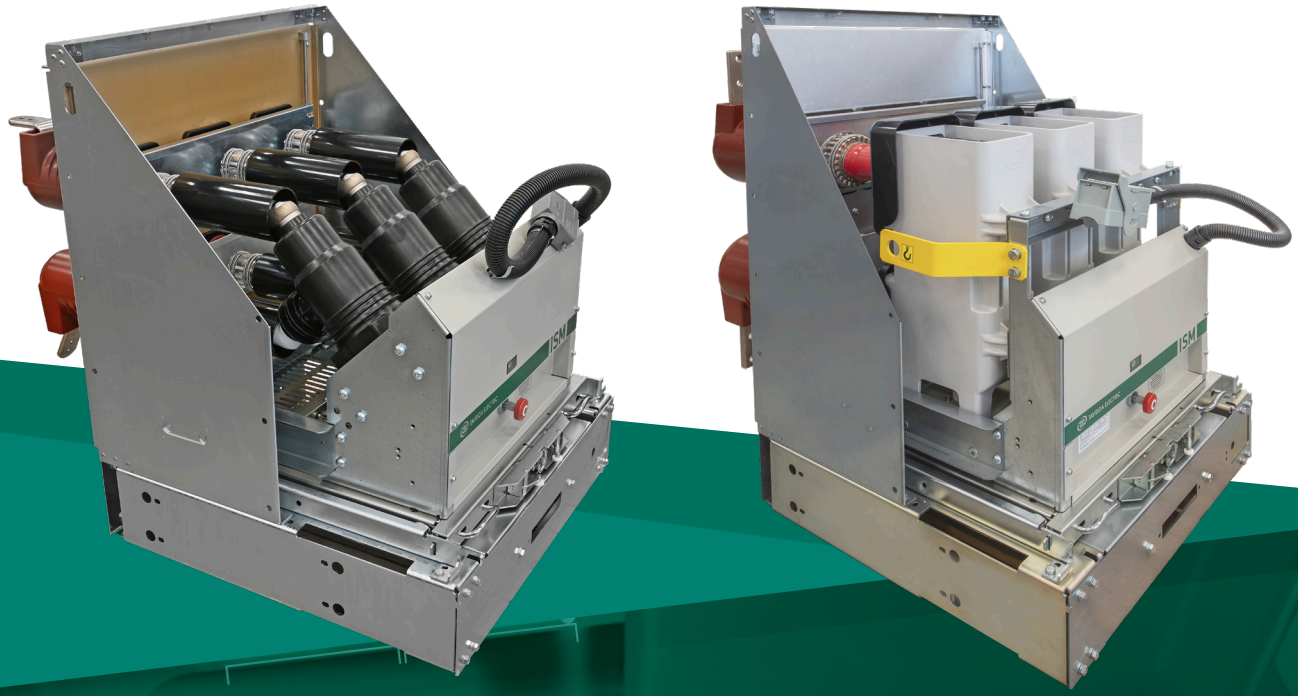
TAVRIDA ELECTRIC
Excellence in Engineering

WITHDRAWABLE VCB

VACUUM CIRCUIT BREAKER

15 kV, ...31,5 kA, ...1250 A



TECHNICAL MANUAL

VERSION 2.2

Contents

1. Introduction

This Technical Manual describes the Withdrawable Vacuum Circuit Breakers manufactured by Tavrida Electric.

Tavrida Electric MD Circuit Breakers are designed for rated voltages up to 15 kV.

Withdrawable Vacuum Circuit Breakers are designed for indoor installation in air-insulated switchgear panels and are intended to perform switching operations in network rated and faulty modes.

The breakers consist of the following main components:

- Indoor Switching Module (ISM) - The air-insulated ISM incorporates Tavrida Electric vacuum interrupters incorporated in solid dielectric insulator controlled by per phase monostable magnetic actuators. 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 Withdrawable Vacuum Circuit Breakers application properties.

This manual 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.

Other technical documents which cover the product:

Document name	Target audience	Purpose of the document
Routine Test Certificate	Customer procurement service	Provide information on supplied equipment serial numbers.

1.1 Abbreviations

AC	Actuator Coil
AS	Auxiliary Switch
BIL	Basic Insulation Level
EMC	Electromagnetic Compatibility
CM	Control Module
CO	Close - Open Operations Cycle
DOU	Draw-Out Unit
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
52a	Normally Open Contact
52b	Normally Closed Contact
PCD	Phase Center Distance
USB	Universal Serial Bus
VCB	Vacuum Circuit Breaker
VI	Vacuum Interrupter

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.

Interrupting Time

The interrupting 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 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 Technical Manual contains information necessary for the installation, commissioning and operation of the withdrawable vacuum circuit breakers. Please read the Technical Manual carefully before starting and to adhere the instructions and the relevant regulations to ensure the proper use of the withdrawable vacuum circuit breakers. Tavrida Electric will not accept any claims for damages caused by improper usage of the withdrawable vacuum circuit breakers. In case of special configurations, please contact Tavrida Electric prior to usage of the withdrawable vacuum circuit breakers.

1.4 Precautions

- Before selecting the circuit breaker, please check whether the installation place (Contact interfaces, pole centre and terminal centre distances, fixed contact shutters operating mechanism, and the surroundings) is suitable for the withdrawable vacuum circuit breakers.

- 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 withdrawable vacuum circuit breakers certain parts are subject to dangerous voltage. Mechanical parts, also remote-controlled, can move quickly. Failure to comply may result in death, severe personal injury or damage to equipment.

- Pay attention to the hazard statements located throughout the Technical Manual.

- The operating conditions of the withdrawable vacuum circuit breakers shall comply with the technical data specified in the Technical Manual.

- Personnel installing, operating and maintaining the equipment shall be familiar with the Technical Manual and its contents.

1.5 Warranty

Unless otherwise stated in the contract, the warranty period is stated in Standard Warranty Policy. If otherwise agreed to, the contract conditions apply. No warranty is given in the following cases:

a) The warranty period has 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. Product Handling

2.1 Transportation

The VCBs are transported in the original package only. Any kind of transport and combinations thereof are applicable.

Transportation shall be provided in waterproof compartments. If air transportation is used all products shall be transported inside heated, pressurized compartments. Packages with goods shall be handled in accordance with the handling symbols. Loading procedures for VCB package shall be carried out only using forklifts, hoists or cranes. During transportation the VCB must not be subjected to sharp impacts or dropped.

2.2 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 (main contacts in the open position);
- Desiccant must be placed inside the packaging;
- Storage must be dry, well ventilated and the room temperature should be between – 40°C and + 55°C.

Average humidity measured over a 1 year period shall not exceed 75% at 50°C. If the storage term exceeds one year from the production date, it is recommended to perform the procedure of CM 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 CM storage.

2.3 Unpacking and Inspection

2.3.1 Unpacking and Checking the VCB

Before unpacking, check the package 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 VCB.

Unloading procedures for VCB shall be carried out by hoists or cranes only. Methods of lifting the VCB out of the package are shown below and must be strictly followed.

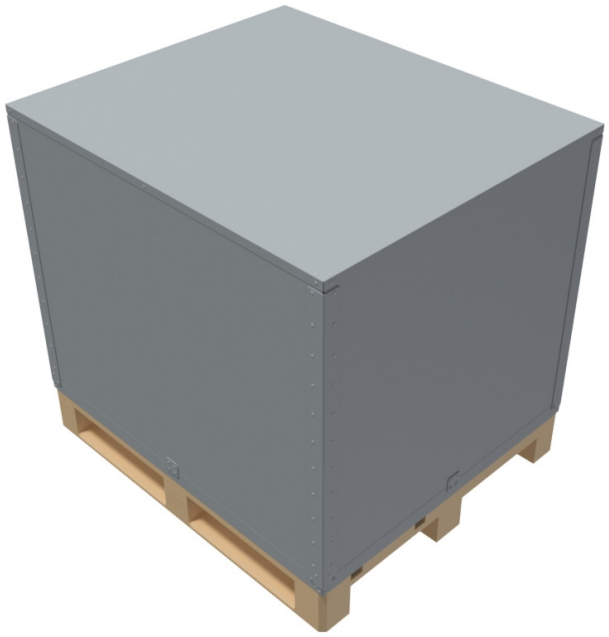


Figure 1
Withdrawable VCB Package

Unscrew the packing metal holder's fastening screws as shown below and remove the package cover

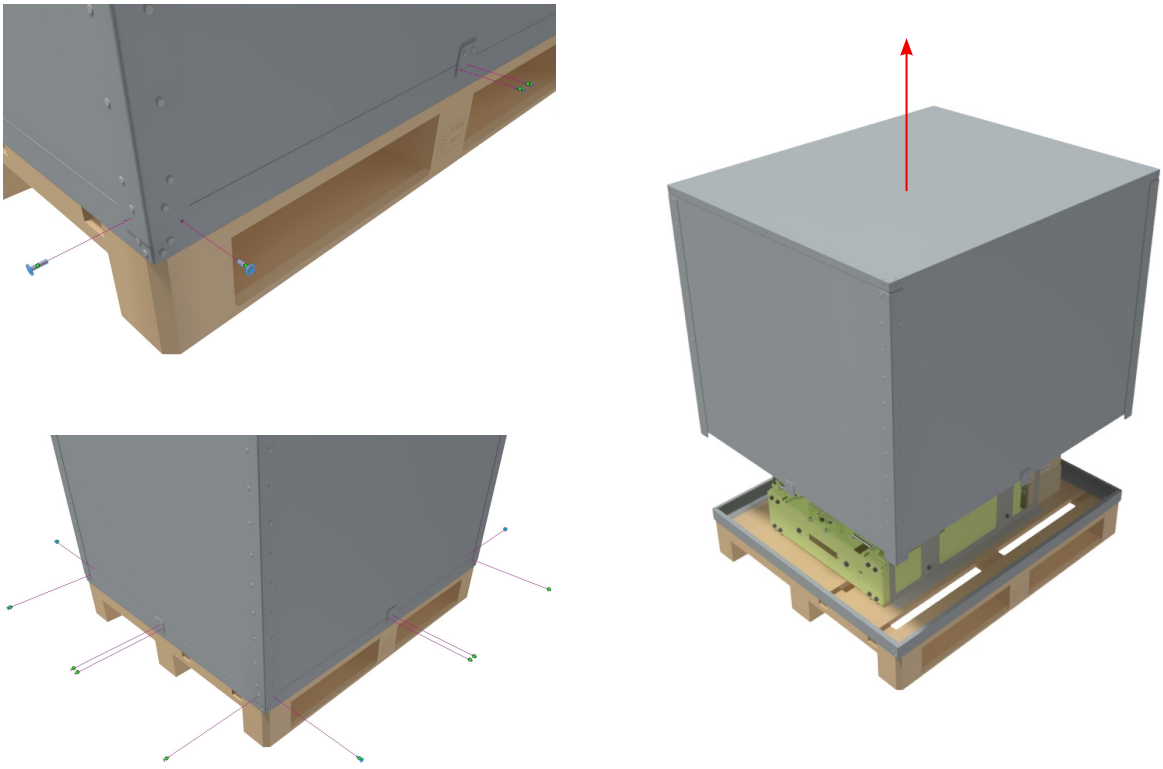
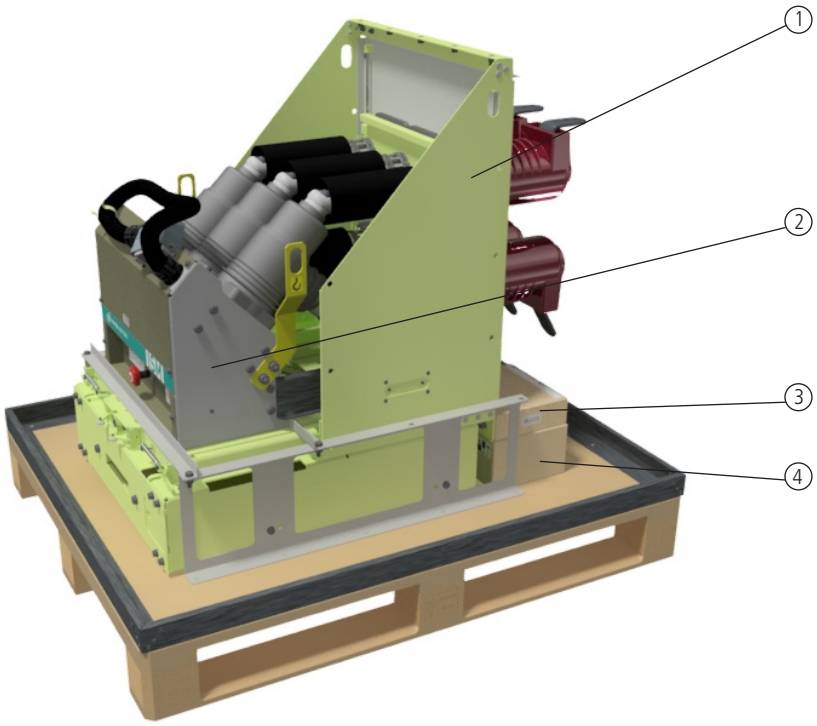
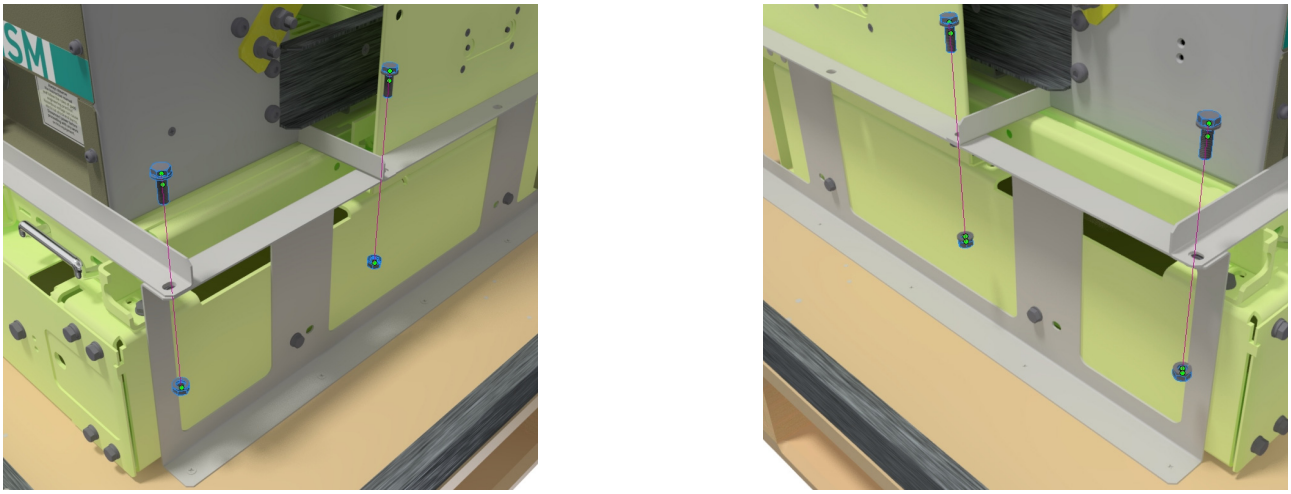


Figure 2
Unpacking of VCB



1. Fixed Parts (Cradle)
2. Withdrawable VCB
3. CM
4. CBkit_Plug_1

Figure 3
VCB Components on the Pallet

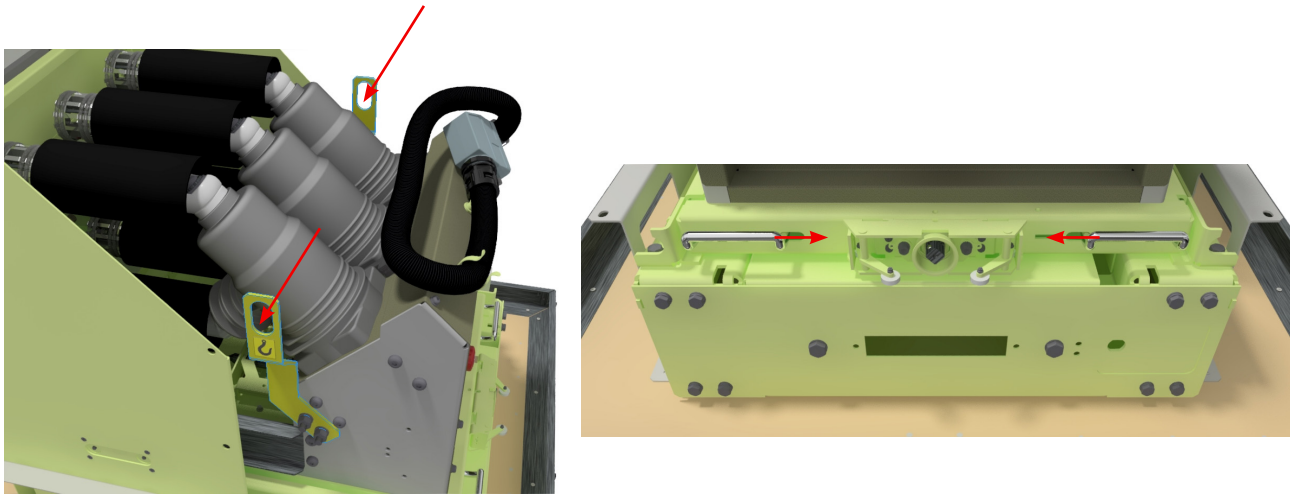


a) b)

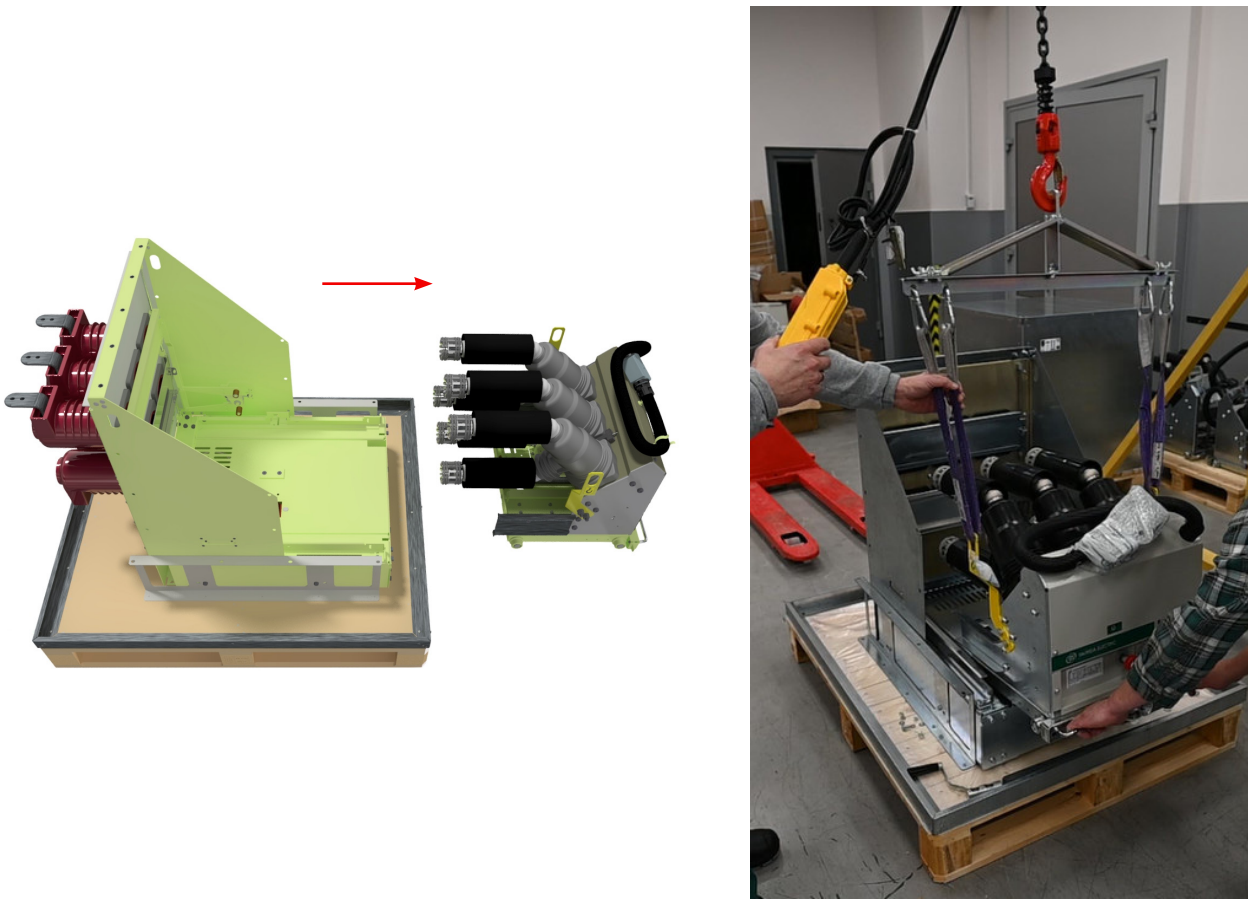
c)

