CBkit_Shell15_1(310) | 1<br>1<br>1 | 790x275x800 | 67.4 | 62.9 |
| VCB15_Shell2_16F(CB_12_31.5_2000_275_1_60_No) | ISM15_Shell_2(275_H)<br>CM_16_1(60_CB_3) | 1<br>1 | 790x275x600 | 59.1 | 56 |
| VCB15_Shell2_16F(CB_12_31.5_2000_275_1_220_No) | ISM15_Shell_2(275_H)<br>CM_16_1(220_CB_3) | 1<br>1 | 790x275x600 | 59.1 | 56 |
| VCB15_Shell2_16F(CB_17.5_31.5_2000_275_1_60_No) | ISM15_Shell_2(275_H)<br>CM_16_1(60_CB_3)<br>CBkit_Shell15_1(310) | 1<br>1<br>1 | 790x275x800 | 68.4 | 64.9 |
| VCB15_Shell2_16F(CB_17.5_31.5_2000_275_1_220_No) | ISM15_Shell_2(275_H)<br>CM_16_1(220_CB_3)<br>CBkit_Shell15_1(310) | 1<br>1<br>1 | 790x275x800 | 68.4 | 64.9 |
| VCB25_LD1_16F(CB_17.5_16_800_210_1_60_No) | ISM25_LD_1(210_S)<br>CM_16_1(60_CB_4) | 1<br>1 | 645x290x550 | 39.1 | 37 |
| VCB25_LD1_16F(CB_17.5_16_800_210_1_220_No) | ISM25_LD_1(210_S)<br>CM_16_1(220_CB_4) | 1<br>1 | 645x290x550 | 39.1 | 37 |
| VCB25_LD1_16F(CB_24_16_800_210_1_60_No) | ISM25_LD_1(210_S)<br>CM_16_1(60_CB_4)<br>CBkit_Ins_3 | 1<br>1<br>3 | 645x290x550 | 39.7 | 37.6 |
| VCB25_LD1_16F(CB_24_16_800_210_1_220_No) | ISM25_LD_1(210_S)<br>CM_16_1(220_CB_4)<br>CBkit_Ins_3 | 1<br>1<br>3 | 645x290x550 | 39.7 | 37.6 |
| VCB25_LD1_16F(CB_24_12.5_630_210_1_60_DY800) | ISM25_<br>LD_1(210_G_1)<br>CM_16_1(60_CB_4) | 1<br>1 | 645x290x550 | 39.1 | 37 |
| VCB25_LD1_16F(CB_24_16_800_275_1_60_No) | ISM25_LD_1(275_S)<br>CM_16_1(60_CB_4)<br>CBkit_Ins_3 | 1<br>1<br>3 | 775x290x550 | 41.7 | 39.6 |
| VCB25_LD1_16F(CB_24_16_800_275_1_220_No) | ISM25_LD_1(275_S)<br>CM_16_1(220_CB_4)<br>CBkit_Ins_3 | 1<br>1<br>3 | 775x290x550 | 41.7 | 39.6 |
| VCB25_LD2_16F (CB_24_16_630_150_1_60_No) | ISM25_LD_2(1)<br>CM_16_1(60_CB_4) | 1<br>1 | 645x290x550 | 38.1 | 36 |
| VCB25_LD2_16F (CB_24_16_630_150_1_220_No) | ISM25_LD_2(1)<br>CM_16_1(220_CB_4) | 1<br>1 | 645x290x550 | 38.1 | 36 |
| VCB25_LD2_16F (CB_24_16_630_150_2_60_No) | ISM25_LD_2(2)<br>CM_16_1(60_CB_4) | 1<br>1 | 645x330x550 | 40.1 | 38 |
| VCB25_LD2_16F (CB_24_16_630_150_2_220_No) | ISM25_LD_2(2)<br>CM_16_1(220_CB_4) | 1<br>1 | 645x330x550 | 40.1 | 38 |
| VCB25_LD3_16F(CB_24_16_800_NA_1_60_No) | ISM25_LD_3<br>CM_16_1(60_CB_5)<br>CBkit_Ins_3 | 1<br>1<br>1 | 645x290x550 | 18.3 | 15.2 |
| VCB25_LD3_16F(CB_24_16_800_NA_1_220_No) | ISM25_LD_3<br>CM_16_1(220_CB_5)<br>CBkit_Ins_3 | 1<br>1<br>1 | 645x290x550 | 18.3 | 15.2 |

# Appendix 2.
# Overall drawings

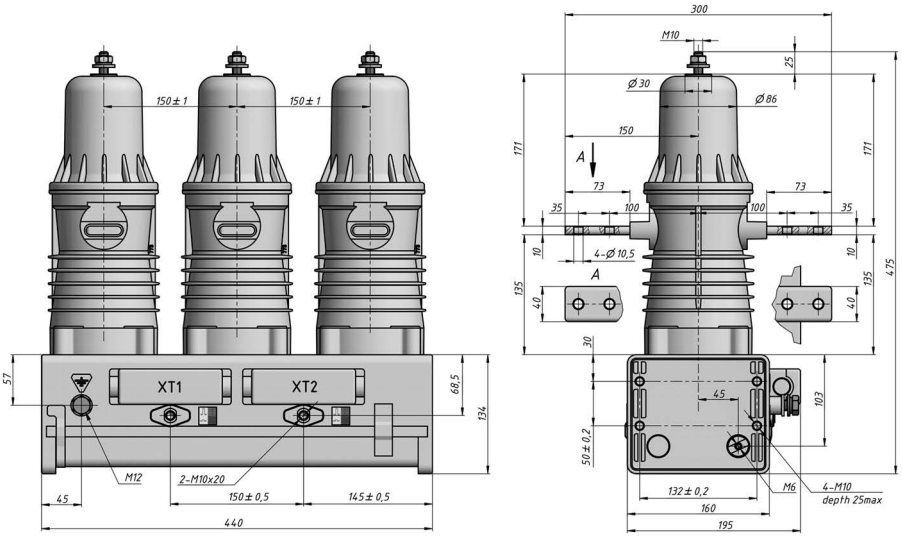
# Dimensions of Indoor Switching Modules