Figure 4
Extracting Holder Drawout Breaker

Lifting of the withdrawable VCB:



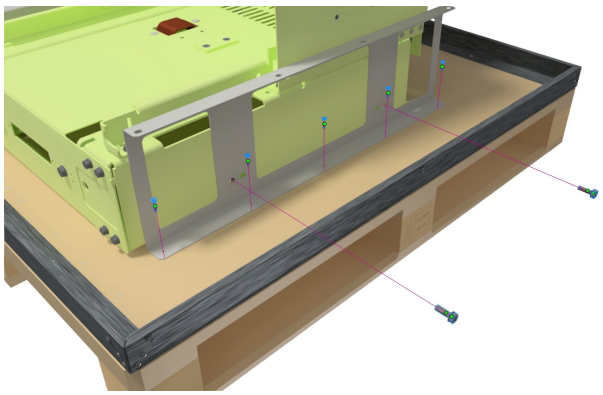
a) b)



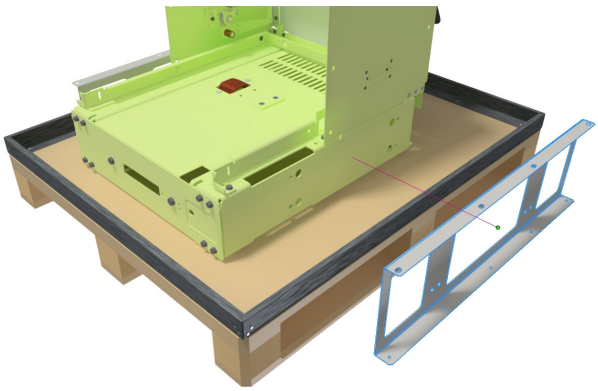
c) d)

Figure 5

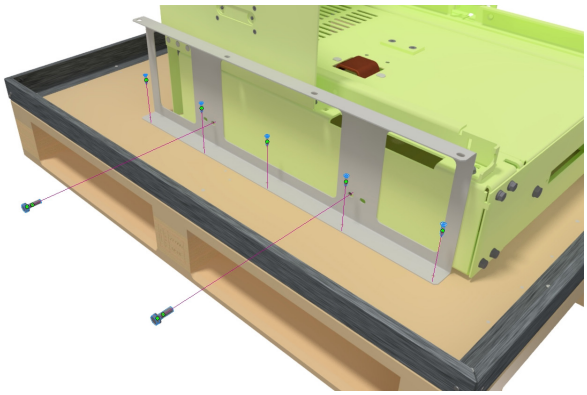
Extracting Drawout Breaker from Cradle



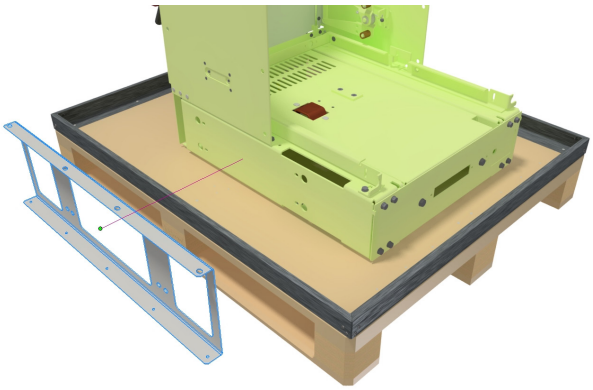
a)



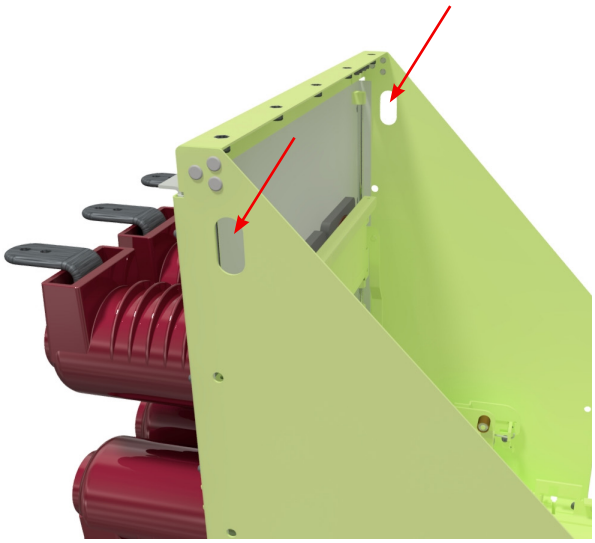
b)



c)



d)

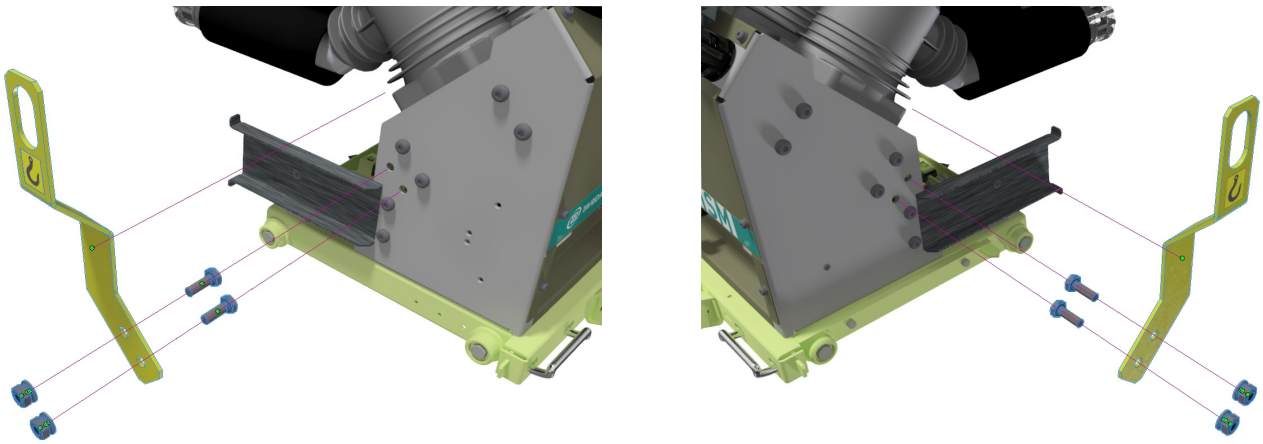


e)

f)

Figure 6

Removing the Cradle from the Pallet



a) b)

c)

Figure 7
Removal of Lifting Brackets of the VCB

To lift and handle the circuit-breaker and cradle, proceed as shown in **Figure 5** d) and **Figure 6** f) . The special lifting tool is not supplied.

The lifting brackets of the VCB should be removed before using the withdrawable VCB (**Figure 7**).

All items should be checked visually for:

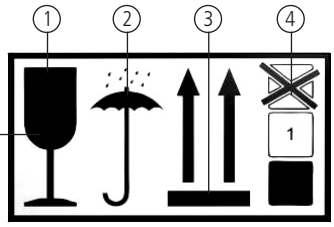
- Mechanical damage, scratches, discoloration, corrosion.

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

2.3.2 VCB Packaging and Scope of Supply

The VCB is placed in a metal box on the pallet (**Figure 10**) with following labels:

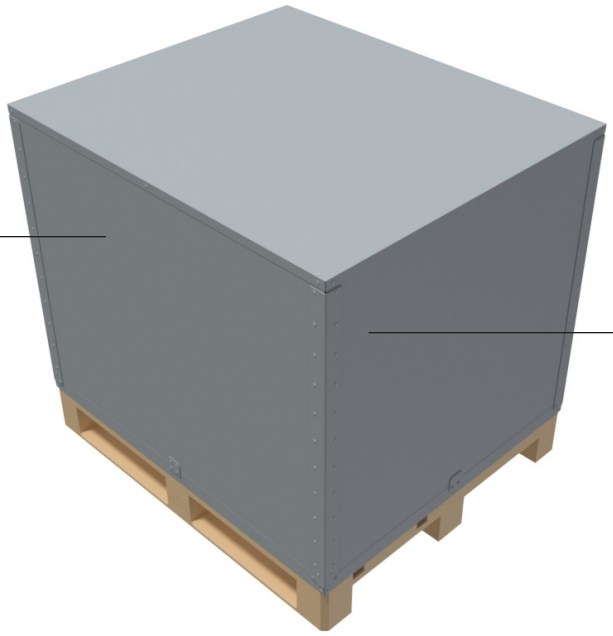
- Handling symbols label for transport and storage of the delivery unit (**Figure 8**).
- Labels for manufacturers and product information (**Figure 9**).



1. Fragile, handle with care
2. Keep dry
3. This side up
4. Stacking level limitation

Figure 8

Handling Symbols



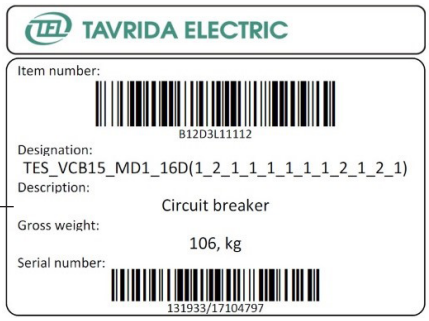


Figure 9

Label for Manufacturer and Product Information

Figure 10

VCB Package

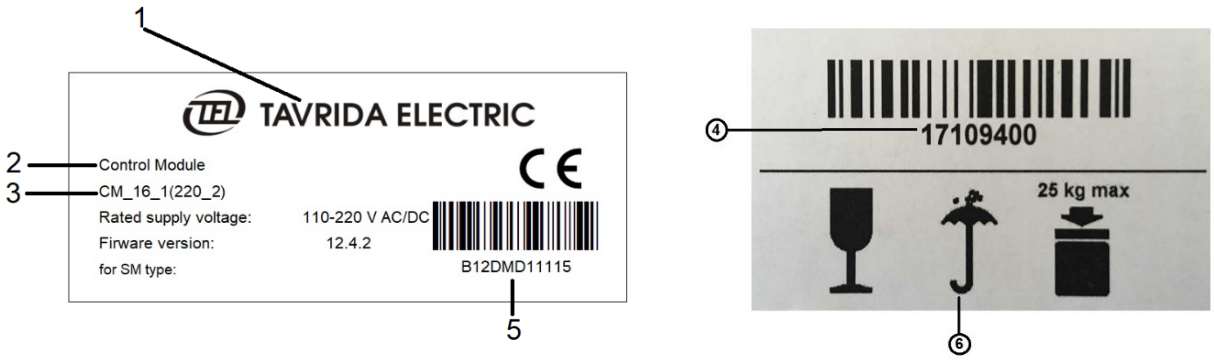
The VCB delivery set contains:

1. Fixed Parts (Cradle)
2. Withdrawable VCB
3. CBkit_Plug_1

2.3.3 CM Packaging (not in the Scope of Supply)

CM is not included in the scope of the supply and should be ordered separately from VCB.

Figure 11
CM Packaging



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

Figure 12
CM Packaging Labels

Each CM includes the following components:

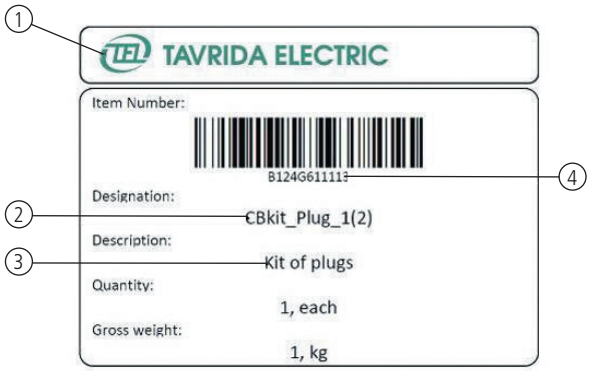
a) CM b) Screwdriver c) Brackets

Figure 13
CM Delivery Set

2.3.4 CBkit_Plug_1 Scope of Supply

As part of the VCB, the CBkit_Plug_1 is placed inside the VCB package. The kit is packed in a cardboard box.

Figure 14
CBkit_Plug_1 Packaging

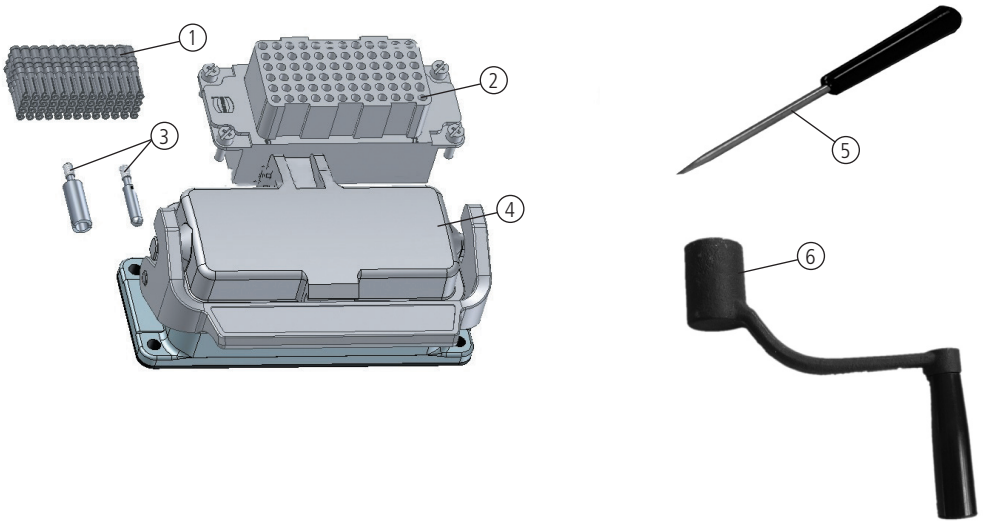


1. Manufacturer
2. Device type
3. Product name
4. Product code

Figure 15
CBkit_Plug_1 Package Labeling

CBkit_Plug_1(2) - Metal Plug 72 Pins

CBkit_Plug_1(2) includes:

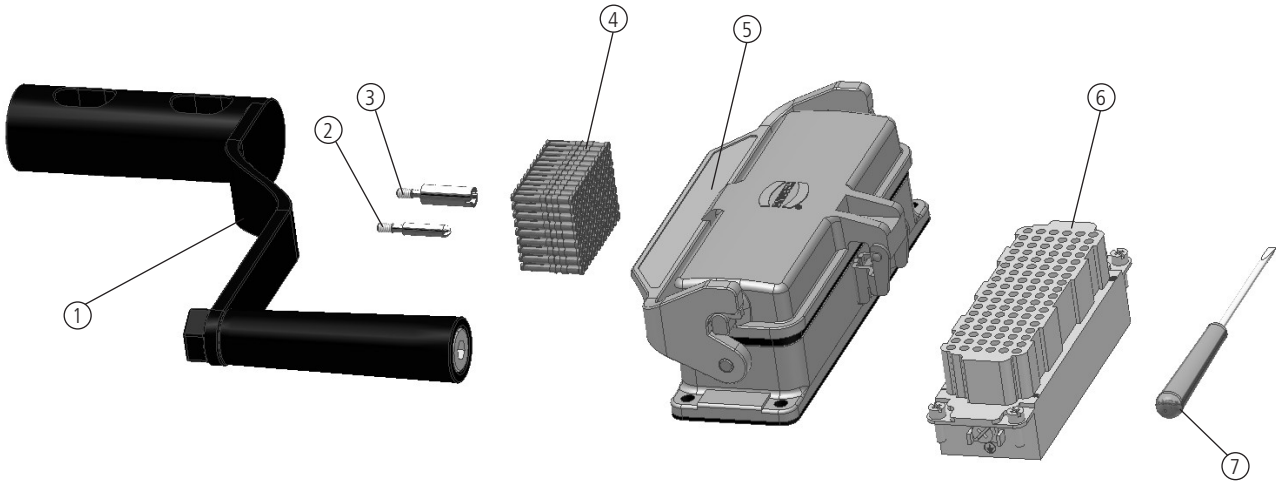


1. Socket pins;
2. Plastic insert;
3. Coding pins;
4. Plug hood;
5. Screwdriver;
6. Lever

Figure 16
CBkit_Plug_1(2) Delivery Det

CBkit_Plug_1(3) - Metal Plug 108 Pins

CBkit_Plug_1(3) includes:



1. Lever
2. Coding pins - HARTING Han Coding System Guide Pin - Article No.: 09 33 000 9908
3. Coding pins - HARTING Han Coding System Bushing - Article No.: 09 33 000 9909
4. Socket pins - HARTING Han D female contact-c 1mm² (Ag) - Article No.: 09 15 000 6202
5. Plug hood - HARTING Han B Base Panel 1 Lever Thermoplastic C- Article No.: 09 30 024 0304
6. Plastic insert - HARTING Han 108DD-SMC-MI-CRT - Article No.: 09 16 108 3001
7. Screwdriver

Figure 17
CBkit_Plug_1(3) Delivery Det

2.4.1 VCB Accessories Unpacking and Check (not in the Scope of Supply)

TNA_CBdet_Stopper_DOU(150.210_Mid_R)

The TNA_CBdet_Stopper_DOU(150.210_Mid_R) (**Figure 18**) stopper is designed to lock the cassette handle rotation, preventing the racking-in of the drawout circuit breaker. More details in section **6.1.1 Basic Inbuilt Interlocking Functionality**.

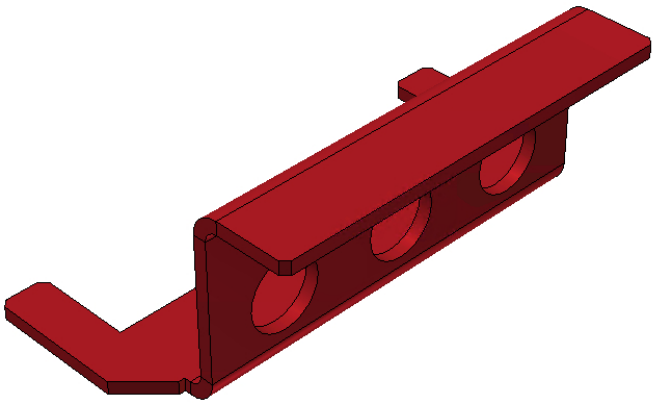


Figure 18
TNA_CBdet_Stopper_DOU(150.210_Mid_R) Delivery Det

2.4 Handling

To avoid equipment damage, please follow the handling recommendations listed below:

1. Handling shall be done in accordance with pictorial symbols.
2. Eliminate any drops.
3. Eliminate any mechanical impacts which can cause package damage.
4. Packages have to be stowed to ensure complete tightness. The boxes should be packed tightly so that they cannot shift inside of a container under any transportation conditions.
5. The modules shall be tied up twice with a 16 mm polyester band.

3. Product Coding and Labels

3.1 Circuit Breaker

Coding

CR15_MD1_16D(Par1_Par2_Par3_Par4_Par5_Par6_Par7_Par8_Par9_Par10_Par11_Par12_Par13)

- CM and VCB implementation type
- ISM type
- Product group

Table 1 - Product Group Description

Code	Description
CR15	Vacuum Circuit Breaker in Cradle with Rated Voltage Up to 15kV

Table 2 - ISM Type Description

Code	Description
MD1	Three-Phase Medium Duty Indoor Switching Module with Rated Normal Current Up to 1250 A

Table 3 - CM and VCB Implementation Type Description

Code	Description
16D	The 16th Series of Control Module and Draw-Out Type VCB

Table 4 - Circuit Breaker Parameters Description

Parameter	Parameter description	Applicable options	Code
Par1	Customization	No Customization	1
Par2	Rated voltage	15 kV	1
Par3	Rated short circuit breaking current	31.5 kA	1
Par4	Rated normal current	1250 A	1
Par5	Phase centre distance	150 mm	1
		210 mm	2
Par6	Terminal centre distance	205 mm	1
Par7	Lower terminal height	260 mm	2
Par8	CM settings	Without CM	2
Par9	Rated auxiliary supply voltage	Without CM	3
Par10	Auxiliary plug	Metal plug - Harting	2
Par11	Optional interlock	Without optional interlock	2
Par12	Earthing switch	Without Earthing switch	1
Par13	Language	English language without CM	3

1) Please contact your local sales representative for information.

CR15_HD1_16D(Par1_Par2_Par3_Par4_Par5_Par6_Par7_Par8_Par9_Par10_Par11_Par12_Par13)

- CM and VCB implementation type
- ISM type
- Product group

Table 5 - Product Group Description

Code	Description
CR15	Vacuum Circuit Breaker in Cradle with Rated Voltage Up to 15kV

Table 6 - ISM Type Description

Code	Description
HD1	Three-Phase Heavy Duty Indoor Switching Module with Rated Normal Current Up to 3150 A

Table 7 - CM and VCB Implementation Type Description

Code	Description
16D	The 16th Series of Control Module and Draw-Out Type VCB

Table 8 - Circuit Breaker Parameters Description

Parameter	Parameter description	Applicable options	Code
Par1	Customization	No Customization	1
Par2	Rated voltage	15 kV	1
Par3	Rated short circuit breaking current	31.5 kA	1
Par4	Rated normal current	2500 A	1
Par5	Phase centre distance	210 mm	1
		275 mm	2
Par6	Terminal centre distance	310 mm	1
Par7	Lower terminal height	280 mm	1
Par8	CM settings	Without CM	2
Par9	Rated auxiliary supply voltage	Without CM	3
Par10	Auxiliary plug	Metal plug - Harting	2
Par11	Optional interlock	Without optional interlock	1
Par12	Earthing switch	Without Earthing switch	1
Par13	Language	English language without CM	3

1) Please contact your local sales representative for information.

Labels

Each VCB has an electrical data label which contains the circuit breaker's serial number:

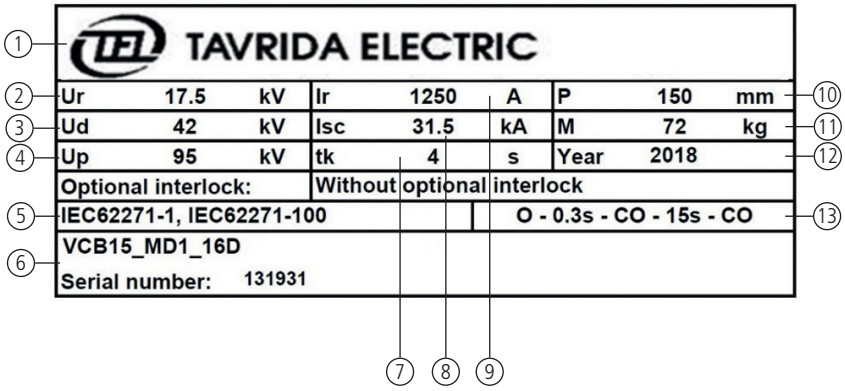


Figure 19

Withdrawable VCB Label

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

The nameplate contains information about the VCB type, the VCB technical parameters and the serial number.

The placement of the electrical data label is shown below.

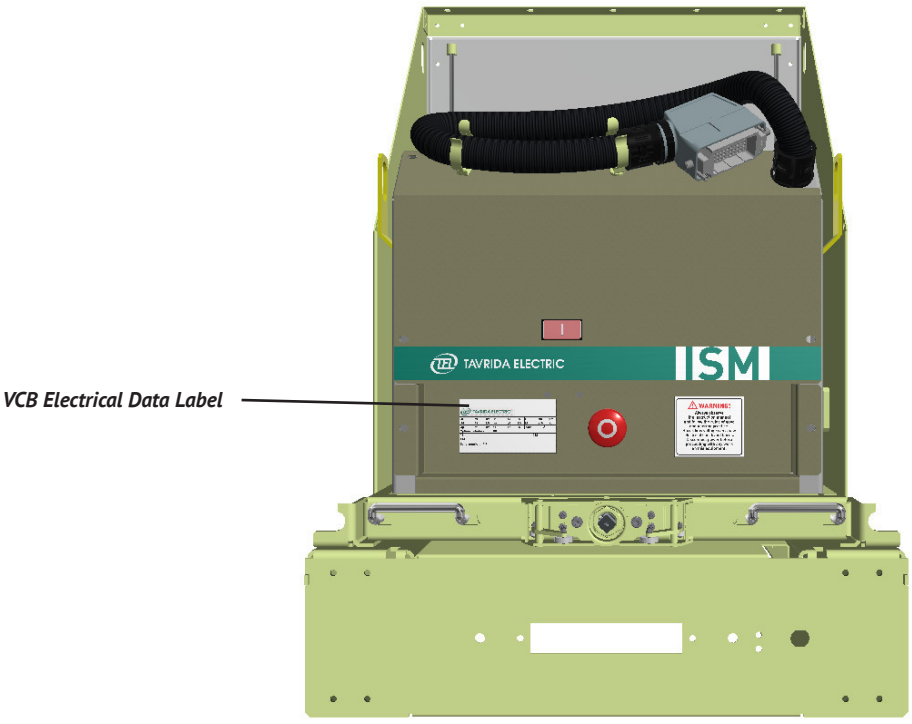


Figure 20

Withdrawable VCB Labeling

3.1.1 Control Module

Coding

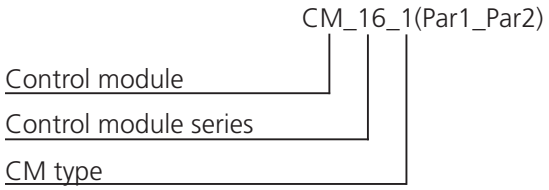


Table 9 - CM Parameters Description

Parameter	Parameter description	Applicable options	Code
Par1	Rated Voltage	19-72V DC	60
		85-265V AC/DC	220
Par2	Version	Up-to-date model	2

Labels and Seal

Each CM_16_1 has the following labels:

- Serial number label
- Information label with terminals connections and main parameters
- Information label with settings code for CM_16_1 modules
- Seals

Figure 21
Serial Number Label

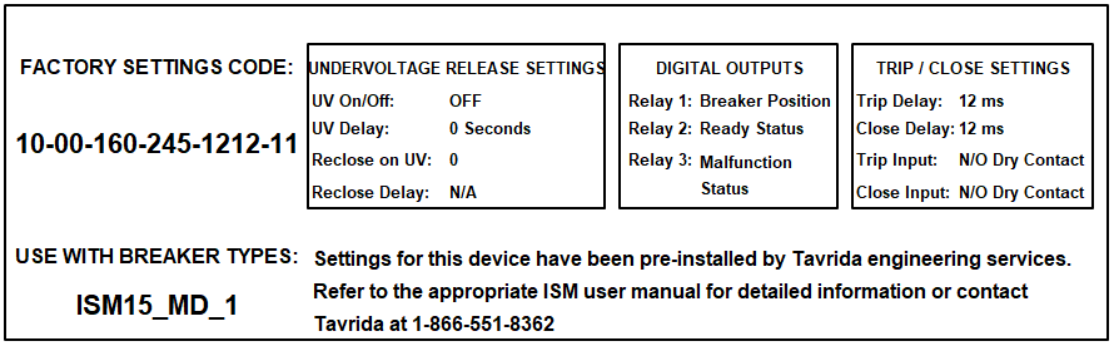


Figure 22
Information Label with Settings Code for CM_16_1 Modules

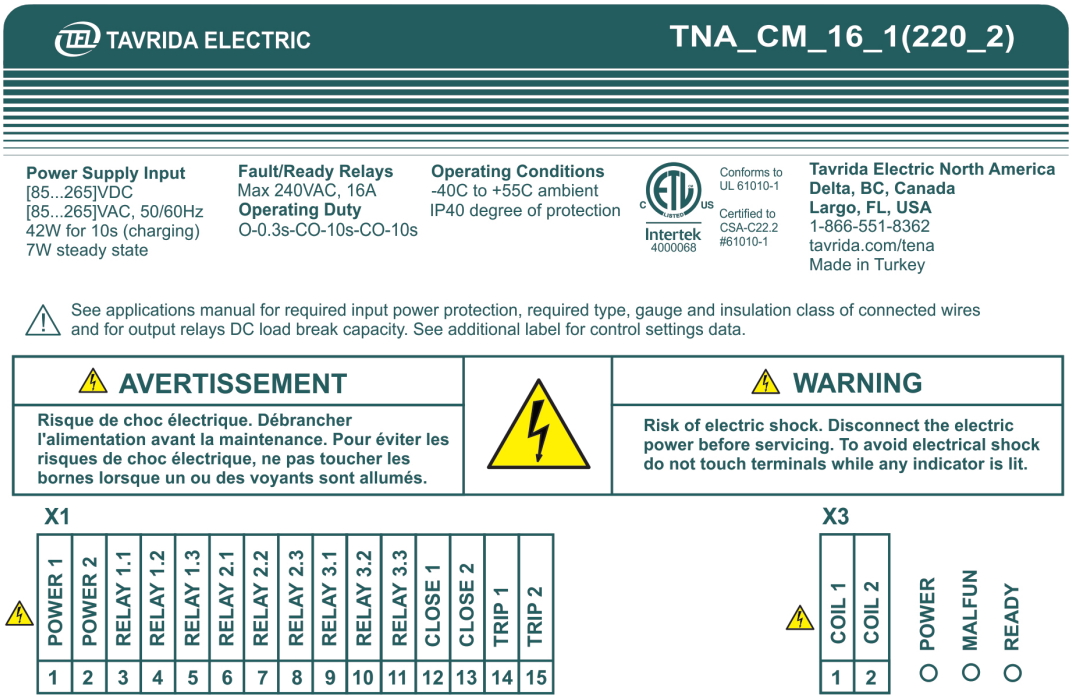
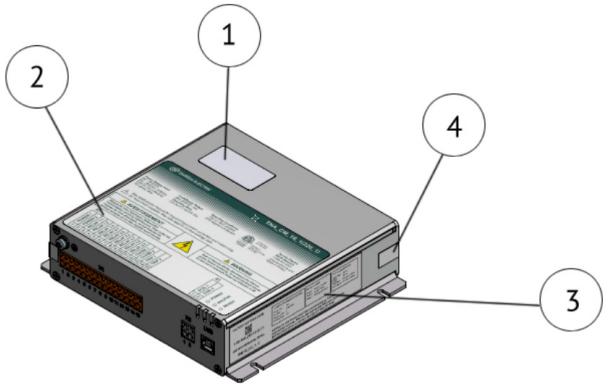


Figure 23

Information Label with Terminals Connections and Main Parameters



1. Serial Number Label
2. Information Label with Terminals Connections and Main Parameters Warning Label
3. Information Label with Settings Code for CM_16_1 Modules
4. Warranty Seal

Figure 24

CM Labels

3.1.2 Auxiliary Plugs Kit

CBkit_Plug_1 is used to provide a counterpart for the DOU auxiliary circuits connector in the switchgear panel.

Drawout circuit breaker is supplied with one type of secondary plug and appropriate counterpart, which can be 72 pins Harting or 108 pins Harting, please ask your local representative for details.

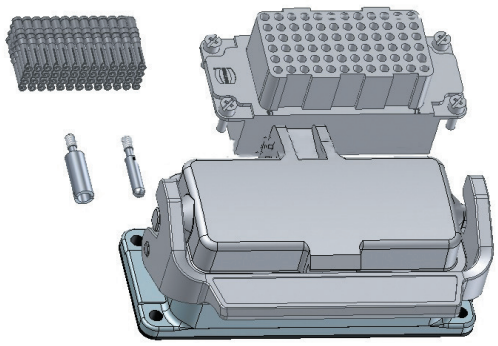


Figure 25

Metal plug (72 pins) Scope of Supply

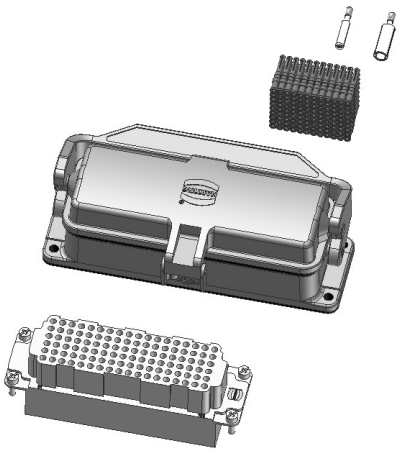


Figure 26

Metal plug (108 pins) Scope of Supply

4. Technical Parameters

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

Table 10 - Main Technical Parameters

Type	CR15_MD1_16D		CR15_HD1_16D	
Rated voltage (Ur)	15 kV		15 kV	
Phase centre distance (PCD), mm	150	210	210 275	
Rated normal current (Ir)	1250 A		2500 A [1]	
Rated power frequency withstand voltage (Ud)	36 kV			
Rated lightning impulse withstand voltage (peak) (Up)	95 kV			
Rated short-circuit breaking current (Isc)	31.5 kA [2]			
Rated peak withstand current (Ip)	82 kA			
Rated short-time withstand current (Ik)	31.5 kA			
Rated duration of short circuit (tk)	4 s			
Rated frequency (fr)	50/60 Hz			
Mechanical life (CO-cycles)	30 000			
Number of operated-isolated operations	500 cycles			
Maximum number of CO-cycles per hour	60			
Operating cycles, rated–short circuit breaking current	50			
Rated Interrupting Time according to IEEE C37.04 [8]	50 ms (3 cycles)			
CM16 Opening Time [9]	12 ms standard, programmable			
ISM Opening Time	8 ms			
Closing Time [10]	32 ms			
CM16 Closing Time	12 ms standard, programmable [9]			
ISM Closing Time	20 ms			
Resistance of main circuit	≤ 31 µOhm		≤ 25 µOhm	≤ 20 µOhm
Rated operating sequence at rated normal current	O-0.3s-CO-10s-CO-10s-CO [3]			
Rated operating sequence at rated short-circuit breaking current	O-0.3s-CO-15s-CO			
Auxiliary Circuits Insulation Strength [4]				
Power frequency test voltage (1 min) in accordance with IEEE C37.09	2.5 kV			
Lightning impulse 1.2ms/50ms/0.5 J in accordance with IEC60255-27	5 kV			
Insulation resistance of 1000V DC in accordance with IEC60255-27	≥ 5 MOhm			
Design class of switching module with regard to severity of service conditions in accordance with IEC 60932	Class 0			

Table 10 - Main Technical Parameters

Type	CR15_MD1_16D	CR15_HD1_16D
Standards	IEEE C37.09, C37.09a, C37.09b, C37.04	
Mechanical vibration withstand capability according to IEC 60721-3-4	Class 4M4	
Weight (depending on Phase Centre Distance)	143-159.1 kg	
Altitude above sea level	1000 m [5)]	
Relative humidity in 24 hours	≤ 95 %	
Relative humidity over 1 month	≤ 90 %	
Temperature Range	-25 °C ... +55 °C	
Degree of protection of main circuit terminals in accordance with IEC 60529	IP00	
Degree of protection of actuators compartment in accordance with IEC 60529	IP40	
Service conditions	a) The ambient air is not polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt and would be considered as having a site pollution severity class (SPS) "very light" according to IEEE C37.04 Table C.1. b) The average value of the water vapor pressure, over a period of 24 h, does not exceed 2.2 kPa. c) The average value of the water vapor pressure, over a period of one month, does not exceed 1.8 kPa.	
Type of driving mechanism	Monostable magnetic actuator	
Operation counter	Electrical, built in into control module	
Design/Switching Capacity of ISM Auxiliary Contacts		
Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC	
Minimum current for 12 V AC / DC, ohmic load	100 mA	
Minimum current for 12 V AC / DC, inductive load (t=20 ms, cosj =0,3)	100 mA	
Maximum current for 30 V DC, ohmic load	10 A [6)]	
Maximum current for 30 V DC, inductive load (t=20 ms)	3 A	
Maximum current for 60 V DC, ohmic load	0.9 A	
Maximum current for 60 V DC, inductive load (t=20 ms)	0.9 A	
Maximum current for 125 V DC, ohmic load	0.5 A	
Maximum current for 125 V DC, inductive load (t=20 ms)	0.03 A	
Maximum current for 250 V DC, ohmic load	0.25 A	
Maximum current for 250 V DC, inductive load (t=20 ms)	0.03 A	
Maximum current for 125 V AC, ohmic load	10 A [6)]	

Table 10 - Main Technical Parameters

Type	CR15_MD1_16D	CR15_HD1_16D
Maximum current for 125 V AC, inductive load (cosj =0,3)	5 A	
Maximum current for 250 V AC, ohmic load	10 A [6]	
Maximum current for 250 V AC, inductive load (cosj =0,3)	5 A	
Design/Switching Capacity of DOU Plate Auxiliary Contacts		
Number of available auxiliary contacts	5 NO + 5 NC	
Maximum current for voltage up to 660 V AC	10 A	

1) The rating depends on the metal-enclosed switchgear ventilation. Temperature rise type test at 2500 A in Cradle was successfully passed in KEMA.
2) At 40% DC component.
3) The number of sequential Close-Trip operations with a 10 second interval should not exceed 10. The number of Close-Trip operations should not exceed 60 per hour. Sequence of 10s Close-Trip operations can be repeated only after 260 s pause.
4) Isolation resistance check is not applicable for "Actuator Coil" circuits of CM.
5) 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 IEEE Std C37.100.1 compared to the insulation measurement at sea level. The maximum allowed altitude is 2000 m above sea level.
6) At 5 min short-term duty. Continuous current – 5 A.
7) In case of dry contacts "close" and "trip" are open.
8) Rated Interrupting time includes CM16 opening time, ISM opening time and arcing time
9) CM16 standard opening and standard closing times are 12ms, contact your local representative for different values.
10) Standard closing time includes CM16 standard closing time, ISM closing time

Table 11 - CM Main Technical Parameters

Parameter	Value
CM Operation Times	
Preparation time for the operation of the CM after switching on the auxiliary power supply	≤ 15 s
Preparation time for the close operation of the CM after a previous close operation	≤ 10 s
Preparation time for the trip operation of the CM after switching on the auxiliary power supply	≤ 0.1 s
Trip capability after failure of the auxiliary power supply	≥ 60 s [1.]
CM Supply Voltage	
Rated range of supply voltage of CM_16_1(60_2)	24 V to 60 V DC
Rated range of supply voltage of CM_16_1(220_2)	110V to 220V AC/DC 50/60Hz for AC
Rated range of supply voltage of CM_16_2(220_2)	
Operating range (80-120%) of CM_16_1(60_2)	19 V to 72 V DC
Operating range (80-120%) of CM_16_1(220_2)	85V to 265V AC/DC 50/60Hz for AC
Operating range (80-120%) of CM_16_2(220_2)	
CM Power Consumption of CM	
Charging the close and trip capacitors of CM_16_1(60_2)	≤ 25 W
Charging the close and trip capacitors of CM_16_1(220_2)	≤ 42 W AC [2.] ≤ 37 W DC
Charging the close and trip capacitors of CM_16_2(220_2)	
Permanent power consumption (standby) of CM_16_1(60_2)	≤ 5 W
Permanent power consumption (standby) of CM_16_1(220_2)	≤ 7 W AC [3.] ≤ 5 W DC
Permanent power consumption (standby) of CM_16_2(220_2)	
Inrush current of CM_16_1(60_2) with discharged capacitors	≤ 120 A
Inrush current of CM_16_1(220_2) with discharged capacitors	≤ 18 A
Inrush current of CM_16_2(220_2) with discharged capacitors	
Inrush time constant of CM_16_1(60_2) with discharged capacitors	≤ 0.5 ms
Inrush time constant of CM_16_1(220_2) with discharged capacitors	≤ 4 ms
Inrush time constant of CM_16_2(220_2) with discharged capacitors	
Design, Switching Capacity of CM Output Relays (Dry Contacts)	
Number of relays in CM_16_1	3
Number of relays in CM_16_2	
Number of available contacts for one relay	1 NO + 1 NC with common point