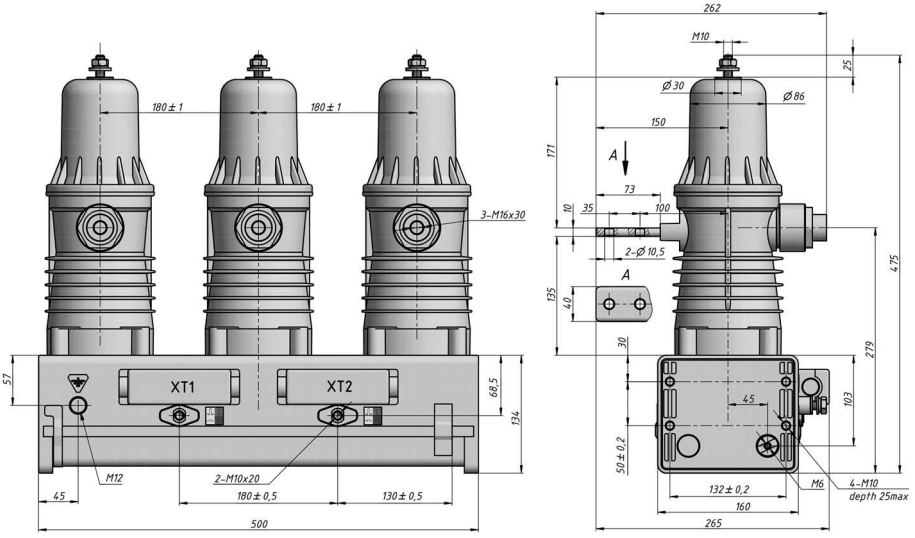

***ISM15_LD_1(67),***
***PCD 150 mm***
***Weight: 34 kg***



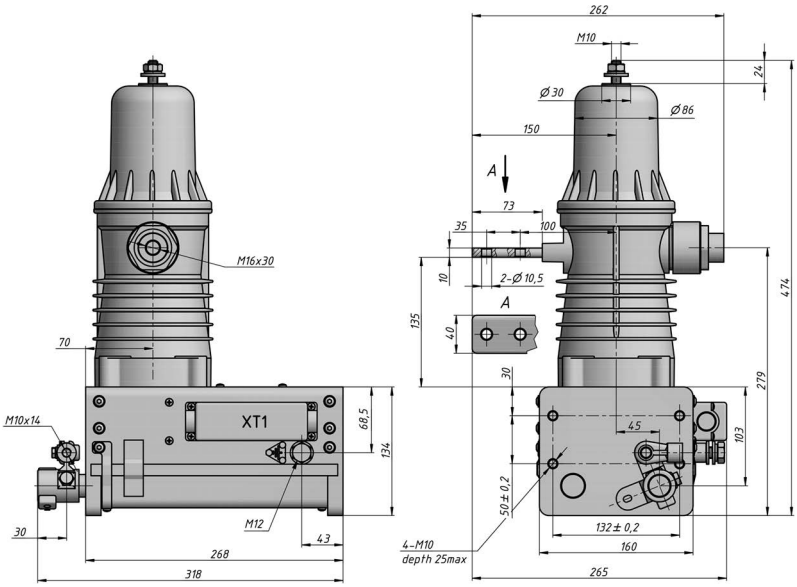

***ISM15_LD_1(55),***
***PCD 210 mm***
***Weight: 36 kg***



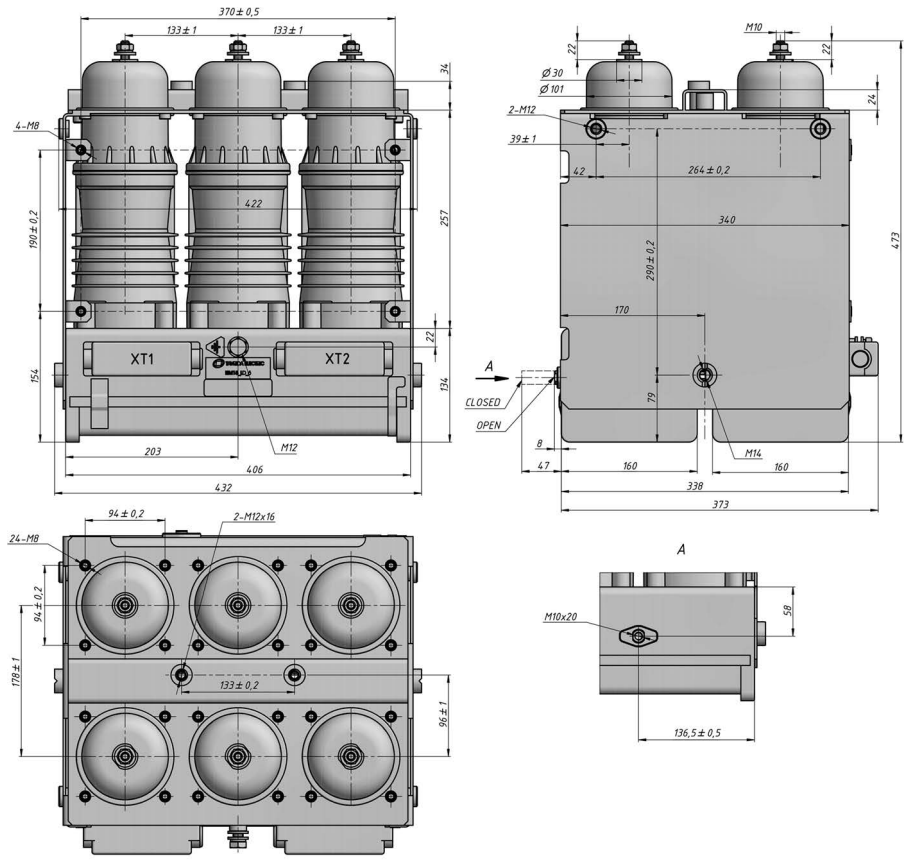

***ISM15_LD_1(80), two lower terminals (continuous busbar),***
***PCD 150 mm***
***Weight: 36 kg***



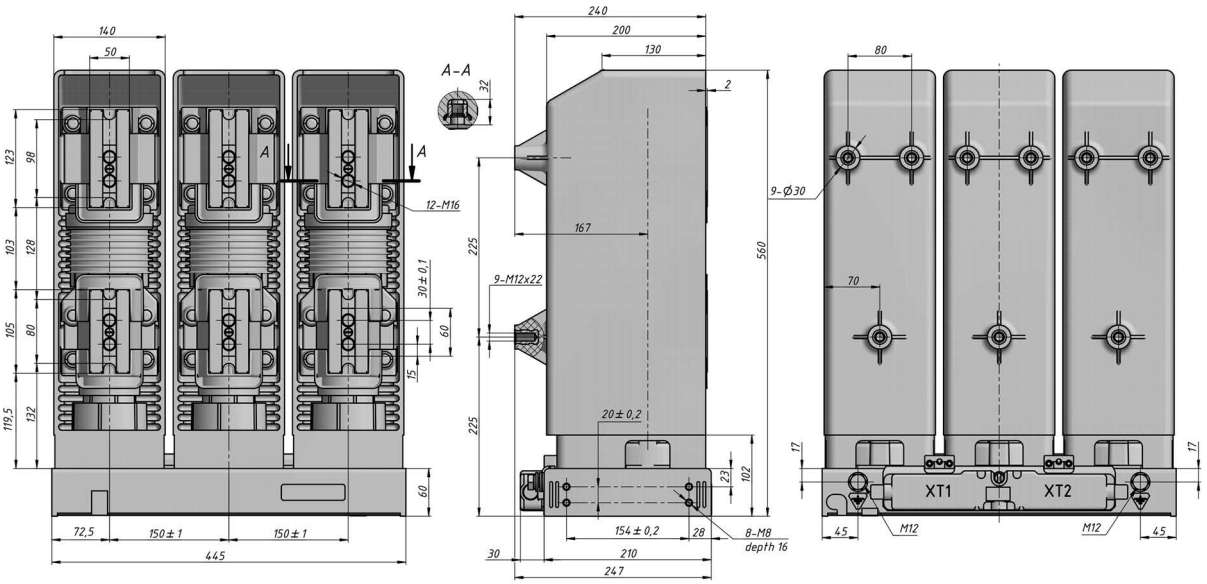

***ISM15_LD_1(90),***
***PCD 180 mm***
***Weight: 36 kg***



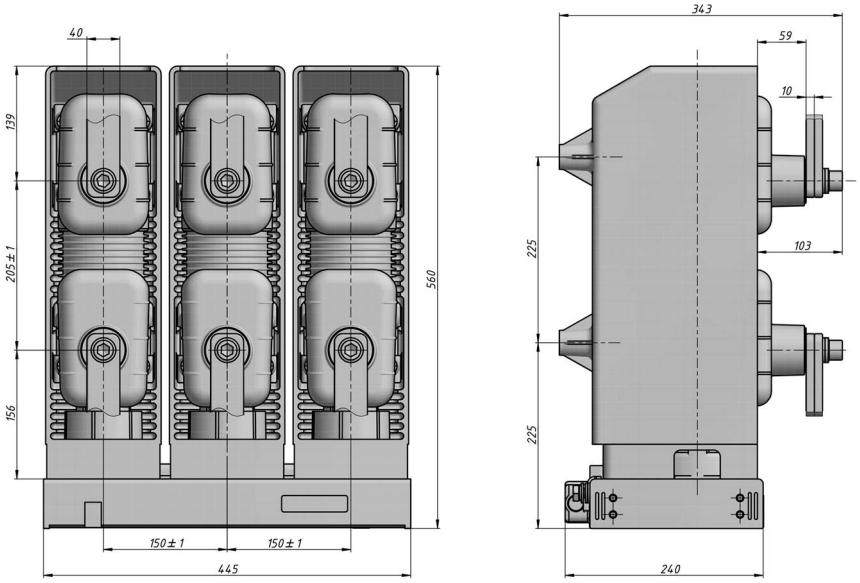

***ISM15_LD_3,***
***Weight: 13 kg***




***ISM15_LD_6,***
***PCD 133 mm***
***Weight: 55 kg***

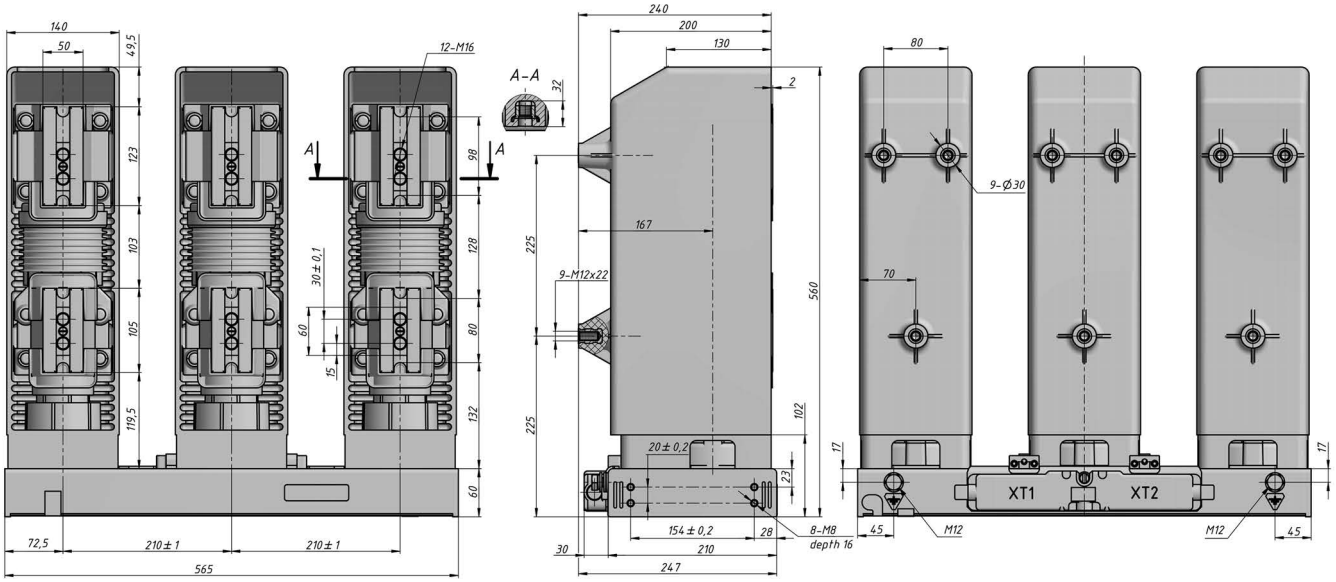



***ISM15_Shell_2(150_L),***
***PCD 150 mm,***
***Weight: 51 kg***

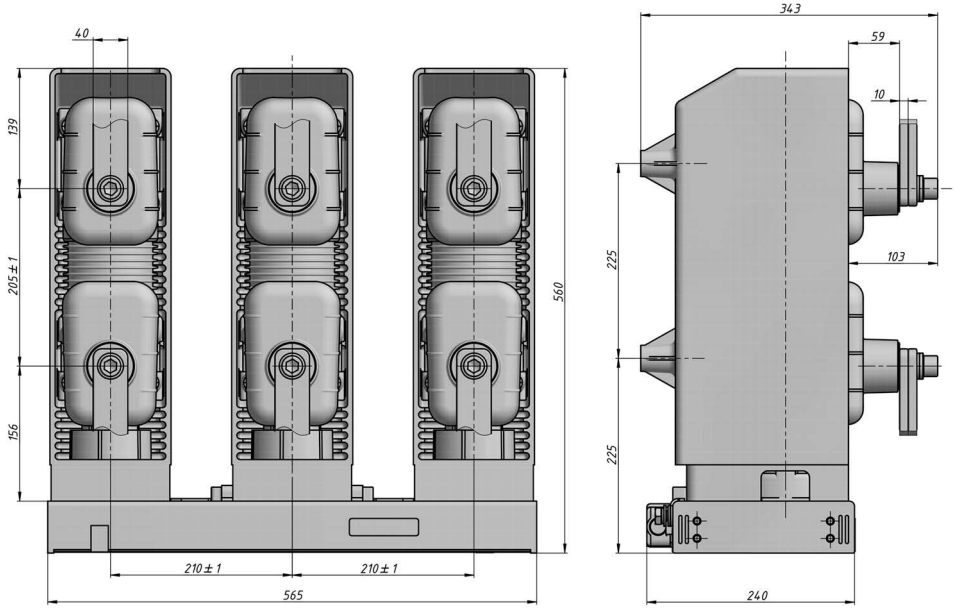



***ISM15_Shell_2(150_L) with CBkit_Shell15_1(205) installed*,***
***PCD 150 mm,***
***Weight: 59,5 kg***

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