Table 11 - CM Main Technical Parameters

Parameter	Value
Rated voltage	240 V
Rated current AC	16 A
Maximum breaking power AC	4000 VA
Maximum switching current 250V DC	0.35 A
Maximum switching current 125V DC	0.45 A
Maximum switching current 48V DC	1.3 A
Maximum switching current 24V DC	12 A
Switching time	5 ms
Operations counter	10 digits, available via USB port
"Close" and "Trip" Dry Contacts Inputs of CM	
Output voltage	≥ 30 V
Contacts closed current	≥ 50 mA
Steady state current	≥ 5 mA
Weight of CM_16_1	1 kg
Weight of CM_16_2	
Overall dimensions of CM [4]	190x165x45 mm
Temperature Range	-40°C…+55°C
Service conditions	a) The ambient air is not polluted by dust, smoke, corrosive and/or flammable gases, vapors or salt and would be considered as having a site pollution severity class (SPS) "very light" according to IEEE C37.04 Table C.1. b) The average value of the water vapor pressure, over a period of 24 h, does not exceed 2.2 kPa. c) The average value of the water vapor pressure, over a period of one month, does not exceed 1.8 kPa.
CT Power Supply Parameters (for CM_16_2(220_2) only)	
Operating current range	2-300 A
Power consumption per phase during charging trip capacitors - 2 A - 5 A - 10 A - 30 A - 300 A	 5 VA 12 VA 25 VA 120 VA 8 kVA

Table 11 - CM Main Technical Parameters

Parameter	Value
Preparation time for trip operation (charging of the trip capacitor), no more than	
- 2 A	1000 ms
- 5 A	400 ms
- 10 A	150 ms
- 30 A	110 ms
- 300 A	100 ms
Current carrying capacity, not less than	
- 2 A	∞
- 5 A	100 s
- 10 A	10 s
- 30 A	1 s
- 300 A	0.1 s
Environmental Conditions: Location, ordinary dry	
Maximum operating temperature	55°C
Maximum operating altitude	2000 m
Maximum humidity, no more	98 % (no condensation)

1. In case of Dry contacts "Close" and "Trip" are open.
2. At Cos j >0.66.
3. At Cos j >0.33.
4. Overall dimensions of ISM are given in Appendix 3. Overall Drawings

Table 12 - CM EMC Parameters

Parameter	Applicable standard	Rated Value
Electromagnetic Compatibility (EMC) Requirements [1]		
Electrostatic discharge	IEC 60255-26 IEC 61000-4-2	8 kV contact 15 kV air
Radiated EM field Immunity	IEC 60255-26 IEC 61000-4-3	80 MHz – 3 GHz Sweep & spot AM 1 kHz 80% 10 V/m
Fast transient burst Immunity	IEC 60255-26 IEC62271-1 IEC 61000-4-4	4 kV common mode
Surge Immunity	IEC 60255-26 IEC 61000-4-5	4 kV common mode 2 kV differential mode
Conducted disturbance induced by Radio frequency fields	IEC 60255-26 IEC 61000-4-6	150 kHz – 80 MHz AM 1 kHz 80% 10 V
Power Frequency Magnetic Field	IEC 60255-26 IEC 61000-4-8	100 A/m continuously 1000 A/m 1 sec
Pulse Magnetic Field	IEC 61000-4-9	1000 A/m
100 kHz Damped Oscillatory Magnetic Field	IEC 61000-4-10	100 A/m
1 MHz damped oscillatory magnetic field	IEC 61000-4-10	100 A/m
AC Voltage Dips and Interruptions	IEC 60255-26 IEC 61000-4-11	ΔU 30% 1 period ΔU 60% 50 periods ΔU 100% 5 periods ΔU 100% 50 periods
Power Frequency Disturbance Voltage	IEC 60255-26 IEC 61000-4-16	300 V common mode 150 V differential mode [2]
100 kHz and 1 MHz Damped Oscillatory Wave Immunity	IEC 60255-26 IEC 62271-1 IEC 61000-4-18	2.5 kV common mode 1 kV differential mode
Ripple on DC Power Supply	IEC 60255-26 I IEC 61000-4-27	10% of Supply voltage, 100 Hz
DC Voltage Dips and Interruptions	IEC 60255-26 IEC 62271-100 IEC 61000-4-29	ΔU 30% 2 sec ΔU 60% 2 sec ΔU 100% 0,3 sec ±20 % 10 sec

1) Cable from electronic relay to connector block should be shielded and the case grounded near the connector. The total length of unshielded wires from connector block to CM WAGO connector should not exceed 200 mm. Electromagnetic compatibility requirements are not applicable for the CM USB port as this port is used only for CM programming during production and not used under service conditions.

2) Test influence is not applicable for CM "Close" and "Trip" dry contacts.

5. Design, Installation and Operation

5.1 Design

5.1.1 Draw-Out Unit

The draw-out plate, with its racking mechanism, allows the VCB to be racked into or out of the service position to test positions inside the switchgear. The main position indicating device is mechanically joined with the synchronizing shaft of the ISM to reliably indicate the status of the ISM. The manual tripping device provides mechanical tripping for the ISM.

A series of interlocks are provided to prevent malfunctions and to ensure maximum operator safety.

The spring-loaded contact system contains insulated contact arms which create an electrical connection between the VCB main terminals and fixed contacts of the switchgear when the draw-out unit is in the service position.

The open design of the draw-out unit provides visual control of the main circuit's disconnection when it is in the test position.

The auxiliary circuit cable contains ISM and DOU auxiliary circuit switches and optional interlock wiring. The auxiliary multi-pin connector provides interconnection between the draw-out circuit breaker's secondary wiring and the switchgear's auxiliary circuits compartment. The CM is installed in the switchgear's auxiliary circuits compartment to provide all control, and the indication wiring is grouped in the low-voltage compartment of the switchgear. In case of auxiliary supply loss, manual charging of the circuit breaker can be performed by connecting to the CM in the low voltage compartment, excluding the necessity of operating inside the high-voltage compartment.

Withdrawable VCB

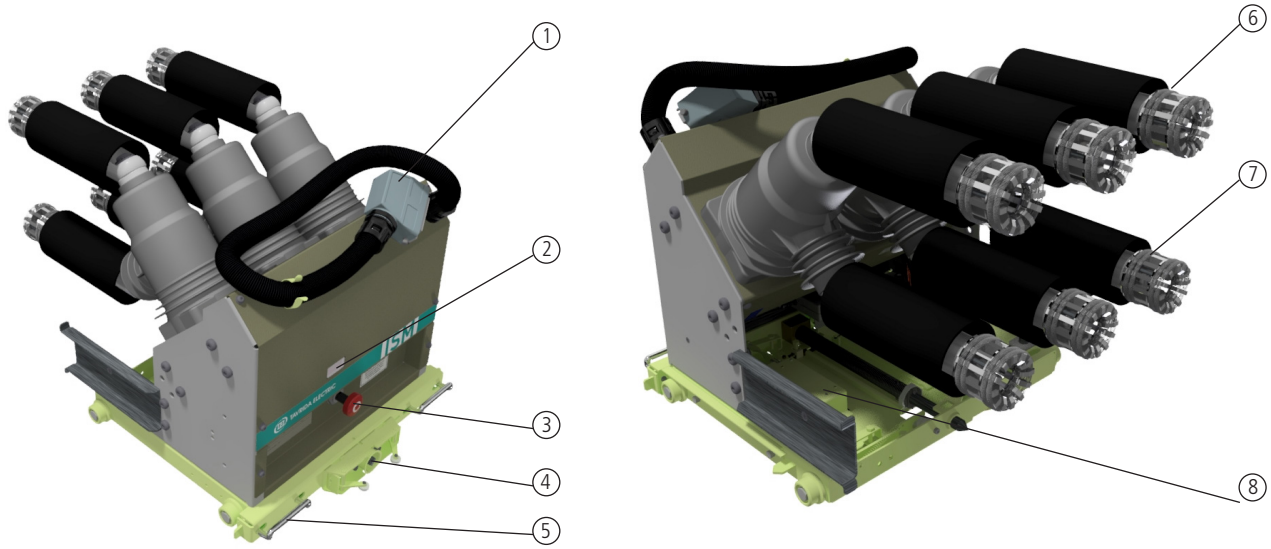


Figure 27
CR15_MD1_16D Withdrawable VCB

1. Control wiring plug
2. Main contacts position indication
3. Manual trip button
4. Racking mechanism of draw-out plate
5. Fixing mechanism of draw-out plate
6. Main contact upper terminal
7. Main contact lower terminal
8. Draw-out plate auxiliary switches module

5.1.2 Fixed Parts (Cradle) for Withdrawable VCB

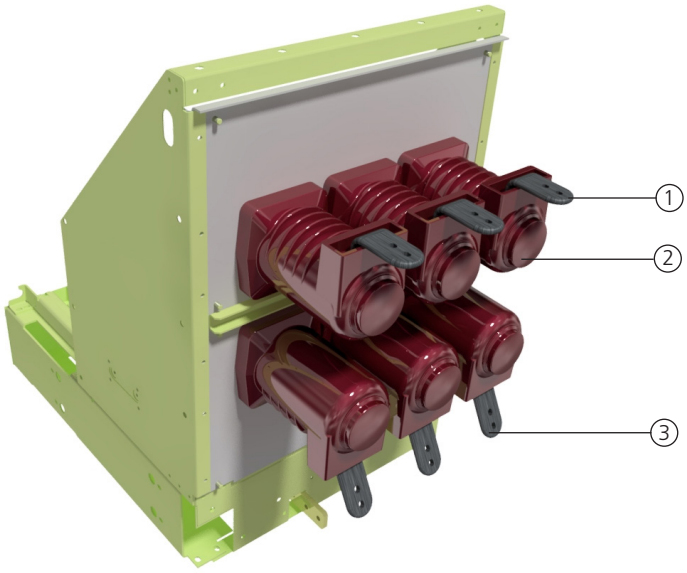
Fixed parts (cradles) with cassette draw-out type vacuum circuit breaker based on ISM15_MD_1.

Figure 28

CR15_MD1_16D

VCB with Cradles are used for replacing fixed circuit breakers with draw-out type vacuum circuit breaker, for retrofitting activities and for upgrading obsolete switchgear to the new standards.

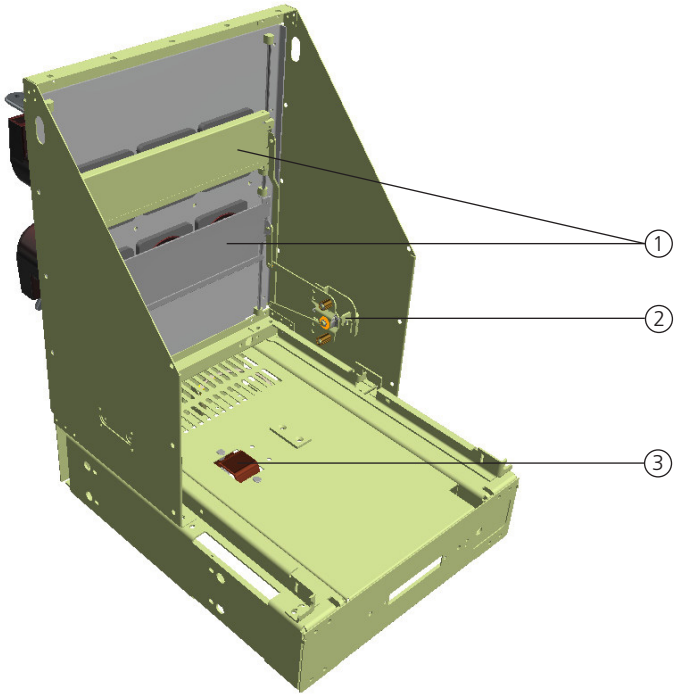
Complete modules allow medium voltage air-insulated switchgear to be constructed with the same rated currents as those of the fixed parts.



1. Top power connections
2. Insulator bushings
3. Bottom power connections

Figure 29

Bushings and Power Connections of the Cradle



1. Metal shutters
2. Scissors (levers)
3. Earthing bar

Figure 30
Front View of the Cradle

Holes that can be used to fix the cradle in the panel:

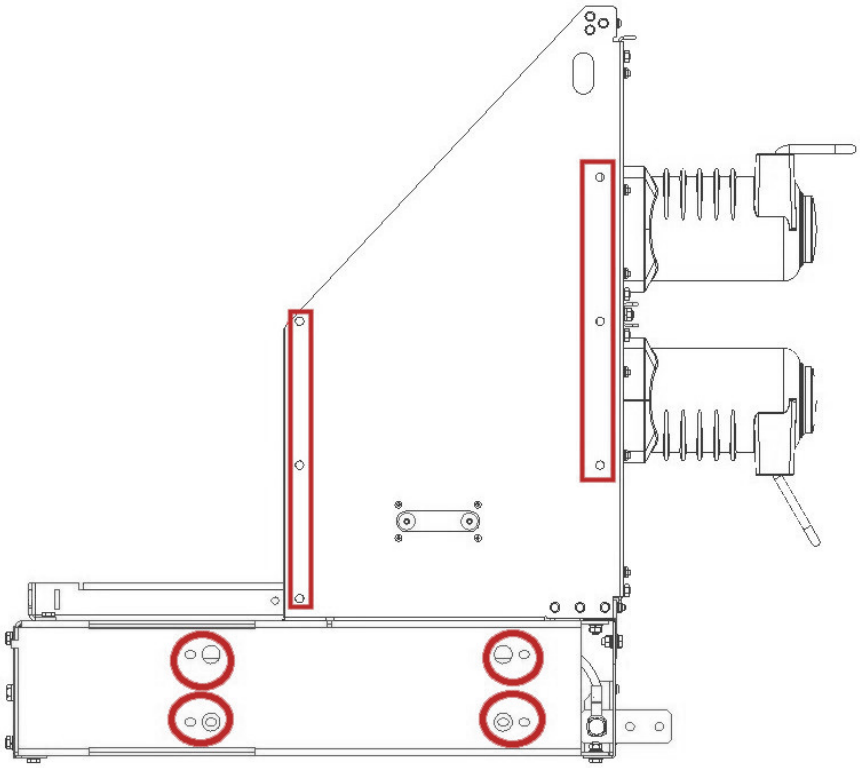


Figure 31
Holes for fastening the cradle

5.1.3 Control Module

Tavrida Electric Control modules provide the following advantages:

Low Power Consumption

Low energy required to close or trip the ISM, no energy consumption by the ISM in its closed or open state and optimization of the CM electrical diagrams leads to low CM power consumption – not more than 42 watts while CM capacitors are charging and no more than 7 watts in standby mode.

Optimal ISM Control

One CM can drive several different ISM types, but is programmed for use with a particular ISM type. The result is optimal ISM close and trip through a wide range of temperatures.

Self-Diagnostic Functionality

The CM has an internal self-diagnostic system that monitors ISM connection, power supply level and internal states of the CM. As a result, the CM can indicate issues through the use of LEDs and built-in relays. Unlikely malfunctions are indicated by the number of corresponding LED blinks.

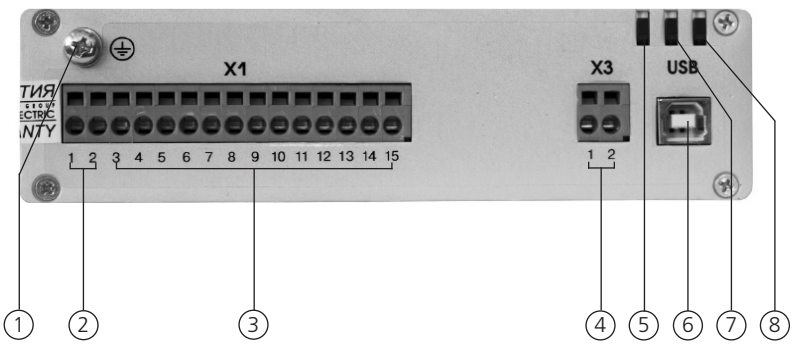
Wiring Optimization

The CM controls the ISM main contact state via the same circuit used to close or trip the ISM. Therefore, only one circuit connection between the ISM and the CM is required. The CM can provide external circuits with information about the ISM main contacts state through the use of built-in relays, which simplifies the switchgear secondary wiring signifcantly [1].

Compact Dimensions and Small Weight of CM

The compact size and small weight of the CM (190x165x45 mm, 1 kg) simplifies the installation. The aluminum housing of the CM provides a high EMC level (**Table 12 - CM EMC Parameters**).

The CM is delivered with mounting brackets for mounting on fat surfaces. The LED indicators are visible from two directions.



1. Earthing stud
2. Terminals for power supply
3. Terminals for I/O (control and indication)
4. Terminals for Switching Module
5. “Power“ LED indicator
6. USB port (for CM programming during production, not used under service conditions)
7. “Malfunction“ LED indicator
8. “Ready“ LED indicator

Figure 32
CM_16_1

1) The position indication of ISM provided by the CM can be incorrect if the CM is not operable due to an absence of auxiliary supply. The relay keeps its state after the CM power supply disconnection. For demanding applications, conventional mechanical microswitches located at the ISM can be used.

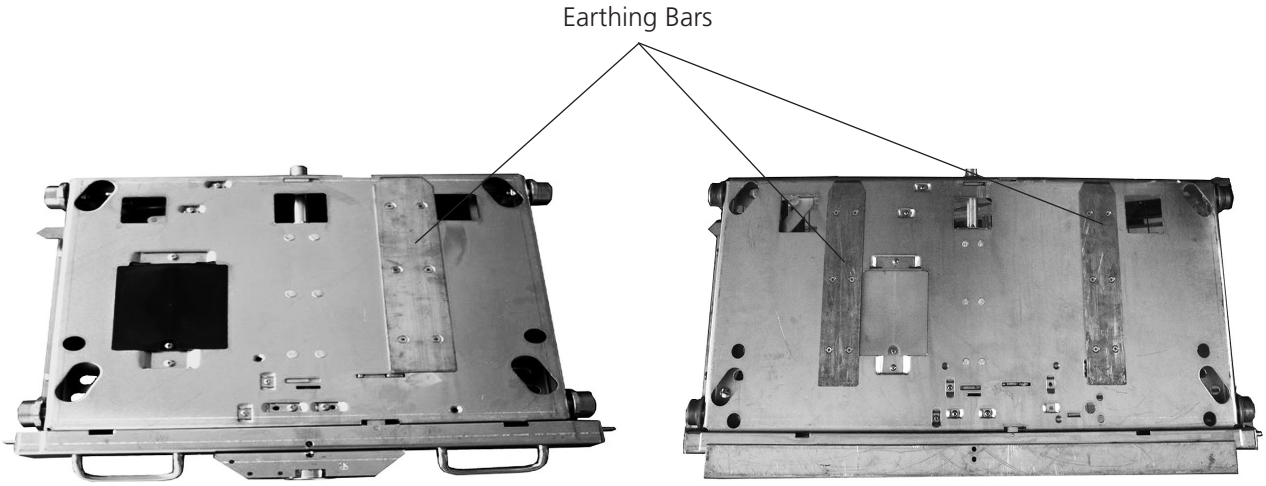
5.2 Installation the Primary Part

5.2.1 Protective Earthing

The draw-out unit is earthed through the use of truck wheels.

Optionally the earthing can be arranged via the earthing bar which is connected to the bottom of the truck.

In this case, the corresponding earthing has to be put in the switchgear (not part of the delivery).



a) Standard Draw-Out Plate

Figure 33
DOU Earthing Bars

5.2.2 Primary Connections

Before the first VCB installation in service position it is essential to check the actual dimensions of the fixed contacts installed in the switchgear. In service position, the connection of VCB flexible contacts with fixed contacts of the switchgear should be in accordance with requirements presented in **Figure 34**. Otherwise, it can lead to overheating and other severe problems.

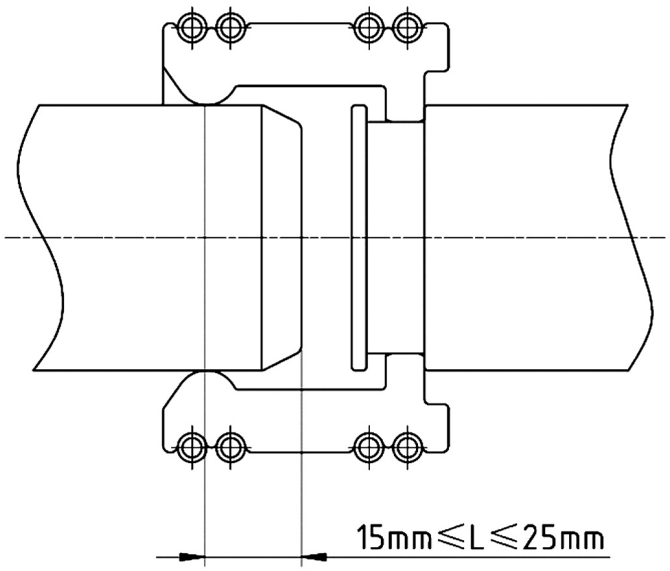


Figure 34
Connection of VCB Removable Contacts with Switchgear Fixed Contacts

5.3 Installation the Secondary part

5.3.1 VCB Secondary Connections

Secondary circuits cable of the VCB can be either equipped by metal (72 or 108 pins) plug. The secondary plugs arrangement is presented in **Table 13** - **Table 14** (Metal Plug). See **Appendix 3. Overall Drawings** for the auxiliary circuits details.

Figure 35

The Metal Plug with 72 Pins

Table 13 - Metal Plug 72 Pins Arrangement

Pin No	Connection	Pin No	Connection
1	Optional interlock (solenoid) XP3.2	37	-
2	DOU plate position switch SQ2.1	38	DOU plate position switch SQ2.7
3	DOU plate position switch SQ2.2	39	DOU plate position switch SQ2.8
4	-	40	ISM auxiliary switch XT3.12
5	-	41	ISM auxiliary switch XT3.10
6	-	42	ISM auxiliary switch XT3.8
7	-	43	ISM auxiliary switch XT3.6
8	-	44	ISM auxiliary switch XT3.4
9	-	45	ISM auxiliary switch XT3.2
10	DOU plate position switch SQ1.6	46	DOU plate position switch SQ1.3
11	ISM auxiliary switch XT2.12	47	ISM auxiliary switch XT2.9
12	ISM auxiliary switch XT2.6	48	ISM auxiliary switch XT2.3
13	Optional interlock (solenoid) XP3.1	49	Actuator coil (via interlock switch) XT1.2
14	DOU plate position switch SQ2.3	50	DOU plate position switch SQ2.9
15	DOU plate position switch SQ2.4	51	DOU plate position switch SQ2.10
16	-	52	ISM auxiliary switch XT3.11
17	-	53	ISM auxiliary switch XT3.9
18	-	54	ISM auxiliary switch XT3.7
19	DOU plate position switch SQ1.12	55	-
20	DOU plate position switch SQ1.10	56	-
21	DOU plate position switch SQ1.8	57	-
22	DOU plate position switch SQ1.5	58	-
23	ISM auxiliary switch XT2.11	59	ISM auxiliary switch XT2.8
24	ISM auxiliary switch XT2.5	60	ISM auxiliary switch XT2.2
25	-	61	Actuator coil XT1.1
26	DOU plate position switch SQ2.5	62	-
27	DOU plate position switch SQ2.6	63	-
28	-	64	-
29	-	65	-
30	-	66	-
31	DOU plate position switch SQ1.11	67	ISM auxiliary switch XT3.5
32	DOU plate position switch SQ1.9	68	ISM auxiliary switch XT3.3
33	DOU plate position switch SQ1.7	69	ISM auxiliary switch XT3.1
34	DOU plate position switch SQ1.4	70	-
35	ISM auxiliary switch XT2.10	71	ISM auxiliary switch XT2.7
36	ISM auxiliary switch XT2.4	72	ISM auxiliary switch XT2.1
-	-	GND	Earthing

Table 14 - Metal Plug 108 Pins Arrangement

Pin No	Connection	Pin No	Connection
1	ISM auxiliary switch XT2.7	45	-
2	ISM auxiliary switch XT2.9	46	-
3	ISM auxiliary switch XT2.11	47	-
4	ISM auxiliary switch XT3.7	48	-
5	ISM auxiliary switch XT3.9	49	Actuator coil XT1.1
6	ISM auxiliary switch XT3.11	50	-
7	ISM auxiliary switch XT2.1	51	-
8	ISM auxiliary switch XT2.3	52	-
9	ISM auxiliary switch XT2.5	53	-
10	ISM auxiliary switch XT3.1	54	-
11	-	55	ISM auxiliary switch XT3.3
12	-	56	ISM auxiliary switch XT3.5
13	-	57	DOU plate position switch SQ2.1
14	-	58	DOU plate position switch SQ2.2
15	-	59	DOU plate position switch SQ2.3
16	-	60	DOU plate position switch SQ2.4
17	-	61	DOU plate position switch SQ2.5
18	-	62	DOU plate position switch SQ2.6
19	ISM auxiliary switch XT2.8	63	DOU plate position switch SQ2.7
20	ISM auxiliary switch XT2.10	64	DOU plate position switch SQ2.8
21	ISM auxiliary switch XT2.12	65	-
22	ISM auxiliary switch XT3.8	66	Actuator coil (via interlock switch) XT1.2
23	ISM auxiliary switch XT3.10	67	-
24	ISM auxiliary switch XT3.12	68	Optional interlock (solenoid) XP3.2
25	ISM auxiliary switch XT2.2	69	-
26	ISM auxiliary switch XT2.4	70	-
27	ISM auxiliary switch XT2.6	71	-
28	ISM auxiliary switch XT3.2	72	-
29	-	73	ISM auxiliary switch XT3.4
30	-	74	ISM auxiliary switch XT3.6
31	-	75	DOU plate position switch SQ2.9
32	Optional interlock (solenoid) XP3.1	76	DOU plate position switch SQ2.10
33	-	77	DOU plate position switch SQ1.3
34	-	78	DOU plate position switch SQ1.4
35	-	79	DOU plate position switch SQ1.5
36	-	80	DOU plate position switch SQ1.6
37	-	81	DOU plate position switch SQ1.7
38	-	82	DOU plate position switch SQ1.8
39	-	83	-
40	-	84	-
41	-	85	-
42	-	86	-
43	-	87	-
44	-	88	-

Table 14 - Metal Plug 108 Pins Arrangement

Pin No	Connection	Pin No	Connection
89	-	100	-
90	-	101	-
91	-	102	-
92	-	103	-
93	DOU plate position switch SQ1.9	104	-
94	DOU plate position switch SQ1.10	105	-
95	DOU plate position switch SQ1.11	106	-
96	DOU plate position switch SQ1.12	107	-
97	-	108	-
98	-	GND	Earthing
99	-		

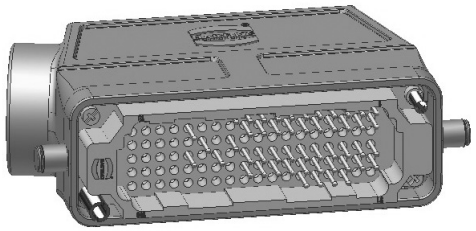


Figure 36

Metal Plug with 108 Pins

5.3.2 DOU Auxiliary Circuits Connector Counterpart Installation

To connect the DOU auxiliary circuits to the switchgear, the counterpart for the DOU auxiliary circuits connector shall be installed at the switchgear panel. The counterpart is provided as a part of delivery set.

The type of counterpart provided in the delivery set complies with the auxiliary circuits connector the VCB has. To install the counterpart at the switchgear panel, the following provisions should be used.

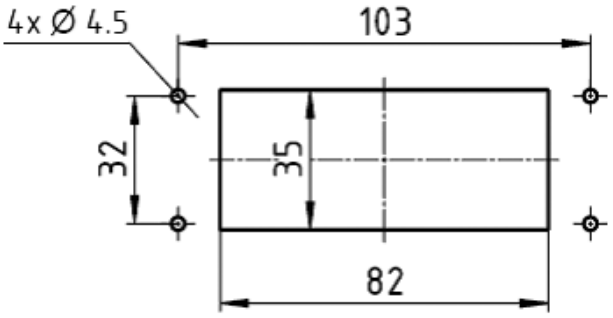


Figure 38

Metal Plug 72 Pins Counterpart Mounting Provisions and Cut Out

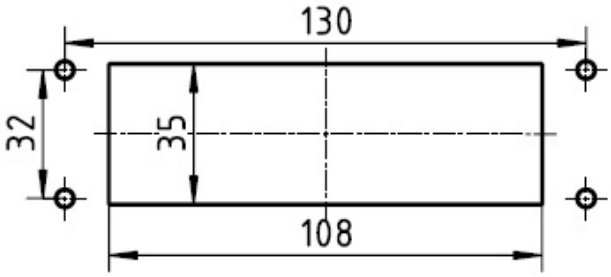


Figure 37

Metal Plug 108 Pins Counterpart Mounting Provisions and Cut Out

5.3.3 Secondary Cables Between Auxiliary Circuits Connector Counterpart and the CM

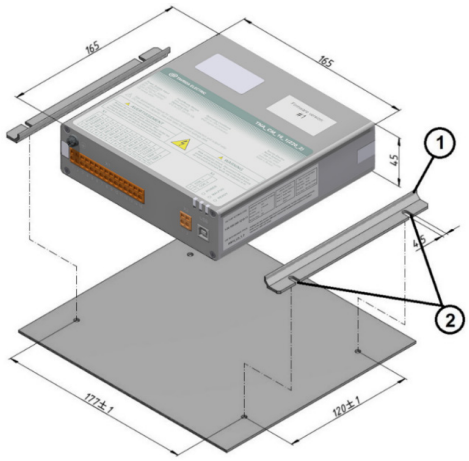
Warning! If the CM label does not show the correct ISM type, the connection shall not be established. It can lead to the damage of the ISM. Contact your nearest Tavrida Electric partner for replacement.

The secondary cable between auxiliary circuits connector counterpart and the CM shall be performed by a screened cable 2x1 mm^2 or equivalent. The degree of coverage of the cable shield shall be not less than 85%.

To achieve the best possible protection against electromagnetic influences, the earthing point of the cable screen shall be as close to the CM as possible. Unshielded parts of wires shall be no longer than 10 cm.

5.3.4 CM Installation

The installation of the CM is carried out 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 39

Provisions for CM_16 Installation

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

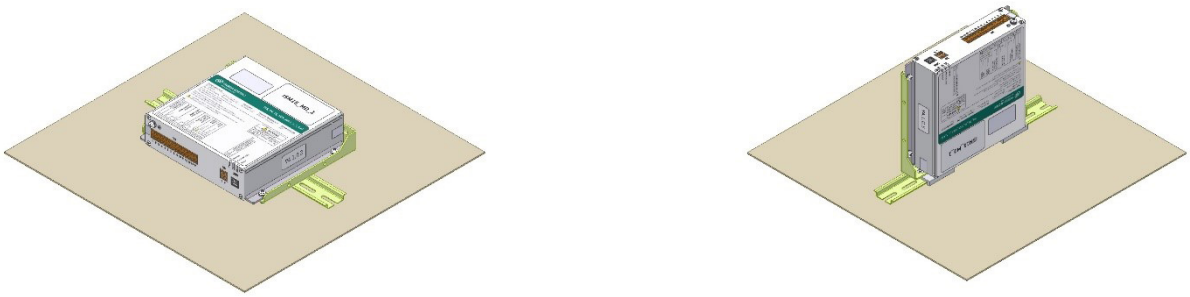


Figure 40

Variants of the CM Installation on the DIN Rail

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

Wires are connected to the CM terminals by using a screwdriver (**Figure 41**). The terminals can accept solid and stranded wire within the range 0.5-2.5 mm (14 - 18 AWG). Use copper conductors only. All wires insulation must be rated 600V or better. The insulation stripping length shall be 6-10 mm. Insulated auxiliary circuits shall provide 2 kV power frequency dielectric strength. Only ring type cable lug or similar should be used for CM16 earthing point connection.

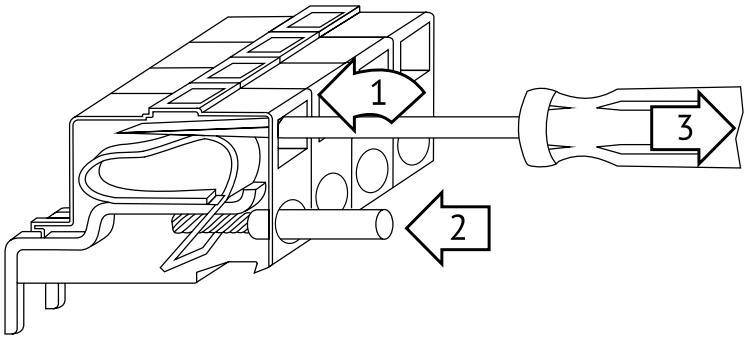


Figure 41

Installation to CM Terminals

5.3.5 CM Secondary Connections

The CM_16_1 secondary connections are shown below.

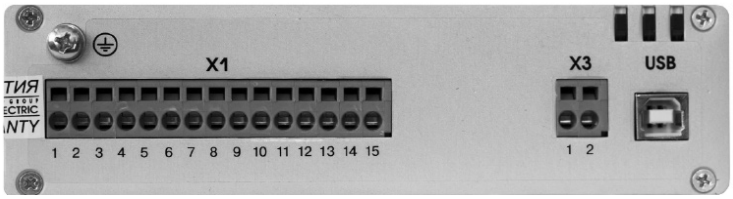


Figure 42

Terminal Arrangement of the CM

Table 15 - CM Terminal Arrangement

XT1		XT3	
Terminal No.	Connection	Terminal No.	Connection
1	Power supply input (+)	1	Actuator coil output
2	Power supply input (-)	2	Actuator coil output
3	Relay output 1 NO		
4	Relay output 1 Com		
5	Relay output 1 NC		
6	Relay output 2 NO		
7	Relay output 2 Com		
8	Relay output 2 NC		
9	Relay output 3 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 or Loss of auxiliary supply" relay

The "ISM main contact position" relay keeps its state (1 NO and 1 NC contacts with common point) after the CM power supply disconnection.

The relay's functionality and the number of relays with the same functionality can be changed upon request. Please contact the nearest Tavrida Electric sales representative for more information.

The CM is connected only to the ISM actuator coil circuits. The position of the ISM main contacts is determined by detecting the ISM coil inductance level. The CM "ISM main contact position" relay indicates the result.

5.3.6 Auxiliary Supply

The connection of CM_16_1 to the power supply is shown below.

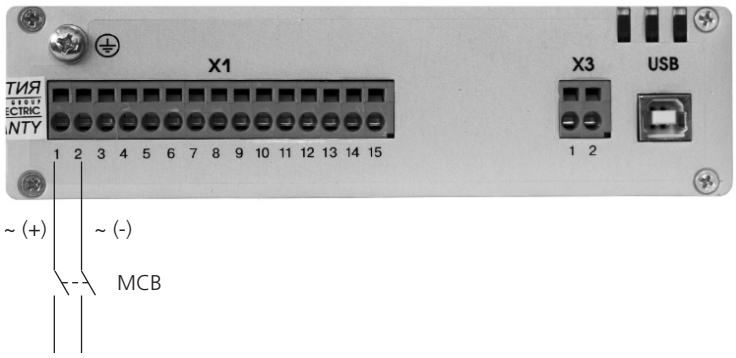


Figure 43

CM_16 Power Supply Connection

The type of MCB shall be selected according to the CM consumption data provided in chapter **4. Technical Parameters**.

Pay special attention to the correct polarity for the low-voltage version of the CM (CM_16_1(Par1_60.1_Par3_Par4_Par5)).

5.4 Operation

5.4.1 VCB Racking In and Out of the Switchgear

To change the VCB position from test to service and vice versa, the DOU plate is equipped with a racking mechanism. To operate it, a handle is used. VCB movement is provided by handle rotation in a clockwise direction for moving to service position and a counterclockwise direction for moving to test position.

Movement is available while the ISM is open.

3 main provisions of the DOU:

1. Test Position - Completely Draw Out;
2. Intermediate Position - Between Test and Service Position;
3. Service Position - Completely Draw In.

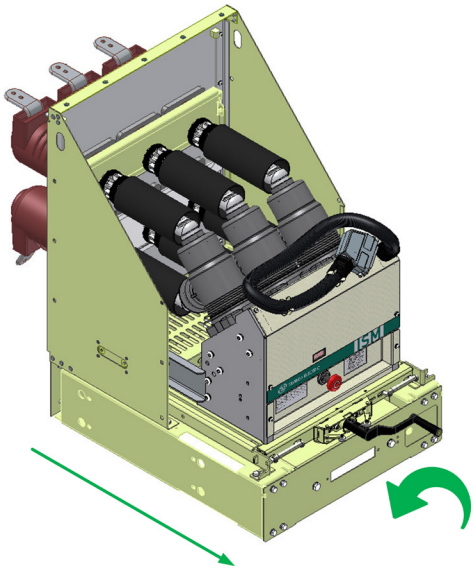


Figure 44
VCB in Test Position

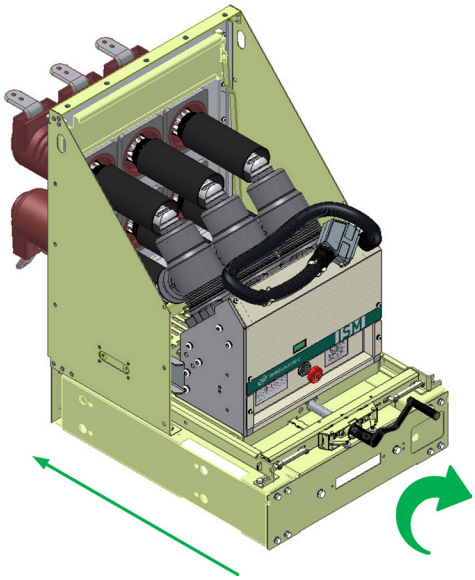


Figure 45
VCB in Intermediate Position

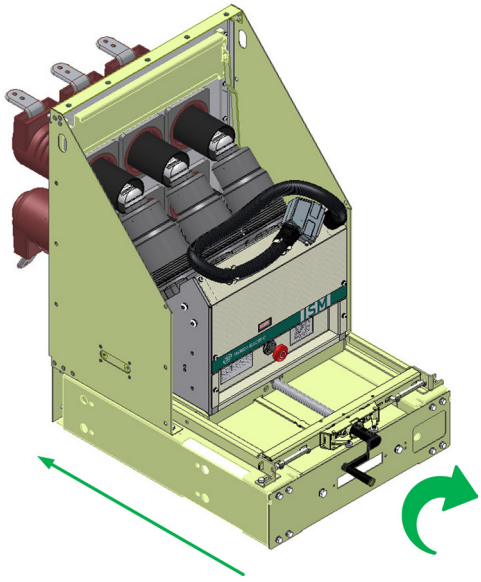


Figure 46
VCB in Service Position

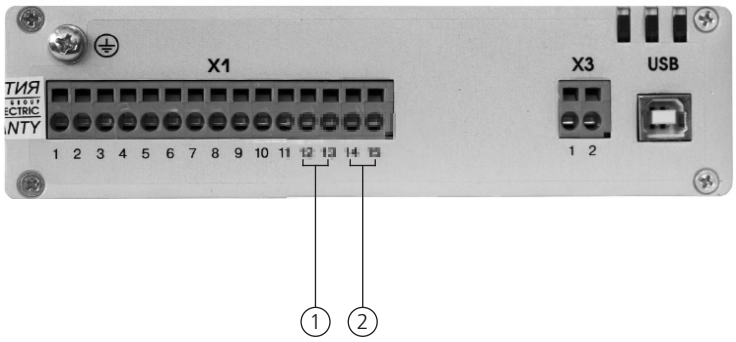
5.4.2 ISM Closing

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

The close command will be accepted in the following cases:

- The CM state is "Ready" (Ready LED flashes green).
- No Trip command is applied.
- Mechanical and electrical interlock is unlocked.

If the "Close" command is applied and held before the CM is in a "Ready" state, the Close command will not be accepted.



1. Close command input
2. Trip command input

Figure 47
CM_16_1 Close and Trip Inputs

5.4.3 ISM 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), even up to 60 seconds after a loss of auxiliary power supply.

If the trip command is applied and kept before the CM is in a "Ready" state, the trip command will be accepted after the CM is in a "Ready" state. Holding the "Trip" command will block the "Close" command execution.

5.4.4 ISM Emergency Opening

The ISM can also be opened manually. To open the ISM manually, apply force to the manual trip button. See **Figure 48** below.