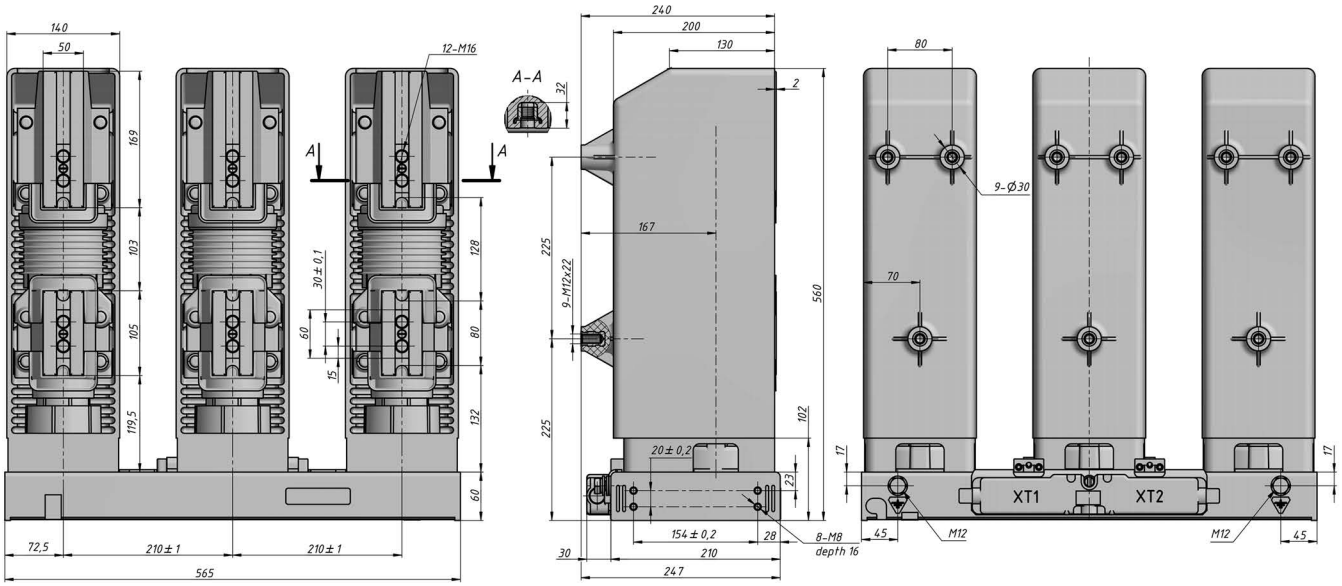



***ISM15_Shell_2(210_L),***
***PCD 210 mm,***
***Weight: 52 kg***

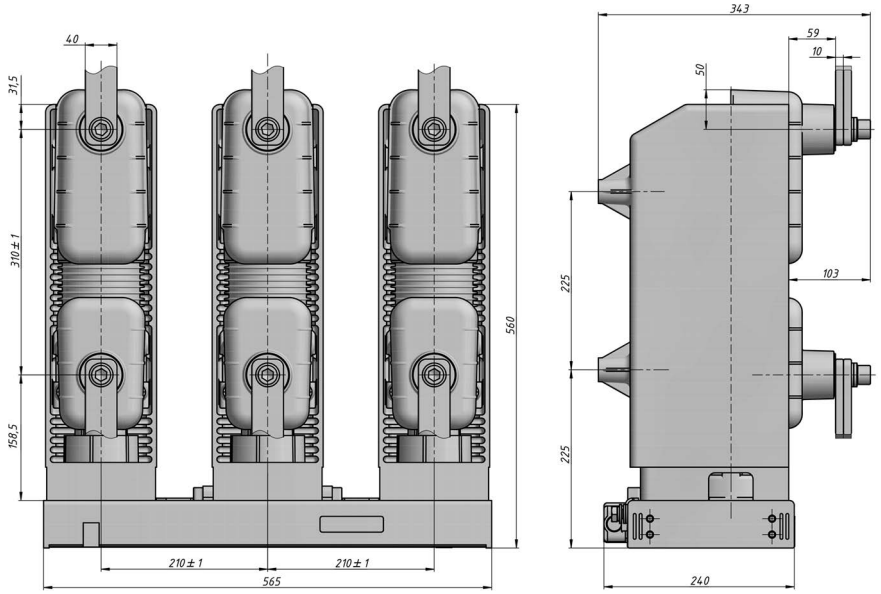



***ISM15_Shell_2(210_L) with CBkit_Shell15_1(205) installed*,***
***PCD 210 mm,***
***Weight: 60,5 kg***

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

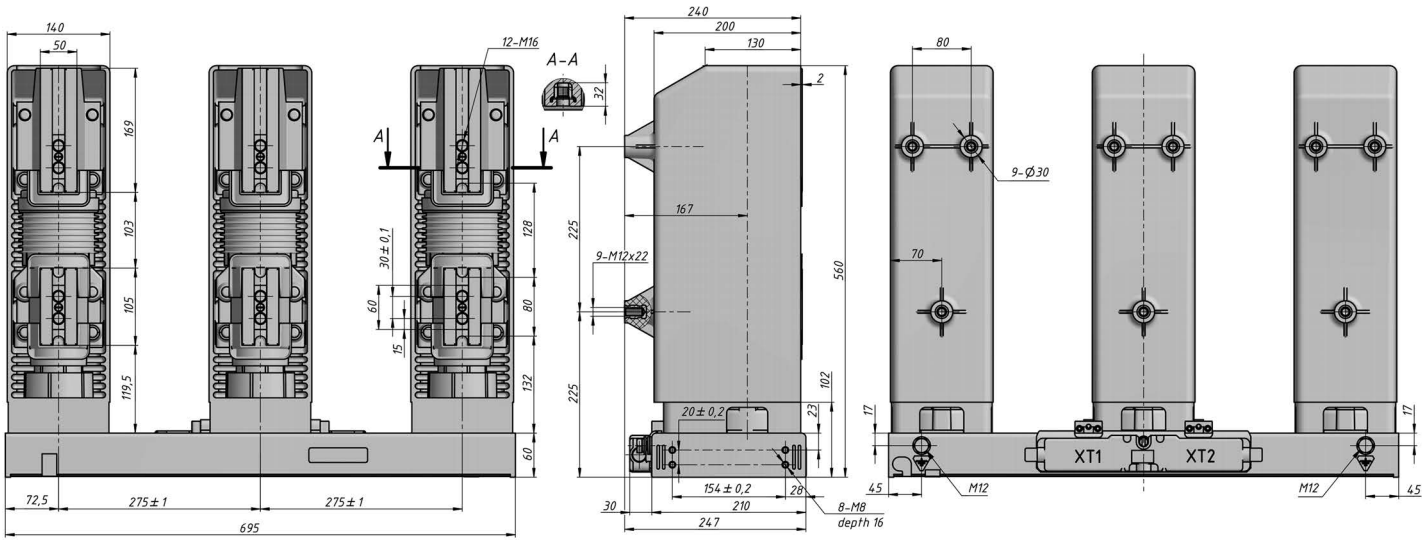



***ISM15_Shell_2(210_H),***
***PCD 210 mm,***
***Weight: 53 kg***

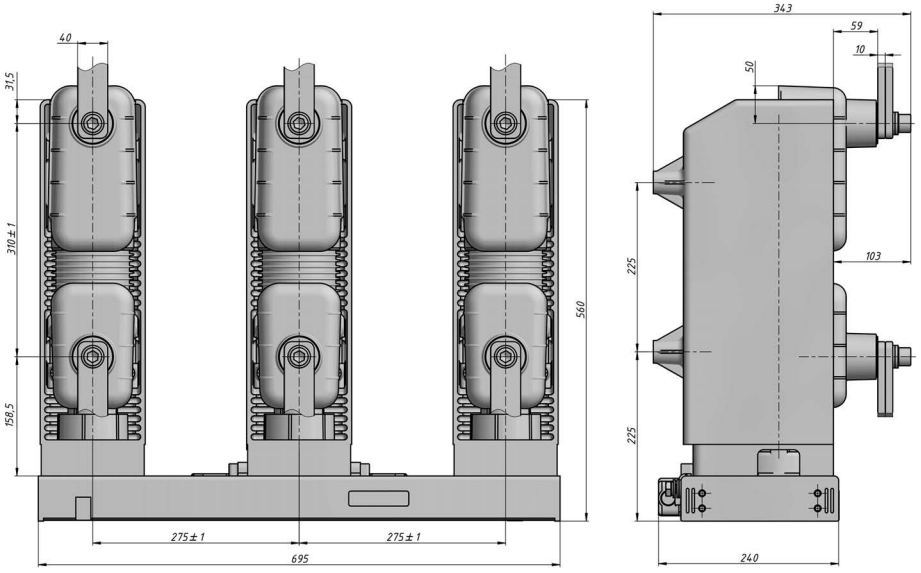



***ISM15_Shell_2(210_H) with CBkit_Shell15_1(310) installed*,***
***PCD 210 mm,***
***Weight: 61,5 kg***

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

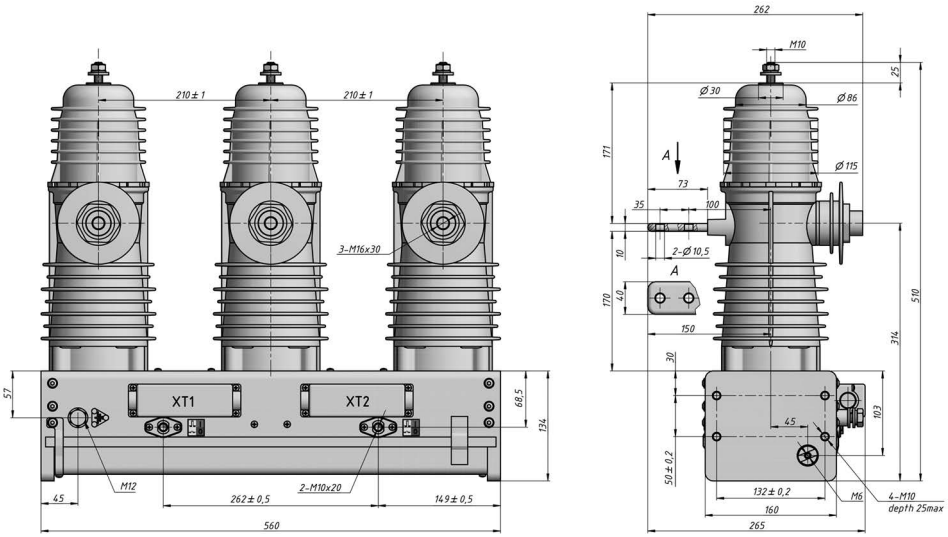



***ISM15_Shell_2(275_H),***
***PCD 275 mm,***
***Weight: 55 kg***

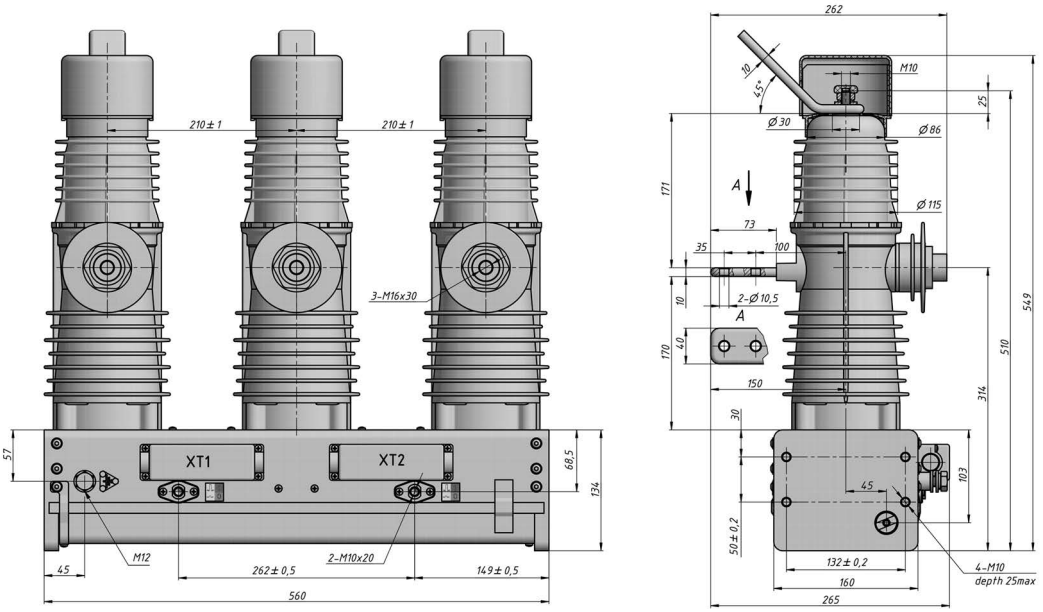



***ISM15_Shell_2(275_H) with CBkit_Shell15_1(310) installed*,***
***PCD 275 mm,***
***Weight: 63,5 kg***

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

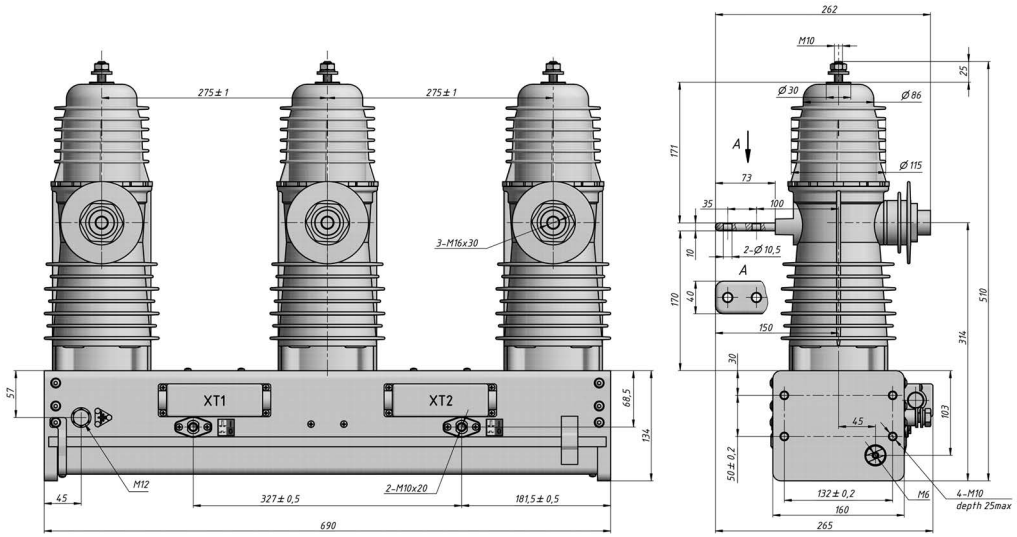



***ISM25_LD_1(210_Par2),***
***PCD 210 mm***
***Weight: 36 kg***

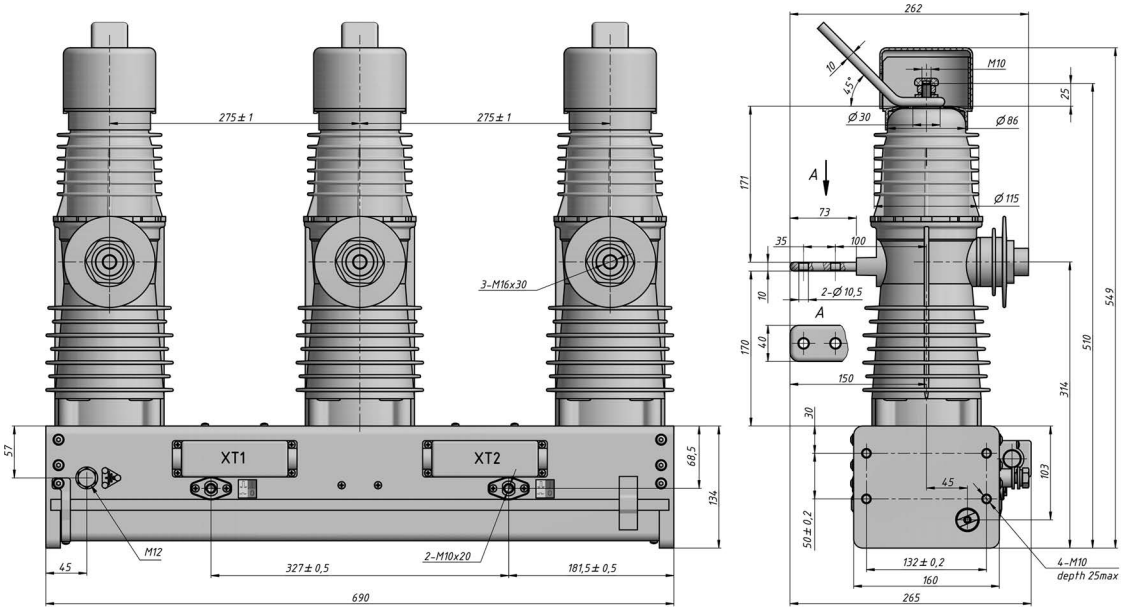



***ISM25_LD_1(210_Par2) with CBkit_Ins_3 installed*,***
***PCD 210 mm,***
***Weight: 36,5 kg***

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

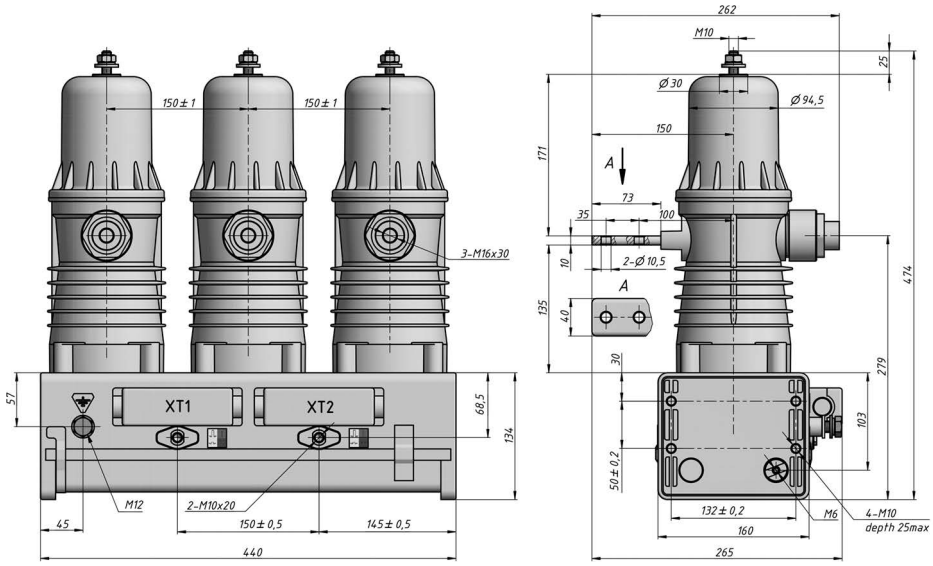



***ISM25_LD_1(275_S),***
***PCD 275 mm***
***Weight: 38 kg***

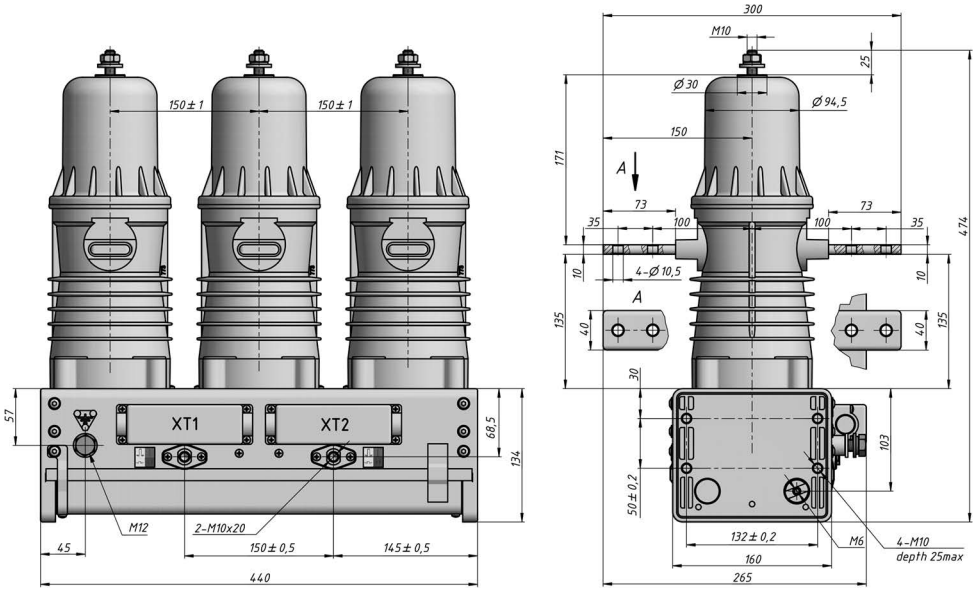



***ISM25_LD_1(275_S) with CBkit_Ins_3 installed*,***
***PCD 275 mm,***
***Weight: 38,5 kg***

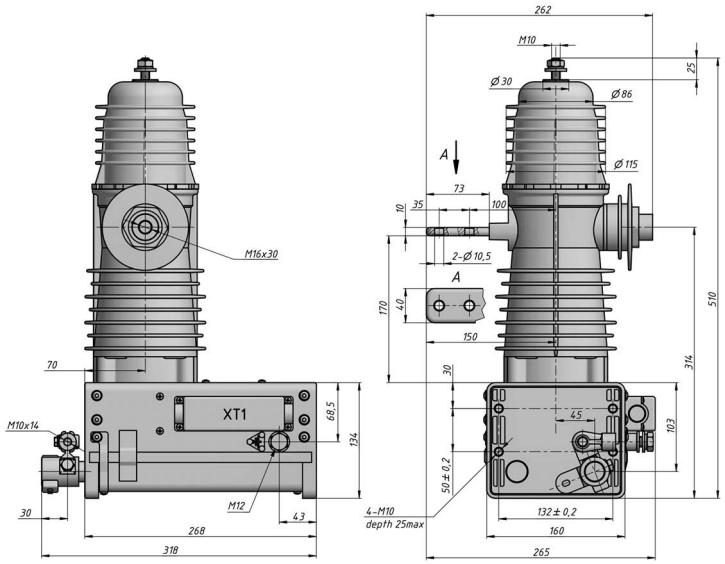
****- upper busbars shown for reference and are not supplied.***