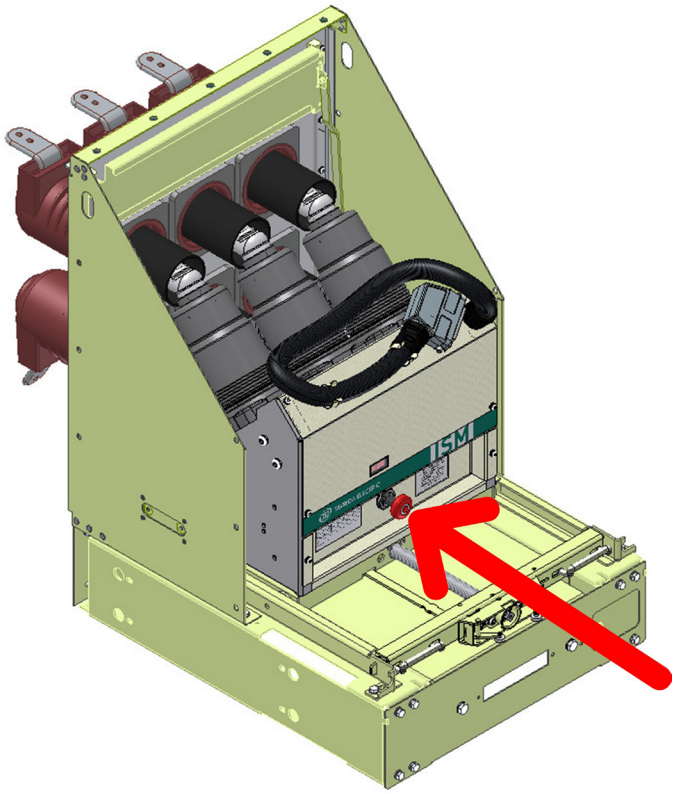


Figure 48

ISM Manual Trip Execution

The button moves the ISM synchronization plate. When the synchronizing plate is moved, a force exceeding the magnetic attraction forces of the ring magnet is applied to the ISM armature, which subsequently starts to move. As the air gap increases, the opening springs and the contact pressure springs exceed the magnetic holding force and the vacuum interrupter opens.

6. Functionality

6.1 Interlocks

6.1.1 Basic Inbuilt Interlocking Functionality

The VCB provides all the interlocks required to provide high level of safety and reliability during installation, commissioning and operation.

Standard safety interlocks included:

- The draw-out unit can only be moved in case the ISM is open and locked against closing.
- The ISM can only be unlocked and operated in case the draw-out unit is exactly in the test or service position.
- The interlocks can only be unlocked and operated if the draw-out unit is in the test or service position.

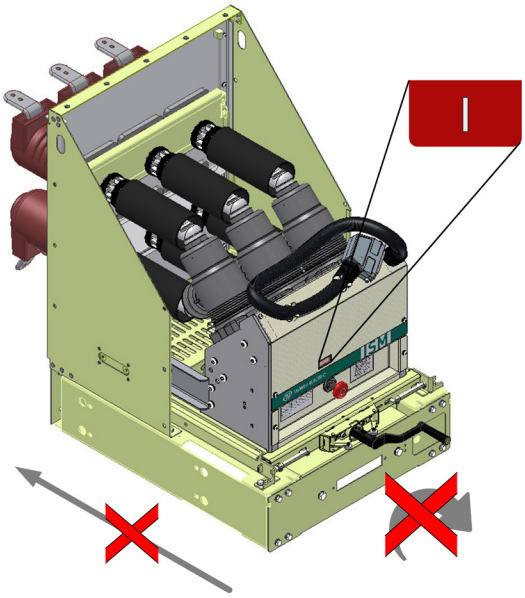


Figure 49

Draw-Out Unit is in the Test Position.
The DOU Cannot Be Moved While the ISM is Closed.

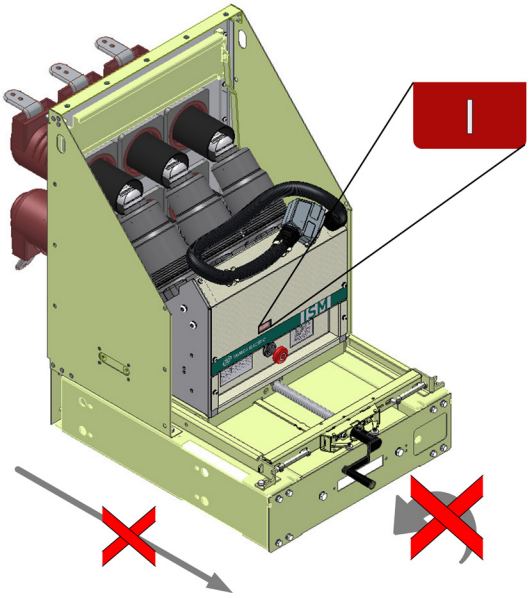


Figure 51

Draw-Out Unit is in the Service Position.
The DOU Cannot Be Moved While the ISM is Closed.

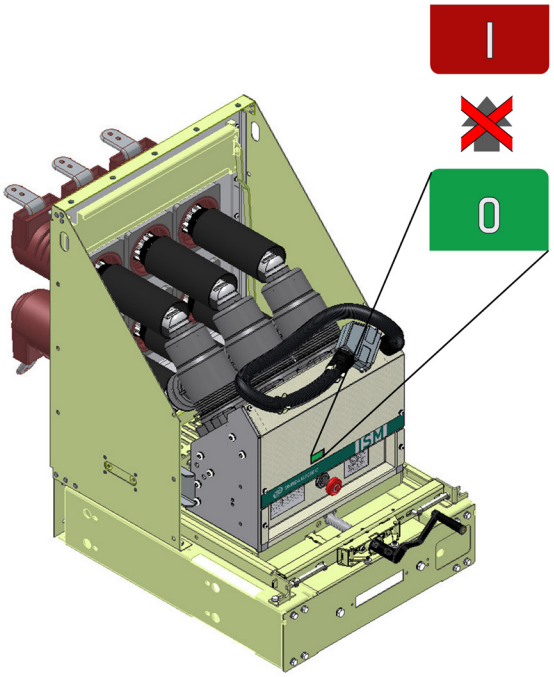


Figure 50

The ISM Cannot Be Closed While the DOU is in The Intermediate Position

Interlocks related to the draw-out unit located inside the switchgear:

- The draw-out unit can only be moved when the earthing switch is open.
- The earthing switch can only be closed when the draw-out unit is in the test position.
- The draw-out unit can only be moved to the service position when the switchgear circuit breaker's compartment door is closed.
- The draw-out unit can only be removed from the switchgear when the draw-out unit is in the test position.

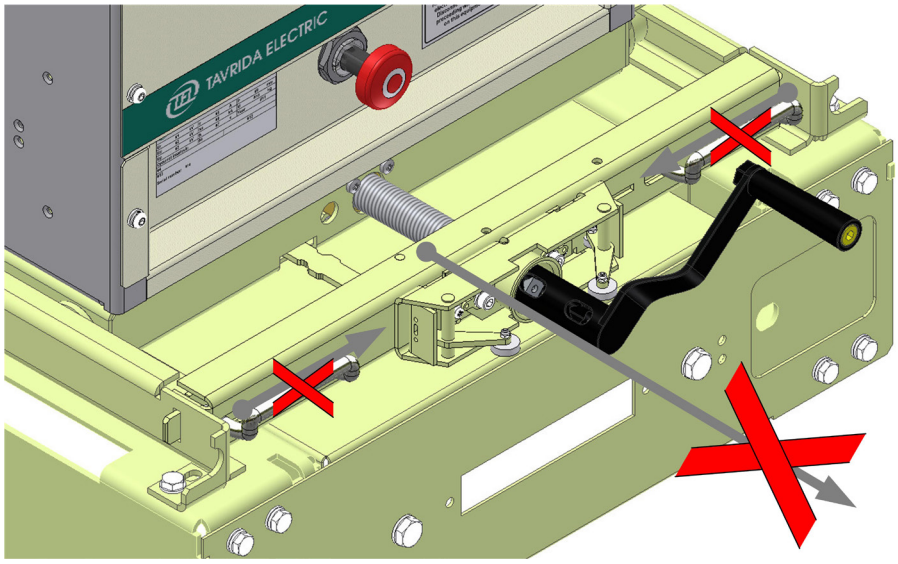


Figure 52

The DOU Cannot Be Removed from the Switchgear When the DOU is Not in the Test Position.

6.1.2 Additional Interlocking Accessories

TNA_CBdet_Stopper_DOU(150.210_Mid_R)

Drawout breaker can be equipped with accessory providing lockout against racking in – cassette handle rotation can be locked using the stopper accessory TNA_CBdet_Stopper_DOU(150.210_Mid_R) (not included in standard supply), while the steel lockout hasp allows a padlock to be attached. (**Figure 53**) Steel lockout hasp should have 1" diameter - Uline Steel Lockout Hasp H-3426 or analogue, Stopper - TNA_CBdet_Stopper_DOU(150.210_Mid_R).

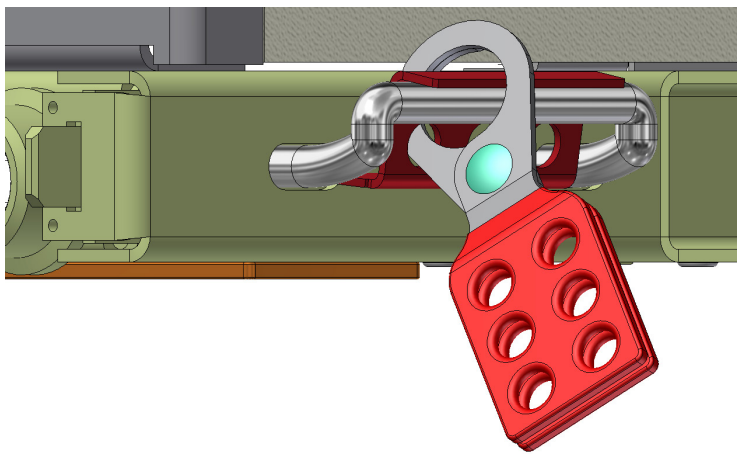


Figure 53

Steel Lockout Hasp and Stopper TNA_CBdet_Stopper_DOU(150.210_Mid_R) for Mechanical Locking of Cassette Movement

Installation of TNA_CBdet_Stopper_DOU(150.210_Mid_R)

The TNA_CBdet_Stopper_DOU(150.210_Mid_R) can be used with CR15_MD1_16D and CR15_HD1_16D withdrawable vacuum circuit breakers with a phase centre distance of 150 mm and 210 mm.

1. Pull the handle of the draw-out cassette to the middle position (**Figure 54**)

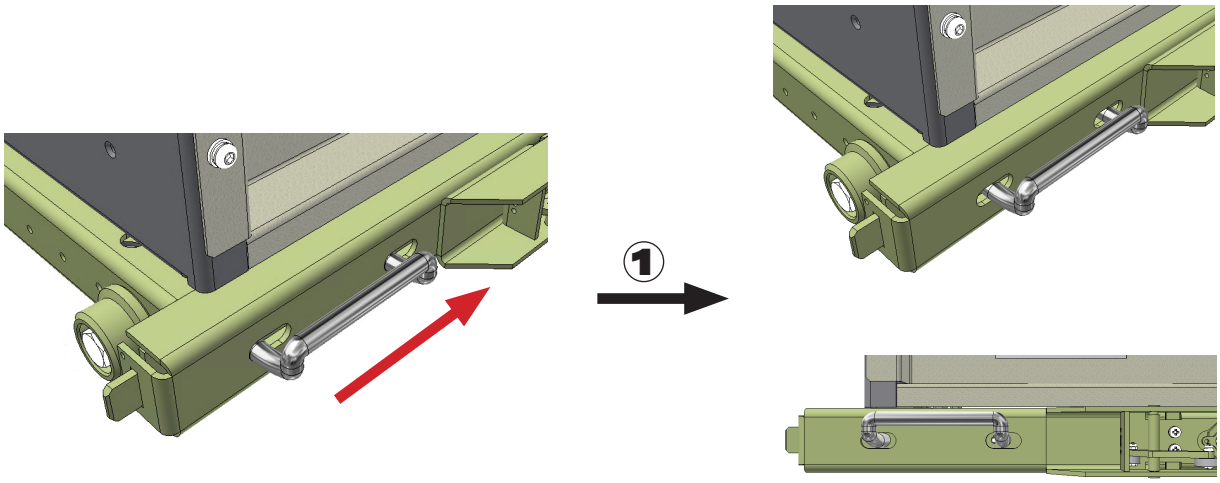


Figure 54
Setting the Handle to the Middle Position

2. Set Stopper as shown in the **Figure 55**.

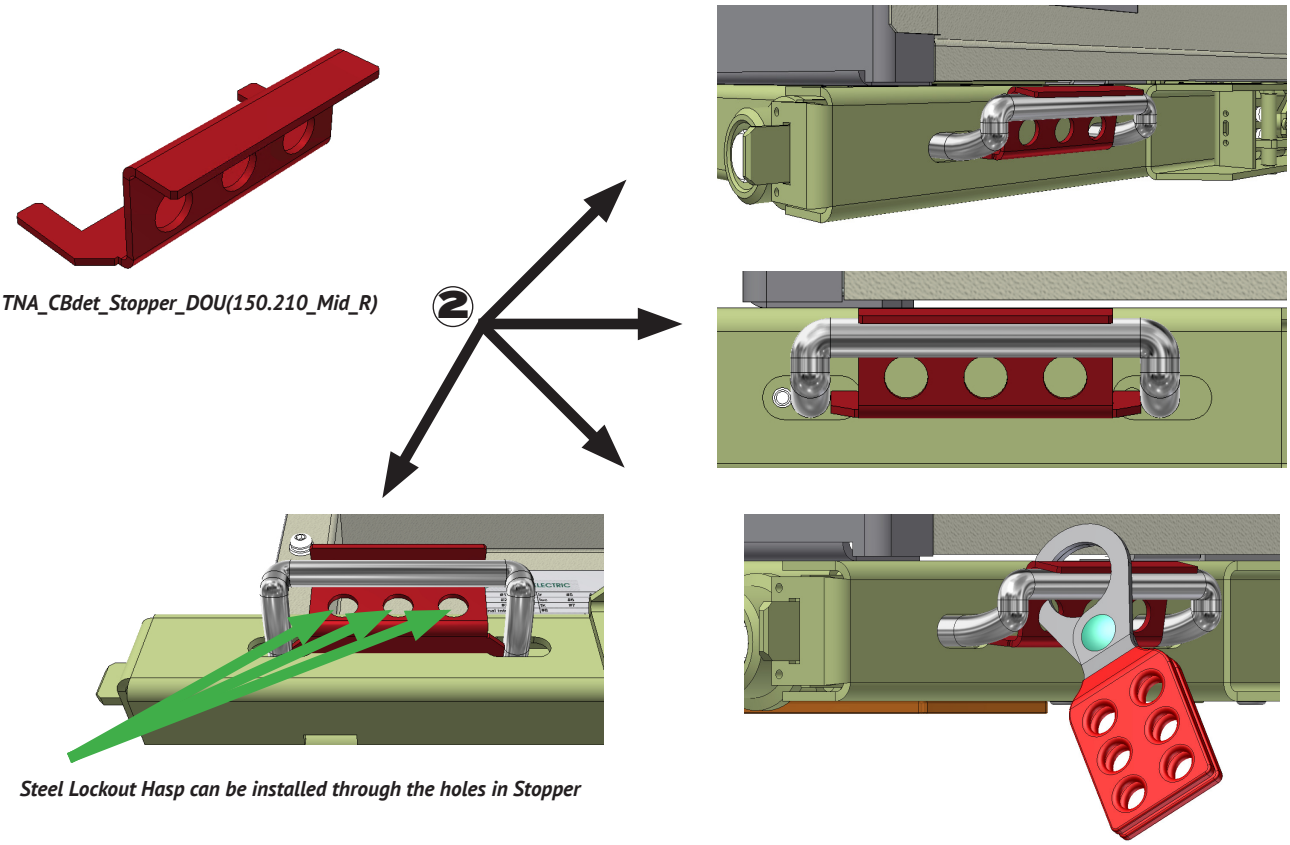


Figure 55
Setting the Stopper Into the Cassette of the Withdrawable Vacuum Circuit Breaker

6.2 CM Indication

The VCB has the following indication functionality:

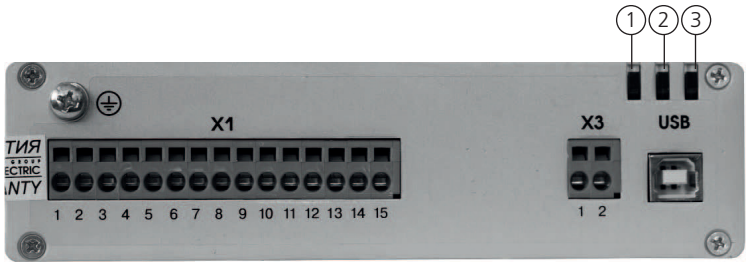
- indication provided by the DOU plate:
  - DOU plate position – DOU plate auxiliary switches (5 NO+5 NC switches).

- indication provided by the ISM:
  - ISM main contacts position (visual indication);
  - ISM main contacts position (electrical indication) – ISM auxiliary switches (6 NO+6 NC switches).

- indication provided by the CM (not in the Scope of Supply):
  - ISM main contacts position (electrical indication) – one [1)] built-in CM relay (1 NO + 1 NC with common point);
  - CM "Power" indication – LED indicator;
  - CM "Ready" state indication – LED indicator and one built in CM relay (1 NO + 1 NC with common point);
  - CM "Malfunction" state indication – LED indicator and one built-in CM relay (1 NO + 1 NC with common point).

Technical data for the ISM and the DOU plate auxiliary switches load and built-in and CM relays is provided in Chapter 4. Technical Parameters.

1) The number of CM relays indicating ISM main circuits position can be increased for certain applications, please contact your nearest sales representative for details.



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

Figure 56
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. Detailed explanations of the blink codes are provided in the **Table 16**.

Table 16 - CM Self-Diagnostic Indication

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

The following information is provided in **Table 16**:

1. The number of blinks in a series followed by 1.5 s intervals, continuous light or off state are shown for the LED indicators.
2. State of relay contact groups (C – closed, O – opened) is indicated for the NC Ready Relay and the Malfunction or Loss of Auxiliary Supply relay.
3. Period of checking the actuator coil state (short-circuit / isolated) – 10 s.

Priority of the fault indication (from highest to lowest priority):

1. CM is out of temperature range
2. The ISM state is open without a command from the CM
3. Excessive trip or close time
4. Manual trip and lock
5. Short-circuit of actuator coil
6. Actuator coil isolated
7. Power supply voltage is absent more than 1.5 seconds

The CM performs the checkup of ISM main contacts position and updates the "ISM Main Contacts Position" relay status in the following cases:

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

If the application project requires you to define the main contacts position faster than the timing mentioned above, please use the auxiliary switches installed in the ISM.

6.2.1 CM Relay Contacts Operation

The relay contacts of CM_16_1 change their state as described below.

Table 17 - CM Relay "Ready" Contacts Operation

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

Table 18 - CM Relay "ISM Main Contact Position" Contacts Operation

ISM State	Relay "ISM Main Contact Position" Contacts State	
	NC (terminals 4-5 by default)	NO (terminals 3-4 by default)
ISM is closed	Open	Closed
ISM is open	Closed	Open

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

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

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

Table 19 - CM Relay "Malfunction or Loss of Auxiliary Supply" Contacts Operation

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

7. Commissioning

The list of commissioning operations and checks is shown in **Table 20** below. Initial state of VCB components before checks: ISM – open, CM – deenergized. Main circuits of VCB shall be disconnected/isolated from the main circuits of substation to avoid high-voltage being applied to the VCB before the commissioning procedure completion. Commissioning and maintenance should only be performed by qualified and trained personnel.

Table 20 - 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 [1)]	Visual check, no tool is required	2 minutes
Protective earthing shall be according to subchapter 4.1.1	Visual check, no tool is required	1 minute
Check actual dimensions of the fixed contacts installed in the Switchgear according to subchapter 4.1.2	Ruler	2 minutes
Insert withdrawable VCB in the switchgear panel and check that the DOU plate of the ISM can be properly fixed in the panel according to **Figure 57**	Visual check, no tool is required	2 minutes
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 should be according to selected CM type	Voltmeter with measurement range according to expected power supply voltage value	2 minutes
The polarity of auxiliary power supply and selection of MCB shall be according to subchapter 4.2.5. Check for compliance between ISM type on VCB electrical data label and on CM designation label	DC voltmeter with measurement range according to expected power supply voltage value – for voltage polarity check. Visual check, no tool is required – for MCB check	2 minutes
The connection between the auxiliary circuits connector counterpart and CM shall be according to subchapters 4.2.1, 4.2.3, 4.2.4 and to the circuit diagrams in Appendix 3: Secondary schemes	Multimeter – for validation of correct wiring connections (utilizing the continuity function of the meter)	5 minutes
Check that all secondary connections have been secured adequately and that the VCB auxiliary circuits connector and its counterpart are properly connected	Visual and mechanical check of connections, no tool is required	1 minute
Turn on the CM auxiliary power supply, then check the following: • The "Power" LED must light up immediately. • The "Ready" LED must light up continuously within 15 s after switching on. • The "Malfunction" LED must not light up. • The "Ready" relay contact must close within 15 s. • The "Malfunction or Loss of auxiliary supply" relay contact must change its state [2)]. • The "ISM main contact position" relay contact must not change its state. • ISM main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute

1) Including the check of fixed contacts and bushings in the switchgear panel where these contacts are installed.