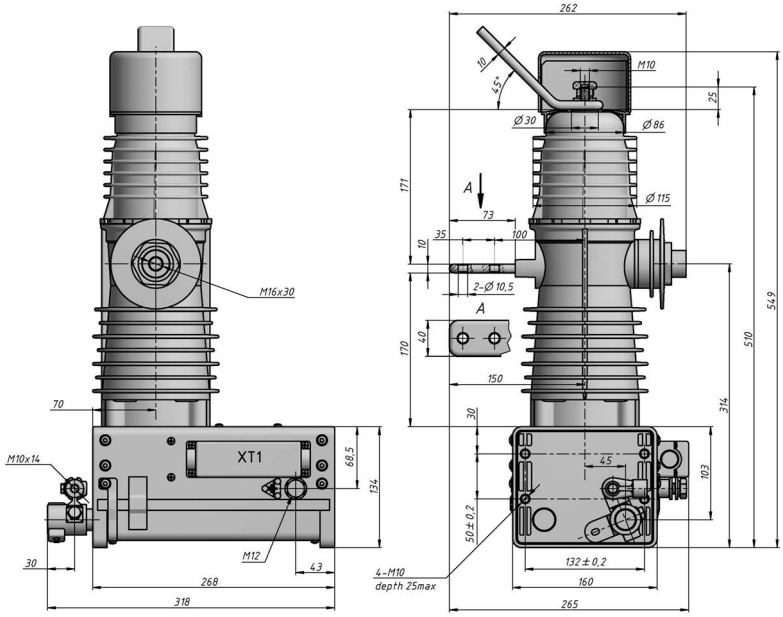

***ISM25_LD_2(1),***
***PCD 150 mm***
***Weight: 35 kg***




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



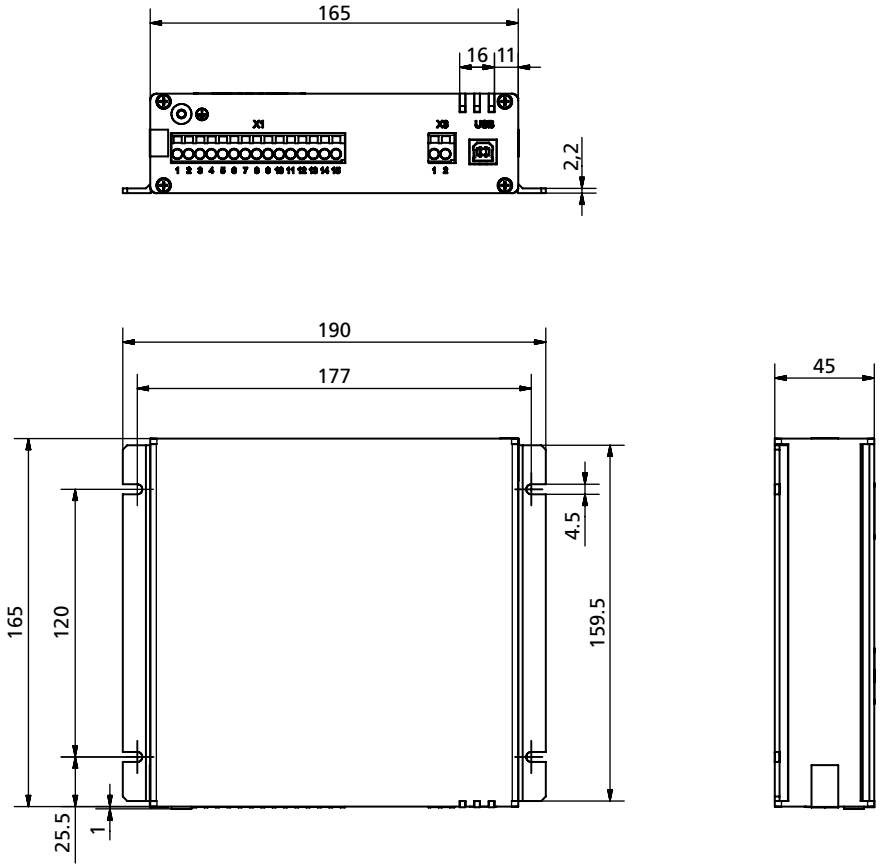

***ISM25_LD_3,***
***Weight: 14 kg***




***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

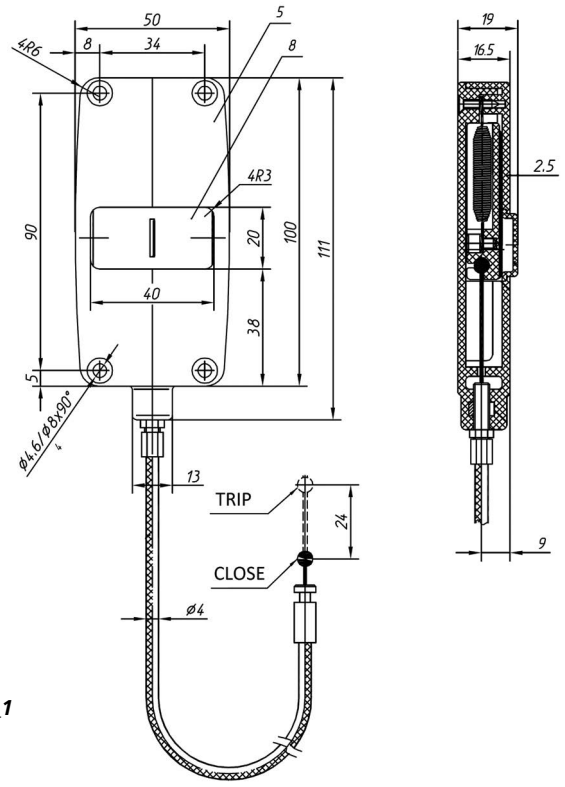



***CM_16_1(Par1_CB_Par3)***

***Weight: 1 kg***

# Dimensions of accessories

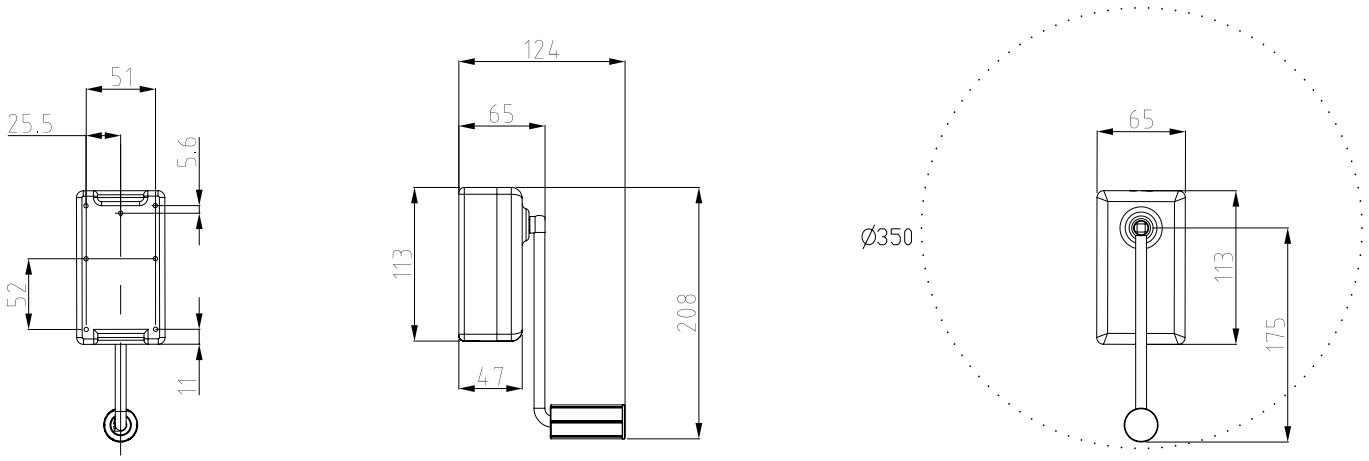
## Dimensions of Position Indicator




***Rope length L=1m***

***Unit_PosInd_3 with connected CBcomp_RelCable_1***

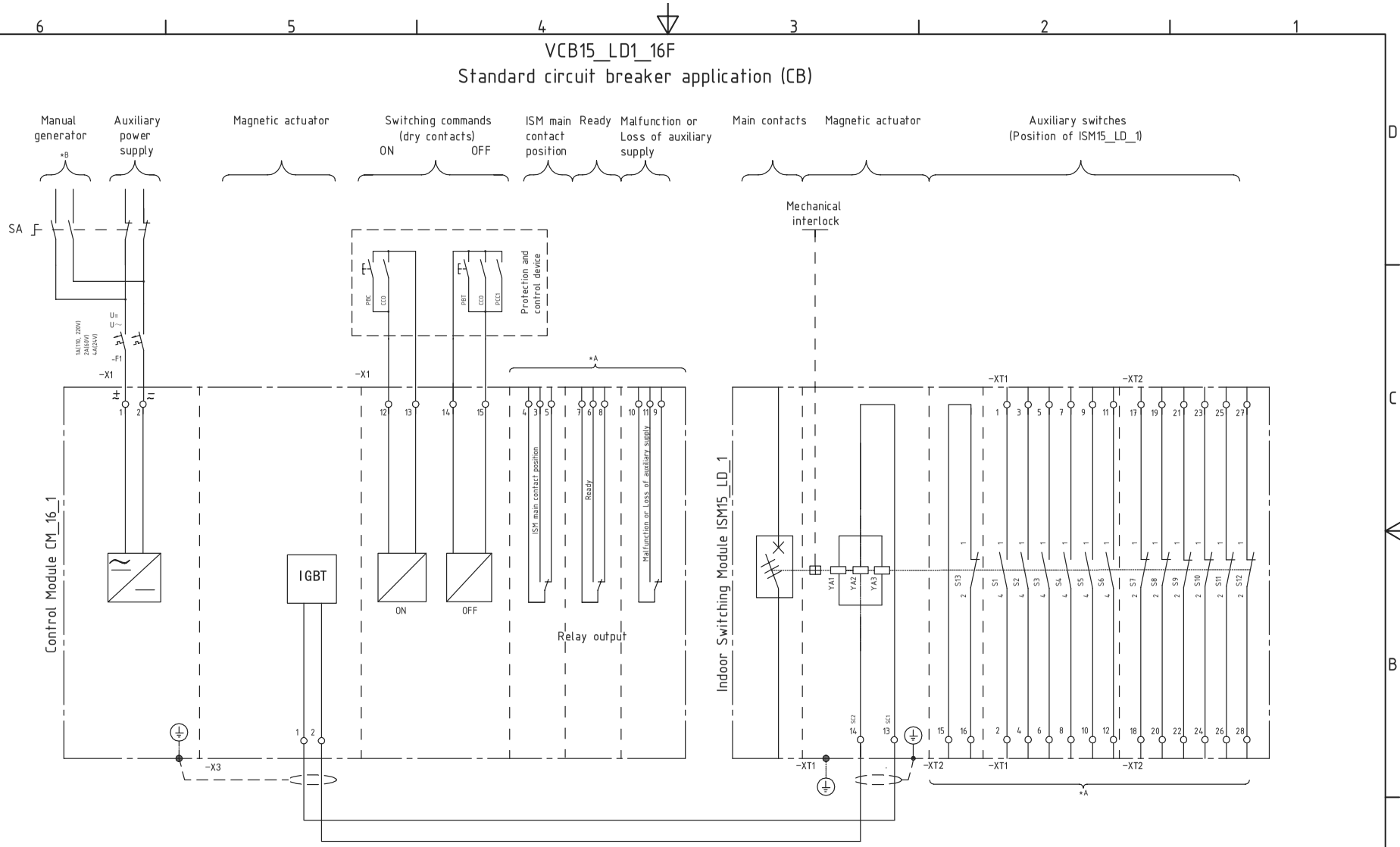
## Dimensions of Manual Generator




***CBunit_ManGen_1, CBunit_ ManGen_2***

# Appendix 3.
# Secondary schemes

# VCB15_LD1_16F
## Standard circuit breaker application (CB)




Legend:

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

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

Projection

Dimensions in mm

| Designed by | Checked by | Approved by | Date | Filename | Date | Weight | Scale |
|---|---|---|---|---|---|---|---|
| I.Matlakova | A.Migunov | A.Migunov | 30.11.2015 | TES_VCB15_LD1_16FED4 | 30.11.2015 | - | |

TAVRIDA ELECTRIC TES

Switching module
Electrical Connection Diagram

| TES_VCB15_LD1_16FED4 | Edition | Sheet |
|---|---|---|
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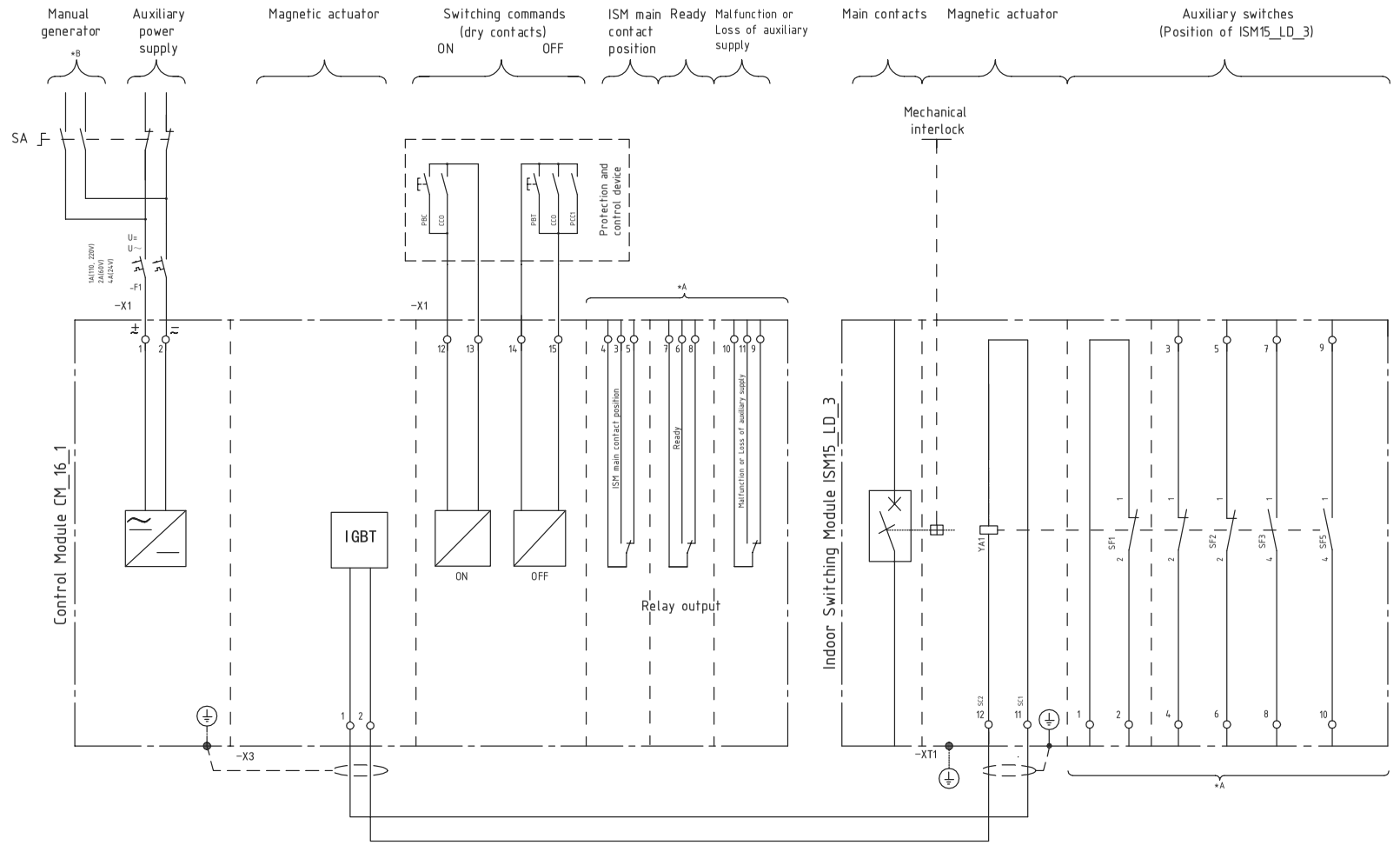
# VCB15_LD3_16F
## Standard circuit breaker application (CB)




Legend:

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

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

Projection

Dimensions in mm

| Designed by | Checked by | Approved by | Date | Filename | Date | Weight | Scale |
|---|---|---|---|---|---|---|---|
| I.Matlakova | A.Migunov | A.Migunov | 01.12.2015 | TES_VCB15_LD3_16FED4 | 01.12.2015 | - | |

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

| TES_VCB15_LD3_16FED4 | Edition | Sheet |
|---|---|---|
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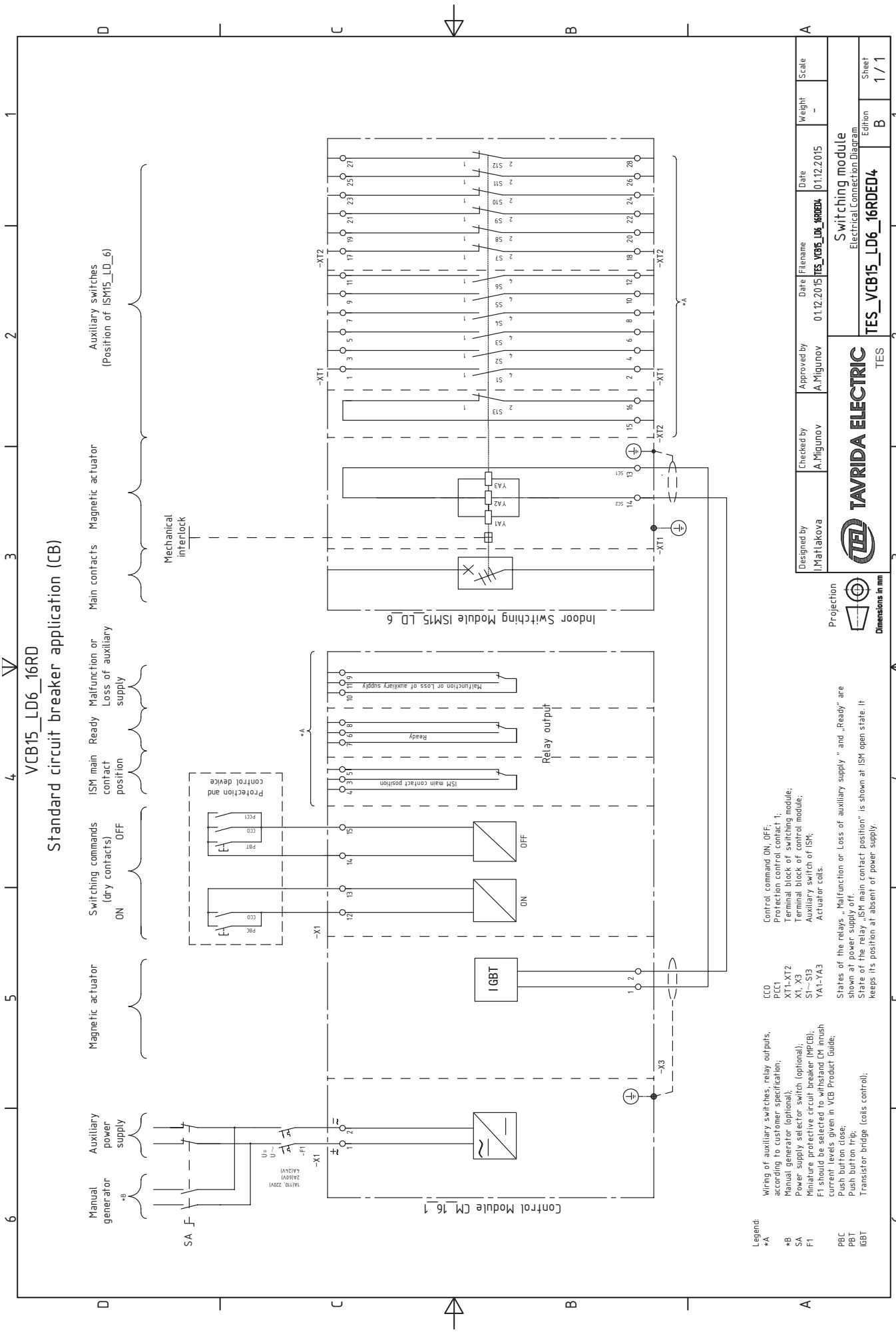
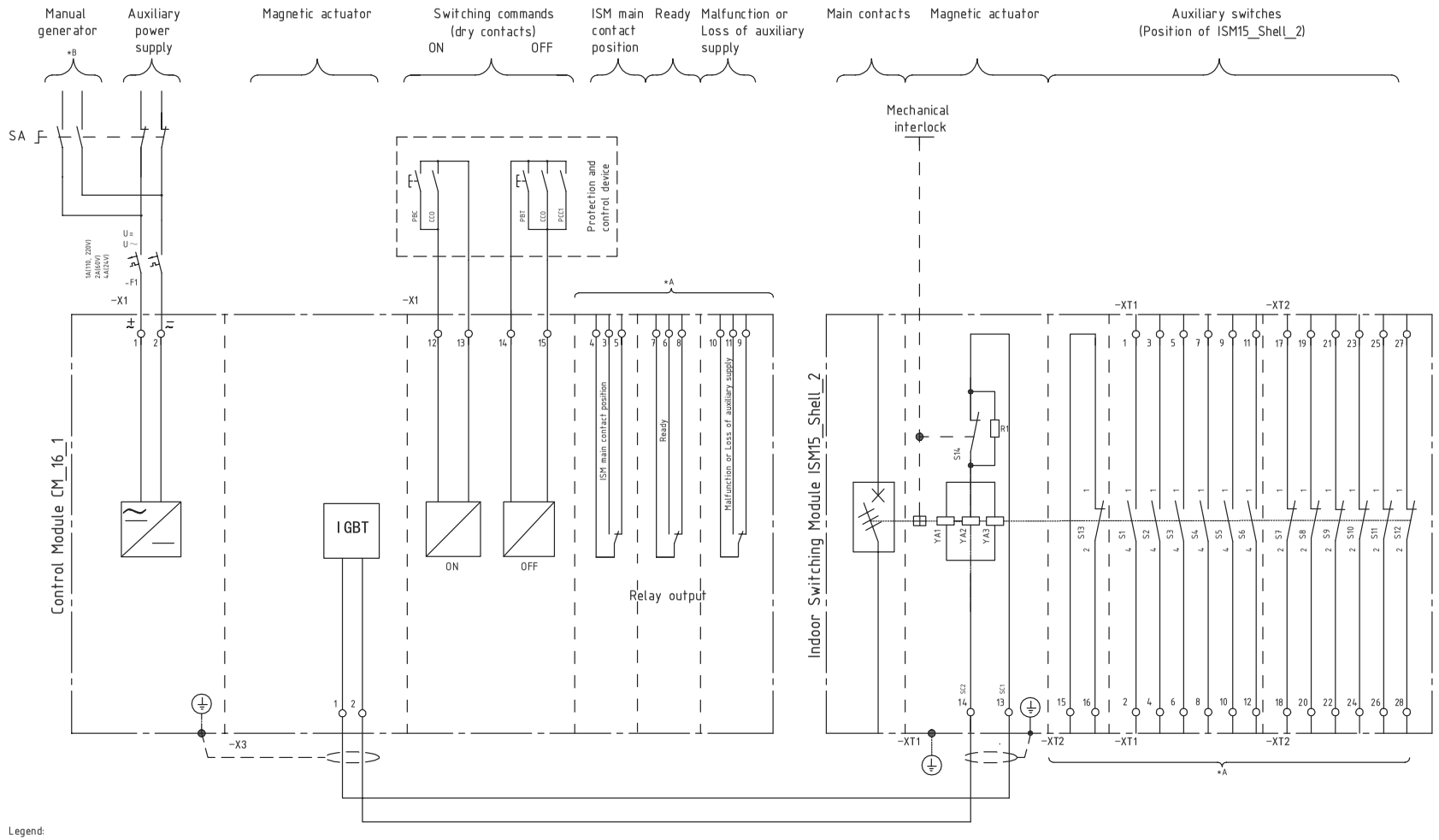