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

Table 20 - List of Commissioning Operations and Check-Ups

Operation Description	Required Tool	Approximate Timing
Tests at the end of installation		
Apply the close command to the CM, then check the following: • The "Power" LED must light up continuously. • The "Ready" LED must light up continuously. • The "Malfunction" LED must not light up. • The "Ready" relay contact must not change its state. • The "Malfunction or Loss of Auxiliary Supply" relay contact must not change its state. • The "ISM main contact position" relay contact must change its state. • ISM main contacts must change their state (ISM shall be closed).	Visual check, no tool is required	1 minute
Apply the trip command to the CM, then check the following: • The "Power" LED must light up continuously. • The "Ready" LED must light up continuously. • The "Malfunction" LED must not light up. • The "Ready" relay contact must not change its state. • The "Malfunction of Loss of auxiliary supply" relay contact must not change its state. • The "ISM main contact position" relay contact must change its state. • VCB main contacts must change their state (ISM shall be open).	Visual check, no tool is required	1 minute
Do not remove trip command and apply close command to the CM, then check the following: • The "Power" LED must light continuously. • The "Ready" LED must light continuously. • The "Malfunction" LED must not light up. • The "Ready" relay contact must not change its state. • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state. • The "ISM main contact position" relay contact must not change its state. • VCB main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute
Remove close and trip commands to the CM then check the following: • The "Power" LED must light up continuously. • The "Ready" LED must light up continuously. • The "Malfunction" LED must not light up. • The "Ready" relay contact must not change its state. • The "Malfunction or Loss of auxiliary supply" relay contact must not change its state. • The "ISM main contact position" relay must not change its state. • VCB main contacts must not change their state (ISM shall remain open).	Visual check, no tool is required	1 minute

Table 20 - List of Commissioning Operations and Check-Ups

Operation Description	Required Tool	Approximate Timing
Tests at the end of installation		
Apply and keep the close command and then apply the trip command to the CM, then check the following: • The "Power" LED must light up continuously. • The "Ready" LED must go out after the trip of the ISM and then light up continuously within 10 s. • The "Malfunction" LED must not light up. • The "Ready" relay contact must change its state after the trip of the ISM and then change its state again within 10 s. • The "Malfunction or Loss of Auxiliary Supply" relay contact must not change its state. • The "ISM main contact position" relay contact must change its state each time when ISM is closed and open. • VCB main contacts must change their state each time the ISM is closed and opened.	Visual check, no tool is required	1 minute
Close ISM and try to rack VCB in the switchgear panel according to the **Figure 58**. It shall be impossible to rack the VCB in the panel.	Visual check, no tool is required	1 minute
Open ISM and try to rack VCB in the switchgear panel according to the **Figure 59**. by making one turn of the DOU plate operation lever. It shall be possible to rack the VCB in the panel.	Visual check, no tool is required	1 minute
Try to close ISM while the DOU plate in the intermediate position according to the **Figure 60**. It shall be impossible to close the ISM.	Visual check, no tool is required	1 minute
Rack out the DOU plate and close the ISM. Then trip the ISM mechanically by manual trip button according to the **Figure 61**. The VCB main contacts must change their state each time the ISM is closed and opened.	Visual check, no tool is required	1 minute
Primary Circuits Insulation Check [3)]		
Remove withdrawable VCB from the switchgear panel [4)].	-	2 minutes
Observe safety precautions listed in the danger and warning advisories. Construct proper barriers and warning light systems [5)].	Equipment to provide safety in the test area	10 minutes
Ground each pole of VCB that is not being tested [6)]	Wires	2 minutes
Apply slowly rising 100% [7)] of test voltage [8)] (50 or 60 Hz) across each pole for one minute [9)]. (ISM is open).	Power frequency withstand voltage test set	2 minutes

3) 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.

4) In cases where the VCB is tested separately from the switchgear panel.

5) The insulation barriers shall be also installed between the movable contacts of the withdrawable VCB to prevent the discharges appearance in this area for cases where the VCB is tested separately from the switchgear panel.

6) The VCB should be tested phase by phase only. Therefore, poles not under test should be grounded.

7) For test of separate VCB - 100% level of test voltage, for test of Switchgear with installed VCB - 80% level of test voltage in accordance with IEC 62271-200.

8) Rated test voltage levels (Ud) are given in **Table 10 - Main Technical Parameters**.

9) To apply the test voltage, single-core short cables should be used. The 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 62**) shall be used.

Table 20 - List of Commissioning Operations and Check-Ups

Operation Description	Required Tool	Approximate Timing
Tests at the end of installation		
If the pole sustains the test voltage for that period, its vacuum integrity has been verifed [10].	Power frequency withstand voltage test set	-
Repeat actions above to check each pole of VCB.	Power frequency withstand voltage test set	8 minutes
Close the ISM. Ground each pole of VCB that is not under test [6].	Wires	1 minute
Apply slowly rising 100% [7] of test voltage [8] (50 or 60 Hz) between a primary conductor of the pole and ground for one minute, repeat test for each pole of VCB	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 withdrawable VCB secondary circuits with a shorting wire [11]. VCB shall not be connected to 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. Starting with zero volts, gradually increase the test voltage to 2000 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.	Visual check, no tool is required	2 minutes
Primary Circuits Contact Resistance Check		
ISM shall be closed before the test. There should not be any external circuits connected to VCB main terminals that provide parallel circuit with the VCB main circuits otherwise tests will be invalid.	Visual check, no tool is required	1 minute
Test equipment shall be connected to VCB main circuits terminals according to **Figure 63** to 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 10 - Main Technical Parameters**	Visual check, no tool is required	-

10) 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.

11) The VCB auxiliary circuits connector counterpart may be used for this.

After these tests have been performed successfully, the VCB can be put into operation.

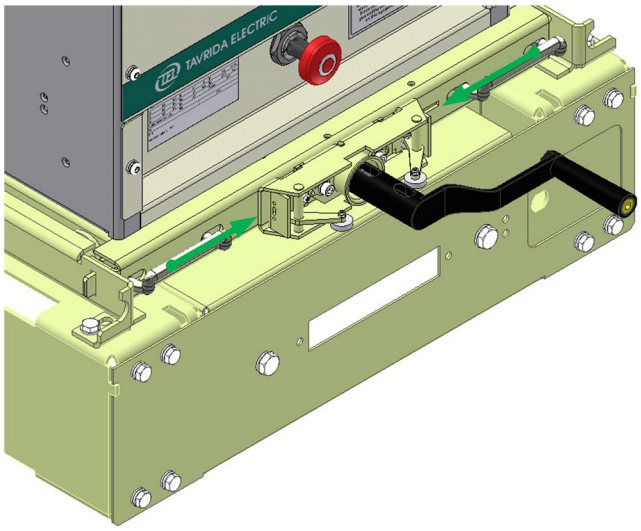


Figure 57
Checkup of the Withdrawable VCB Fixing Iin the Switchgear Panel

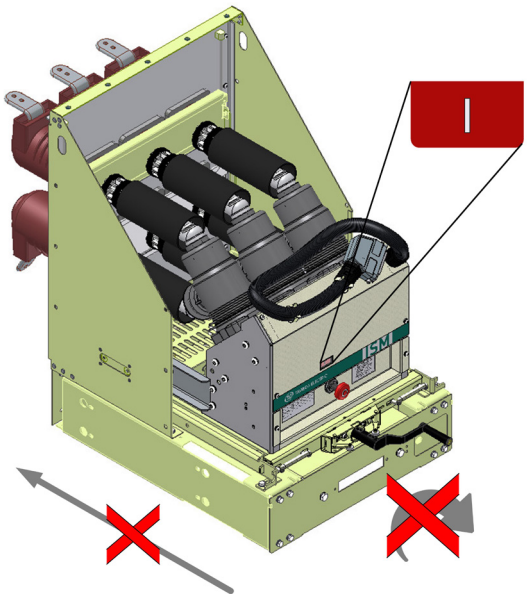


Figure 58
The DOU Cannot Be Moved While the ISM is Closed

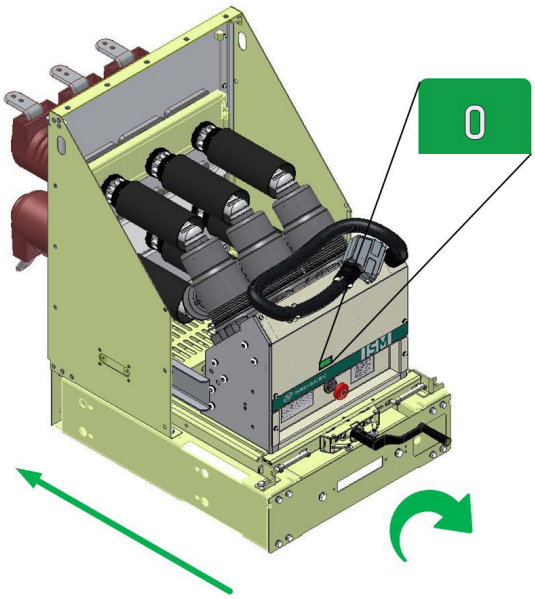


Figure 59
The DOU Plate Can Be Racked in While ISM is Open

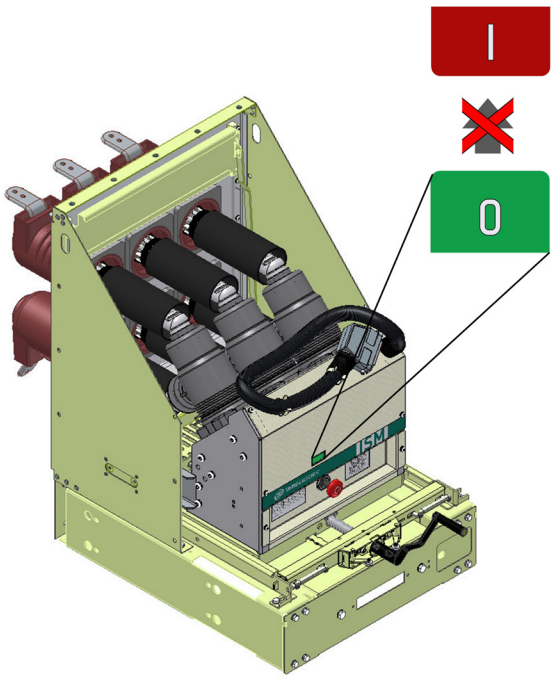


Figure 60
The ISM Cannot Be Closed While DOU in the Intermediate Position

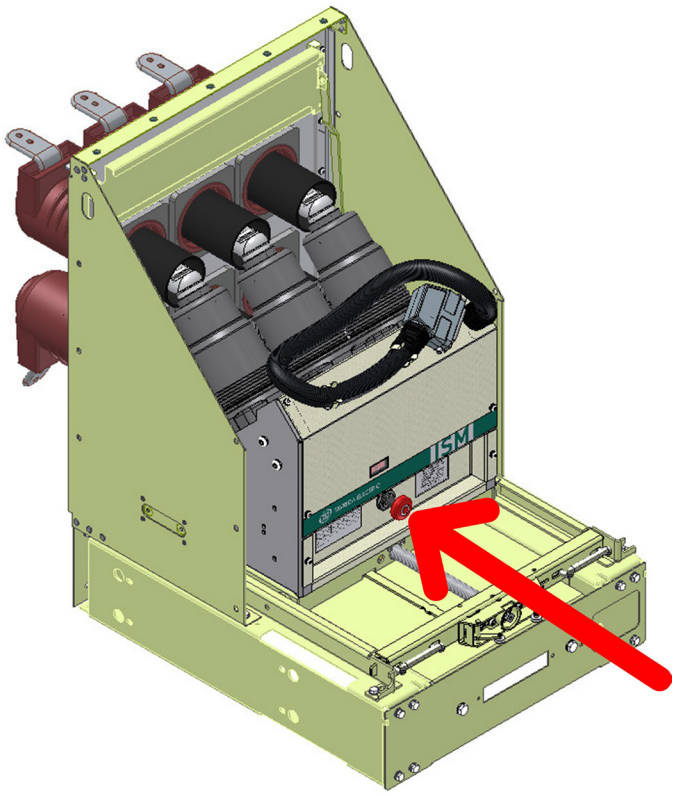


Figure 61

The ISM Manual Trip Execution

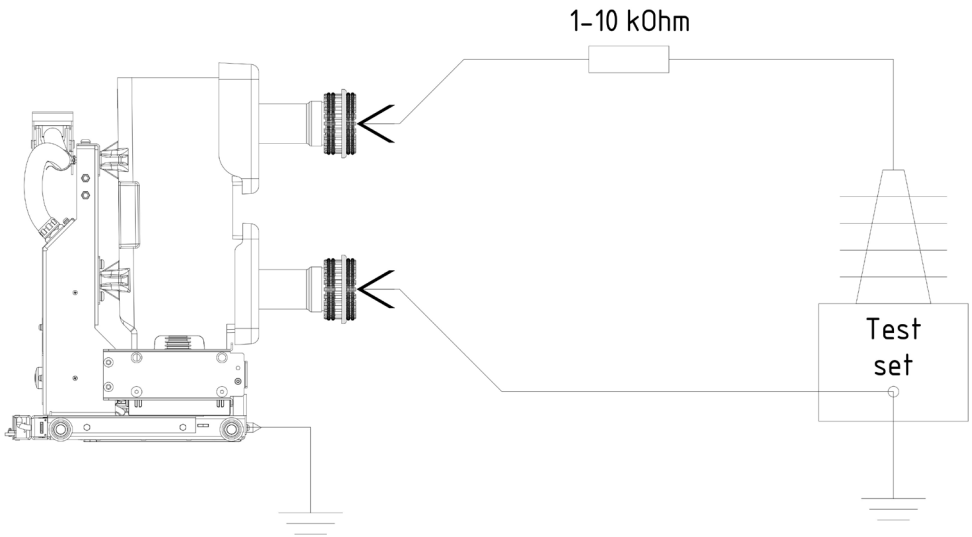
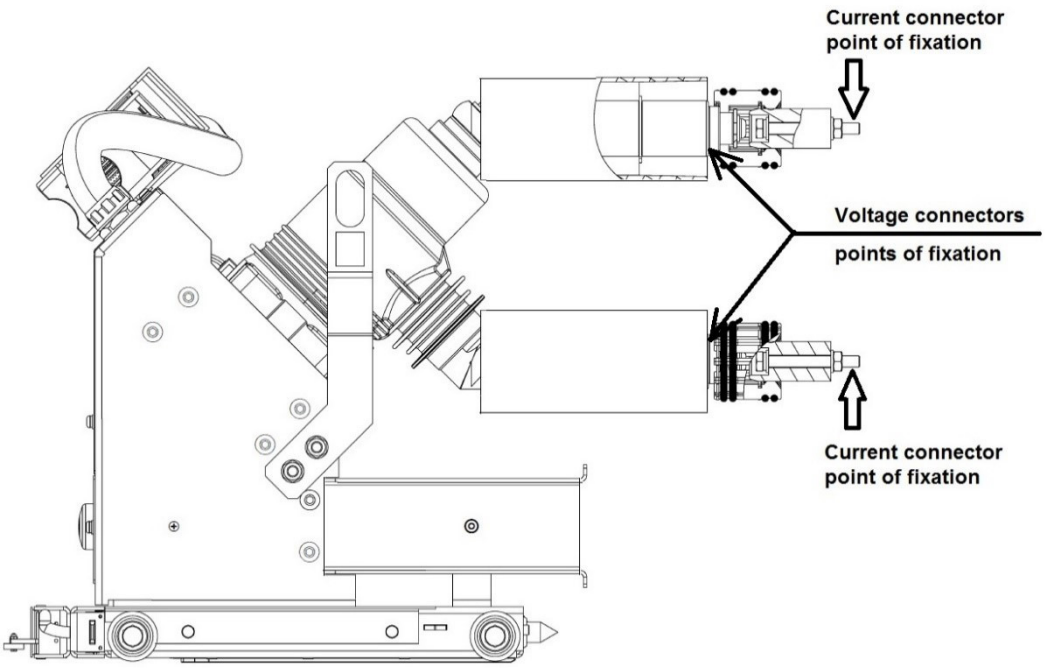
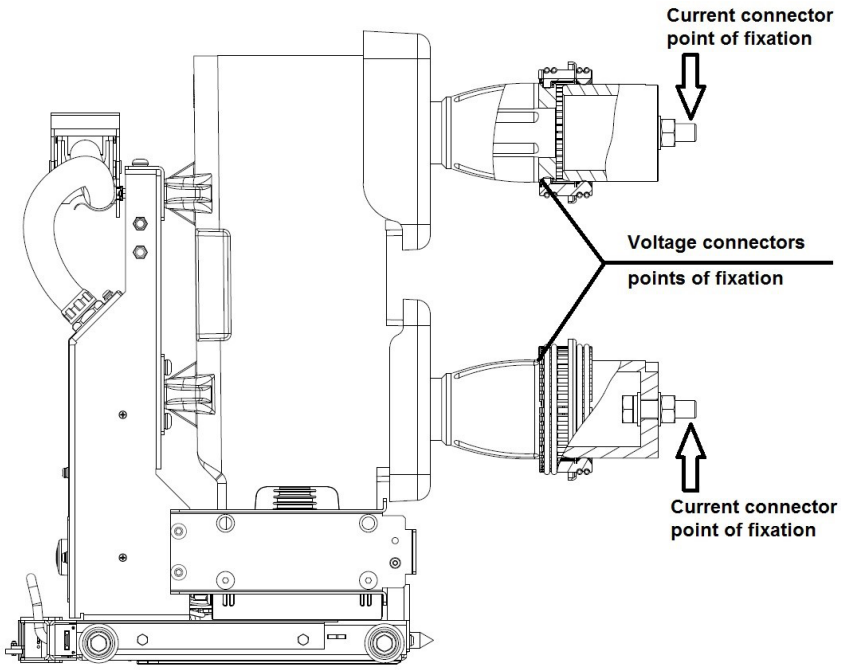


Figure 62

The Vacuum Integrity and Solid Insulation Test Installation



a) VCB15_MD1_16D



b) VCB15_HD1_16D

Figure 63

The Connection Points of the Contact Resistance Meter

Note:

To conveniently attach the current connectors and to prevent damage to the fixed contacts surface, please insert bolts (used for the contacts attachment in the switchgear panel) in the fixed contacts and screw them tightly with nuts. Then use these bolts as points to attach the current connectors.

8. Maintenance and Troubleshooting

8.1 Primary Circuits

Under normal operating conditions (see **Table 10 - Main Technical Parameters**), the ISM is maintenance-free until it has reached the permissible number of operating cycles.

However, when maintenance is carried out on the complete switchgear, the commissioning tests should be repeated. Check that the VCB is disconnected from all voltage sources before inspecting its insulating parts. The withdrawable VCB should be inspected at least once every 5 years. More frequent inspections (up to one time per six months) are recommended when the VCB works in unfavorable conditions such as dust and moisture. Test results should be treated as given in **Table 21.**

Table 21 - List of Tests and Check-Ups of the Withdrawable 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
Check the moveable contacts condition – absence of any main contacts overheating tracks and damages of silver coating should be ascertained.	Visual check, no tool is required	1 minute
ISM Operation Check		
Perform close and open operation of the ISM. Modules shall be operable, VCB contacts position indicator shall properly work. Otherwise, check the control circuit.	Visual check, no tool is required	1 minute
Perform interlocks check. Interlocks shall work properly.	Visual check, no tool is required	5 minutes
Primary Circuits Insulation Check [1)]		
Observe safety precautions listed in the danger and warning advisories. Construct the proper barrier and warning light system [2)].	Equipment to provide safety in test area	10 minutes
Ground each pole which is not under test	Wires	2 minutes
Apply slowly rising 100% [3)] of test voltage [4)] (50 or 60 Hz) across each pole for one minute [5)]. (ISM is open.)	Power frequency withstand voltage test set	2 minutes
If the pole sustains the test voltage for that period, its vacuum integrity has been verifed [6)].	Power frequency withstand voltage test set	-

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) The insulation barriers shall be also installed between the movable contacts of the withdrawable VCB to prevent the discharges appearance in this area - in cases where the VCB is tested separately from the switchgear panel.
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 10** above.
5) 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 the VCB, the extra resistor (as shown in **Figure 62**) shall be used.
6) During testing of vacuum interrupter, self-fading restrikes may appear. In case of restrikes, reduce the voltage slightly until the restrikes disappear (for 10-15 seconds) and then increase again.