VCB15_LD6_16RD
Standard circuit breaker application (CB)
Manual generator
Auxiliary power supply
Magnetic actuator
Switching commands (dry contacts)
ON
OFF
ISM main contact position
Ready
Malfunction or Loss of auxiliary supply
Auxiliary switches (Position of ISM15_LD_6)
Main contacts
Magnetic actuator
Mechanical interlock
Protection and control device
Relay output
Malfunction or Loss of auxiliary supply
Ready
ISM main contact position
IGBT
Control Module CM_16_1
Indoor Switching Module ISM15_LD_6
Designed by I.Matlakova
Checked by A.Migunov
Approved by A.Migunov
Date 01.12.2015
Filename TES_VCB15_LD6_16RDED4
Date 01.12.2015
Weight -
Scale
Switching module
Electrical Connection Diagram
TES_VCB15_LD6_16RDED4
Edition B
Sheet 1 / 1
TAVRIDA ELECTRIC
TES
Projection
Dimensions in mm
Legend:
*A Wiring of auxiliary switches, relay outputs, according to customer specification;
*B Manual generator (optional);
SA Power supply selector switch (optional);
F1 Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC Push button close;
PBT Push button trip;
IGBT Transistor bridge (coils control);
CCO Control command ON, OFF;
PCC1 Protection control contact 1;
XT1–XT2 Terminal block of switching module;
X1, X3 Terminal block of control module;
S1—S13 Auxiliary switch of ISM;
YA1–YA3 Actuator coils.
States of the relays „Malfunction or Loss of auxiliary supply " and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.

# VCB15_Shell2_16F
## Standard circuit breaker application (CB)




Legend:

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

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

Projection

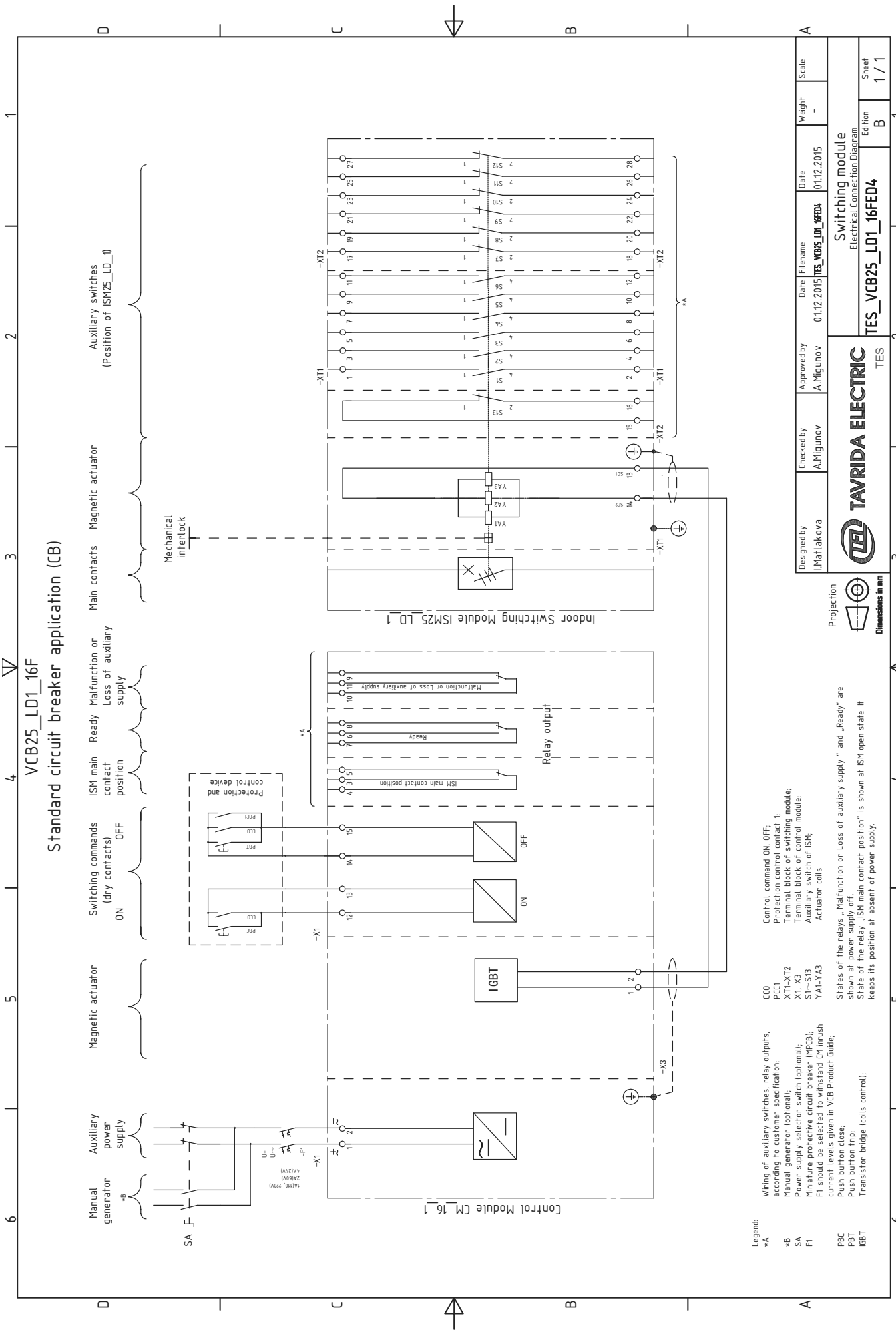
Dimensions in mm

| Designed by | Checked by | Approved by | Date | Filename | Date | Weight | Scale |
|---|---|---|---|---|---|---|---|
| I.Matlakova | A.Migunov | A.Migunov | 01.12.2015 | TES_VCB15_Shell2_16FED4 | 01.12.2015 | - | |

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

| TES_VCB15_Shell2_16FED4 | Edition | Sheet |
|---|---|---|
| | B | 1 / 1 |


VCB25_LD1_16F
Standard circuit breaker application (CB)
Manual generator
Auxiliary power supply
Magnetic actuator
Switching commands (dry contacts) ON
OFF
ISM main contact position
Ready
Malfunction or Loss of auxiliary supply
Main contacts
Magnetic actuator
Auxiliary switches (Position of ISM25_LD_1)
Mechanical interlock
Protection and control device
Relay output
ISM main contact position
Ready
Malfunction or Loss of auxiliary supply
IGBT
ON
OFF
Control Module CM_16_1
Indoor Switching Module ISM25_LD_1
Legend:
*A Wiring of auxiliary switches, relay output's, according to customer specification;
*B Manual generator (optional);
SA Power supply selector switch (optional);
F1 Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC Push button close;
PBT Push button Trip;
IGBT Transistor bridge (coils control);
CCO Control command ON, OFF;
PCC1 Protection control contact 1;
XT1-XT2 Terminal block of switching module;
X1, X3 Terminal block of control module;
S1—S13 Auxiliary switch of ISM;
YA1-YA3 Actuator coils.
States of the relays „Malfunction or Loss of auxiliary supply" and „Ready" are shown at power supply off.
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power supply.
Designed by I.Matlakova
Checked by A.Migunov
Approved by A.Migunov
Date 01.12.2015
Filename TES_VCB25_LD1_16FED4
Date 01.12.2015
Weight -
Scale
TAVRIDA ELECTRIC
TES
TES_VCB25_LD1_16FED4
Switching module
Electrical Connection Diagram
Edition B
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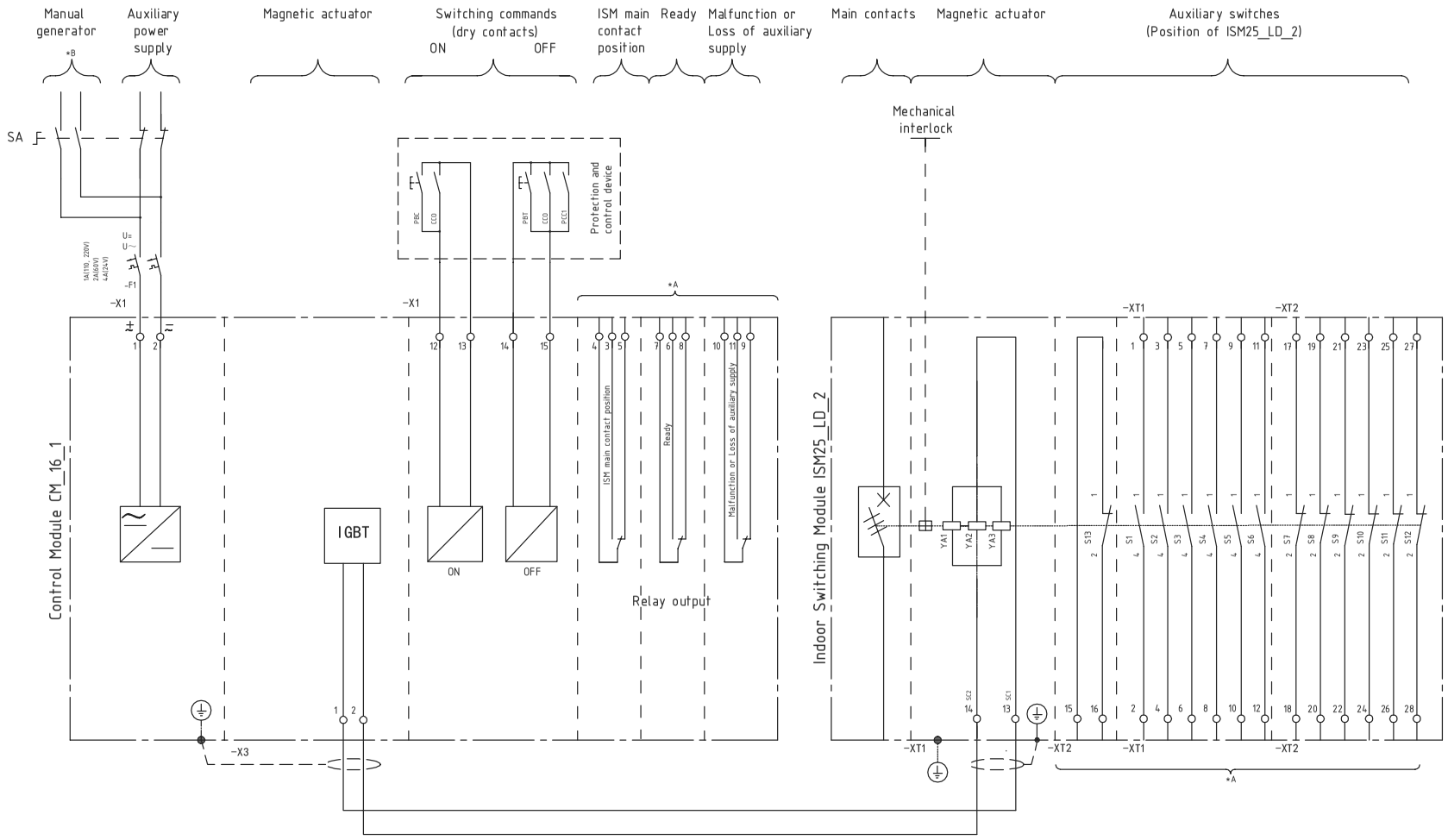
Projection
Dimensions in mm

# VCB25_LD2_16F
## Standard circuit breaker application (CB)




Legend:

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

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

Projection

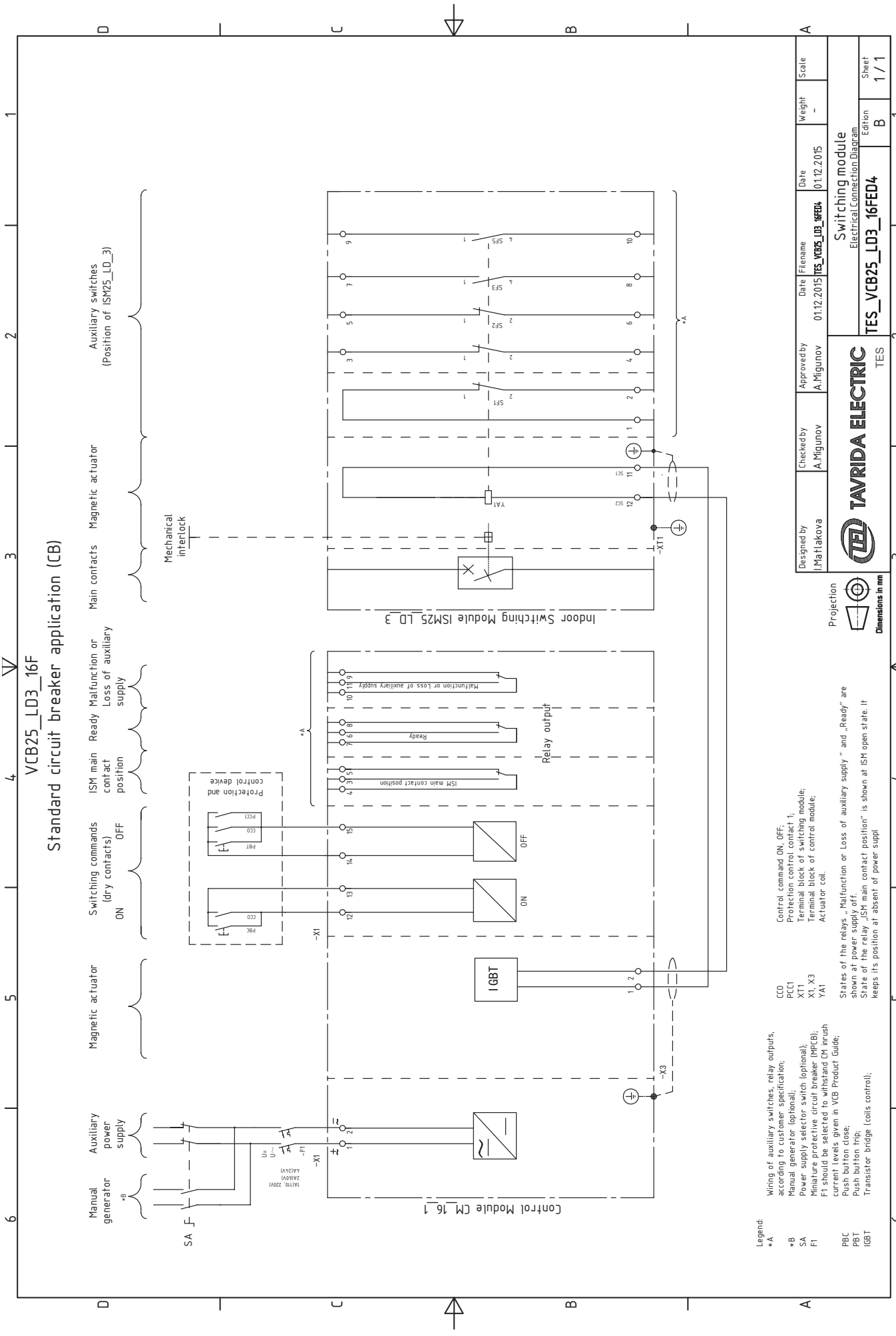
Dimensions in mm

| Designed by | Checked by | Approved by | Date | Filename | Date | Weight | Scale |
|---|---|---|---|---|---|---|---|
| I.Matlakova | A.Migunov | A.Migunov | 01.12.2015 | TES_VCB25_LD2_16FED4 | 01.12.2015 | - | |

TAVRIDA ELECTRIC
TES

Switching module
Electrical Connection Diagram

| TES_VCB25_LD2_16FED4 | Edition | Sheet |
|---|---|---|
| | B | 1 / 1 |


VCB25_LD3_16F
Standard circuit breaker application (CB)
Manual generator
Auxiliary power supply
Magnetic actuator
Switching commands (dry contacts) ON
OFF
ISM main contact position
Ready
Malfunction or Loss of auxiliary supply
Main contacts
Magnetic actuator
Auxiliary switches (Position of ISM25_LD_3)
Mechanical interlock
Protection and control device
Relay output
Malfunction or loss of auxiliary supply
Ready
ISM main contact position
IGBT
ON
OFF
Control Module CM_16_1
Indoor Switching Module ISM25_LD_3
Legend:
*A Wiring of auxiliary switches, relay outputs, according to customer specification;
*B Manual generator (optional);
SA Power supply selector switch (optional);
F1 Miniature protective circuit breaker (MPCB); F1 should be selected to withstand CM inrush current levels given in VCB Product Guide;
PBC Push button close;
PBT Push button trip;
IGBT Transistor bridge (coils control);
CCO Control command ON, OFF;
PCC1 Protection control contact 1;
XT1 Terminal block of switching module;
X1, X3 Terminal block of control module;
YA1 Actuator coil.
States of the relays „ Malfunction or Loss of auxiliary supply " and „Ready" are shown at power supply off;
State of the relay „ISM main contact position" is shown at ISM open state. It keeps its position at absent of power suppl
Projection
Dimensions in mm
Designed by I.Matlakova
Checked by A.Migunov
Approved by A.Migunov
Date 01.12.2015
Filename TES_VCB25_LD3_16FED4
Date 01.12.2015
Weight -
Scale
TAVRIDA ELECTRIC
TES
Switching module
Electrical Connection Diagram
TES_VCB25_LD3_16FED4
Edition B
Sheet 1 / 1

# List of changes

| Documents version | Change Date | Scope of change | Reason of change | Version author |
|---|---|---|---|---|
| 1.0 | 25.08.2015 | Document creation | - | may |
| 1.1 | 01.10.2015 | Document correction according to changes in the TES development procedure | TES MD request | may |
| 1.2 | 07.10.2015 | Front page pictures and text correction | TES MD request | may |
| 1.3 | 30.10.2015 | Realy Malfunction functionality is changed from Malfunciton to Malfunciton OR Loss of supply<br>Rated operating sequence is changed to O-0.3s-CO-10s-CO-10s-CO | TEG TD request | may |
| 1.4 | 02.12.2015 | Parameter name "Rated supply voltage of auxiliary circuits" change to "Rated auxiliary supply voltage"<br>Change of relay 3 name from „Malfunction" to „Malfunction or Loss of auxiliary supply" and adding for relay „ISM main contact position" detailed description of its state change<br>Amendment of Secondary schemes in Appendix 3 | TES ED and TES TD requests | may |
| 1.5 | 25.01.2016 | Change of relays 1 and 2 contacts in the Table 10 from NC to NO and vice-versa | Mystype correction | may |
| 1.6 | 05.05.2016 | Adding of comment that CM's relay can have incorrect state in case CM is not operable due to absence of auxiliary supply;<br>Adding of description that USB port is not used in service;<br>Adding of CBkit_Interlock_2 in scope of optional kits. | Mystype correction and TES MD request | may |
| 1.7 | 09.11.2016 | Photos on the page 45 were changed | There was obsolete ISM15_Shell_1 on the photos | may |
| | | | | |
| | | | | |

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