Table 21 - List of Tests and Check-Ups of the Withdrawable ISM During Maintenance

Operation Description	Required Tool	Approximate Timing
Repeat actions above to check each pole of the VCB.	Power frequency withstand voltage test set	8 minutes
Close the ISM. Ground each pole not under test.	Wires	1 minute
Apply slowly rising 80% 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 VCB.	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
Primary Circuits Contact Resistance Check [7]		
ISM shall be closed before the test. There should not be any external circuits connected to VCB main terminals that provide parallel circuit with the VCB main circuits, otherwise the tests will be invalid.	Visual check, no tool is required	1 minute
Test equipment shall be connected to VCB main circuits terminals according to **Figure 63** to 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 10 - Main Technical Parameters**.	Visual check, no tool is required	-

7) 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,

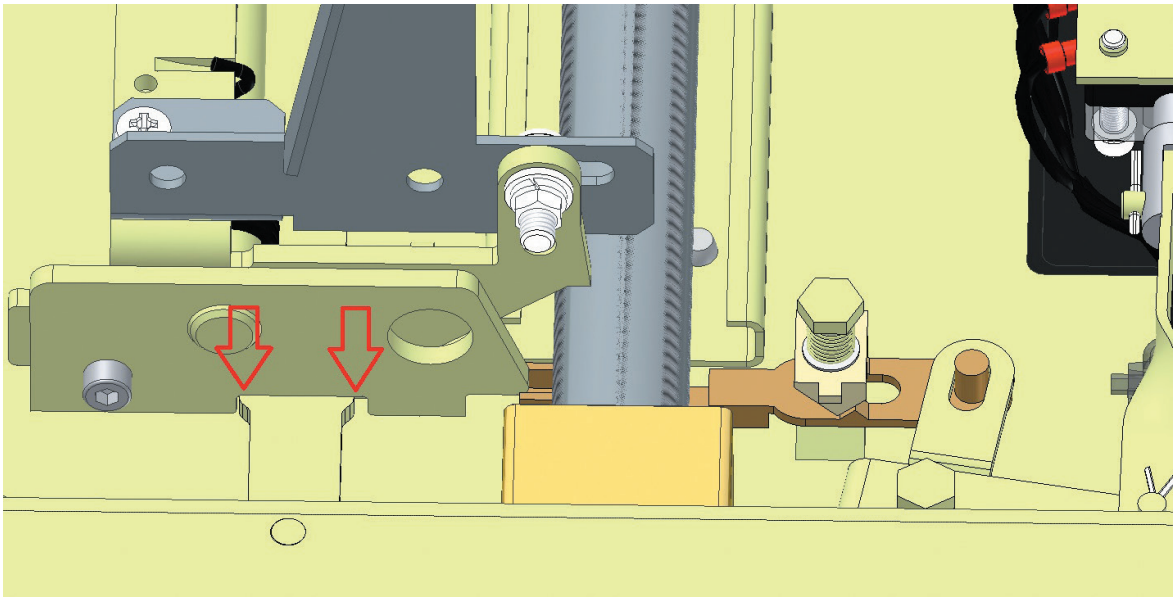
Ir, Rr — rated values (**Table 10**).

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

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

DOU Plate Maintenance

Bearing points and sliding surfaces of DOU plate should be lubricated at least once per five years with a thin film of GE Lubricant D6A15A1 (MobilGrease 28, catalog number 193A1751P1). Clean the surfaces to be lubricated with an industry-approved solvent.



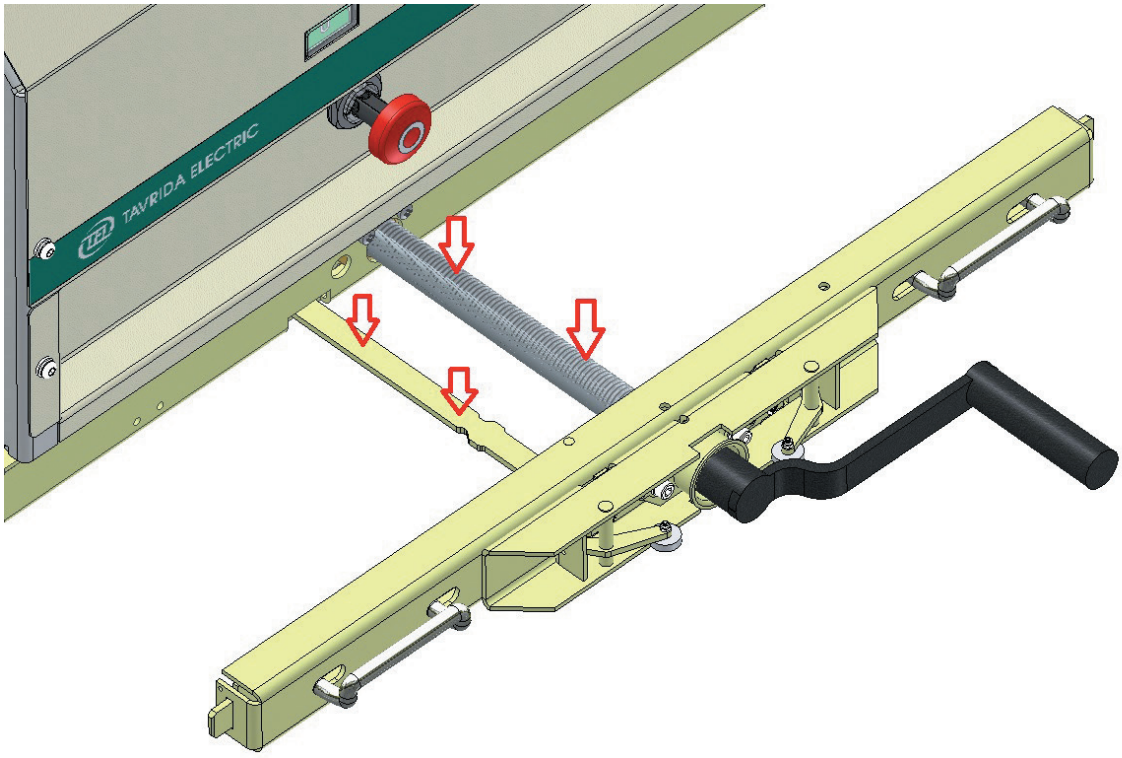


Figure 64
DOU plate lubricated surfaces

Remove all excess lubricant with a clean, lint-free cloth to avoid the accumulation of dirt or dust. Do not lubricate the outside diameters of the DOU plate rollers.

Main Contacts

The fixed contacts in the switchgear panel and the contact surfaces of the ISM movable contacts should be lubricated at least once per five years with a thin film of GE Lubricant D6A15A1 (MobilGrease 28, catalog number 193A1751P1). Clean the surfaces to be lubricated with an industry-approved solvent.

Remove all excess lubricant with a clean, lint-free cloth to avoid accumulation of dirt or dust.

8.2 Secondary Circuits

The CM is inherently maintenance-free. However when maintenance is carried out on the complete 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 22**.

Table 22 - List of Tests and Checkups of the CM During Maintenance

Operation Description	Required Tool	Approximate Timing
Auxiliary Circuits Insulation Check		
Connect all points of the withdrawable VCB secondary circuits with a shorting wire. VCB shall be disconnected from the CM before the test.	Wires	5 minutes
Connect the shorting wire mentioned in previous clause 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.	Visual check, no tool is required	2 minutes

8.3 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 non-conformity, any repairs are strictly prohibited without permission from the sales representative.

If you suspect a failure has occurred, perform the checks as mentioned in **Table 23** prior to contacting our regional representative.

Table 23 - Typical Failure 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 VCB.	VCB internal failure.	Replacement of VCB.
VCB cannot pass power frequency voltage withstand test at 80 % of rated voltage.	VCB internal failure.	Replacement of VCB.

Table 23 - Typical Failure Symptoms and Methods of Their Elimination

Failure Description	Possible Reason	Method of Elimination
ISM cannot perform close/trip operation.	ISM is interlocked.	Check VCB interlocks state and its actuator coil connection with connector CM.
	CM failure.	Check CM LED states.
	VCB internal failure.	Replacement of VCB.
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 CM, check state of VCB electrical interlocks.
3 blinks of CM "Malfunction" LED.	ISM actuator coil circuit is interrupted.	Check the circuit of ISM actuator coil connection with CM, check state of VCB electrical interlocks
4 blinks of CM "Malfunction" LED.	Short circuit of ISM actuator coil circuit.	Check the circuit of ISM actuator coil connection with CM, check state of VCB electrical interlocks.
Failure description	Possible reason	Method of elimination
5 blinks of CM "Malfunction" LED.	Manual trip of ISM and ISM is electrically interlocked.	Check the ISM and VCB interlock state
6 blinks of CM "Malfunction" LED.	Overheating of CM.	Stop performing CO operations until the blinks stop if temperature is above the temperature range or move CM into environment with higher temperature if temperature is below the temperature range.
7 blinks of CM "Malfunction" LED.	ISM state is open without command from the CM.	Check the ISM and VCB interlock state.
CM "Malfunction" LED lights continuously.	CM internal failure.	Replacement of CM.
None of CM LEDs lights.	Absence of CM power supply.	Check presence of CM power supply, its polarity and voltage level.
	CM internal failure.	Replacement of CM.

The VCB 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.

9. 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.
Type Tests

Type Tests of ISM15_MD

Standard	Chapter	Test name	Test center name	Test report
IEC 62271-100	6.2.6.1	Power-frequency withstand voltage test	KEMA	KEMA 1398-18
IEC 62271-100	6.2.6.2	Lightning impulse withstand voltage test	KEMA	KEMA 1398-18
IEC 62271-100	6.2.9	Partial discharge tests	KEMA	KEMA 1398-18
IEC 62271-100 IEC 60255-27	6.2.10 10.6.4.2	Dielectric tests on auxiliary and control circuits	KEMA	KEMA 1398-18
IEC 62271-100	6.10.3	Electrical continuity of earthed metallic parts test	KEMA	KEMA 1398-18
IEC 62271-100	6.4	Measurement of the resistance of the main circuit	KEMA	KEMA 1399-18
IEC 62271-100	6.5	Temperature-rise tests on the main circuits	KEMA	KEMA 1399-18
IEC 62271-100	6.5.5	Temperature-rise tests on auxiliary and control equipment	KEMA	KEMA 1399-18
IEC 62271-200	6.102.2	Mechanical and electromechanical interlocks tests	KEMA	KEMA 2221-18
IEC 62271-100	6.6	Short-time withstand current and peak withstand current tests	KEMA	KEMA 2222-18
IEC 62271-100	6.102-6.106	Short-circuit current making and breaking tests	KEMA	KEMA 2085-19
IEC 62271-100	6.102-6.105, 6.108	Single-phase earth fault test	KEMA	KEMA 2222-18
IEC 62271-100	6.102-6.105, 6.108	Double-earth fault test	KEMA	KEMA 2222-18
IEC 62271-100	6.102-6.105, 6.112	Making and breaking tests on class E2	KEMA	KEMA 2085-19
IEC 62271-100	6.101.2	Mechanical operation test at ambient temperature	KEMA	KEMA 2324-18
IEC 62271-100	6.101.3	Low and high temperature tests	KEMA	KEMA 2324-18
IEC 62271-100	6.111.5.1	Line-charging and cable-charging current switching tests	KEMA	KEMA 2269-18
IEC 62271-1	6.11 7.11	X-radiation test for vacuum interrupters	CESI	CESI B8012097
IEEE C37.09	4.4 4.4.7	Continuous current-carrying tests. Measurement of resistance of the main circuits	KEMA	KEMA 1504-18
IEEE C37.09	4.5 5.16	Dielectric withstand tests. Power frequency withstand voltage tests. Dry	KEMA	KEMA 1503-18
IEEE C37.09	4.5.5	Dielectric withstand tests. Lightening impulse voltage test	KEMA	KEMA 1503-18
IEEE C37.09	4.6	Standard operating duty (standard duty cycle) tests	KEMA	KEMA 2086-19
IEEE C37.09	4.7	Interrupting time tests	KEMA	KEMA 2086-19
IEEE C37.09	4.8	TRV tests	KEMA	KEMA 2086-19
IEEE C37.09	4.8	Short-circuit current interrupting tests	KEMA	KEMA 2086-19 KEMA 2267-18
IEEE C37.09	4.9	Load current	KEMA	KEMA 2086-19
IEEE C37.09a	4.10	Cable capacitive current switching test	KEMA	KEMA 2270-18
IEEE C37.09a	4.10	Line capacitive current switching test	KEMA	KEMA 2270-18
IEEE C37.09	4.13	Mechanical endurance tests. Low temperature	KEMA	KEMA 2325-18
IEEE C37.09	4.13	Mechanical endurance tests. Normal conditions	KEMA	KEMA 2325-18

Type Tests of ISM15_HD

Standard	Chapter	Test name	Test center name	Test report
IEC 62271-100	6.2.6.1	Power-frequency withstand voltage test	KEMA	KEMA 1656-18 KEMA 1717-18
IEC 62271-100	6.2.6.2	Lightning impulse withstand voltage test	KEMA	KEMA 1656-18 KEMA 1717-18
IEC 62271-100	6.2.9	Partial discharge tests	KEMA	KEMA 1656-18 KEMA 1717-18
IEC 62271-100 IEC 60255-27	6.2.10 10.6.4.2	Dielectric tests on auxiliary and control circuits	KEMA	KEMA 1656-18
IEC 62271-100	6.10.3	Electrical continuity of earthed metallic parts test	KEMA	KEMA 1656-18 KEMA 1717-18
IEC 62271-100	6.4	Measurement of the resistance of the main circuit	KEMA	KEMA 1719-18 KEMA 1721-18
IEC 62271-100	6.5	Temperature-rise tests on the main circuits	KEMA	KEMA 1719-18 KEMA 1721-18
IEC 62271-100	6.5.5	Temperature-rise tests on auxiliary and control equipment	KEMA	KEMA 1719-18 KEMA 1721-18
IEC 62271-200	6.102.2	Mechanical and electromechanical interlocks tests	KEMA	KEMA 2355-18 KEMA 2370-18
IEC 62271-100	6.6	Short-time withstand current and peak withstand current tests	KEMA	KEMA 2351-18
IEC 62271-100	6.102-6.106	Short-circuit current making and breaking tests	KEMA	KEMA 2351-18
IEC 62271-100	6.102-6.105, 6.108	Single-phase earth fault test	KEMA	KEMA 2351-18
IEC 62271-100	6.102-6.105, 6.108	Double-earth fault test	KEMA	KEMA 2351-18
IEC 62271-100	6.102-6.105, 6.112	Making and breaking tests on class E2	KEMA	KEMA 2351-18
IEC 62271-100	6.101.2	Mechanical operation test at ambient temperature	KEMA	KEMA 2343-18
IEC 62271-100	6.101.3	Low and high temperature tests	KEMA	KEMA 2343-18
IEC 62271-100	6.111.5.1	Line-charging and cable-charging current switching tests	KEMA	KEMA 2353-18
IEC 62271-1	6.11 7.11	X-radiation test for vacuum interrupters	CESI	CESI B8012097

Type Tests of CM_16

Standard	Test name	Test center name	Test report
IEC 60255-26 IEC 61000-4-2	Electrostatic discharge immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-3	Radiated electromagnetic field immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 62271-1 IEC 61000-4-4	Fast transient burst immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-5	Surge immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-6	Conducted disturbance induced by radio frequency fields immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-8	Power frequency magnetic field immunity test	KEMA	KEMA TIC 1371-14
IEC 61000-4-9	Pulse magnetic field immunity test	KEMA	KEMA TIC 1371-14
IEC 61000-4-10	100 kHz damped oscillatory magnetic field immunity test	KEMA	KEMA TIC 1371-14
IEC 61000-4-10	1 MHz damped oscillatory magnetic field immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-11	AC voltage dips and interruptions immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-16	Power frequency disturbance voltage immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 62271-1 IEC 61000-4-18	100 kHz damped oscillatory wave immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 62271-1 IEC 61000-4-18	1 MHz damped oscillatory wave immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 61000-4-27	Ripple on DC power supply immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-26 IEC 62271-100 IEC 61000-4-29	DC voltage dips and interruptions immunity test	KEMA	KEMA TIC 1371-14
IEC 60255-27 IEC 62271-100	Power frequency withstand voltage test	KEMA	KEMA TIC 1371-14
IEC 60255-27	Insulation resistance test	KEMA	KEMA TIC 1371-14
IEC 60255-27	Impulse withstand voltage test	KEMA	KEMA TIC 1371-14

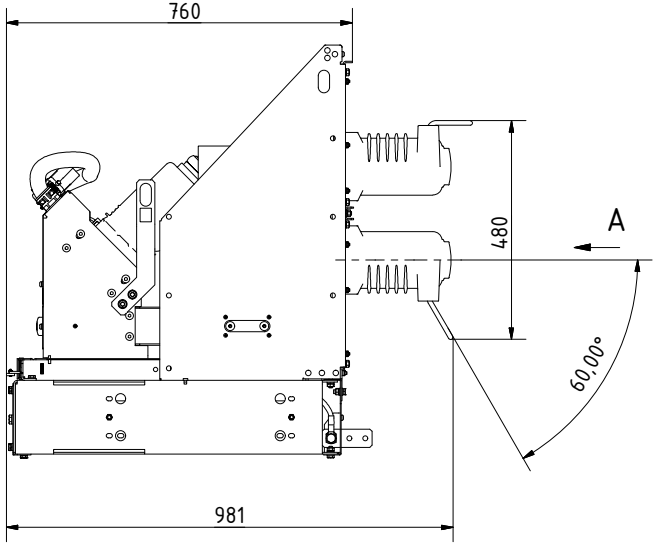
Appendix 2. Withdrawable VCB Package Dimensions

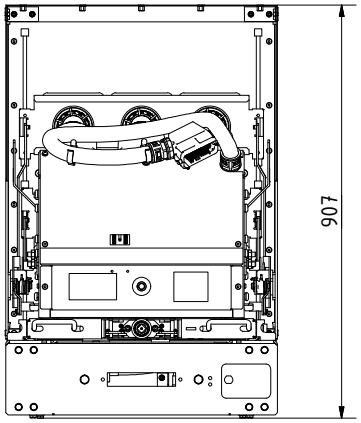
Withdrawable VCB Package Dimensions

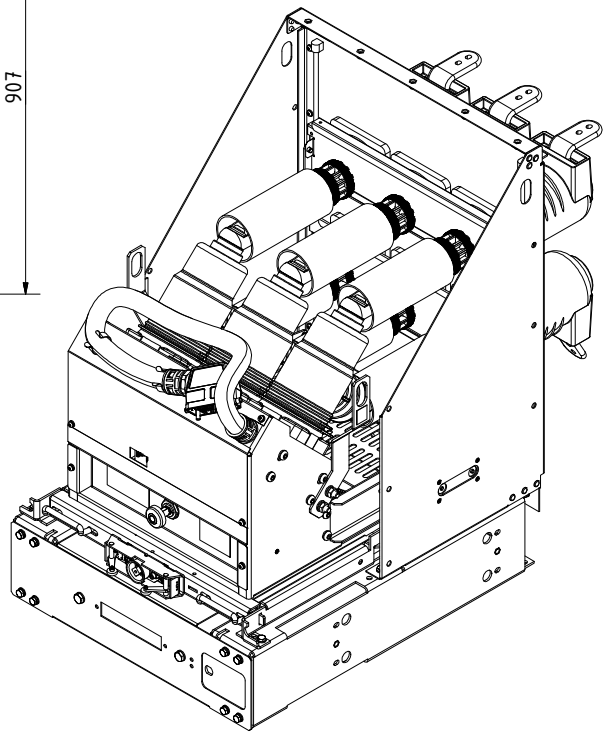
Withdrawable VCB	PCD	Package Dimensions, not more than (LxWxH), mm
CR15_MD1_16D	150	1150x990x1080
	210	
CR15_HD1_16D	210	1150x990x1320
	275	

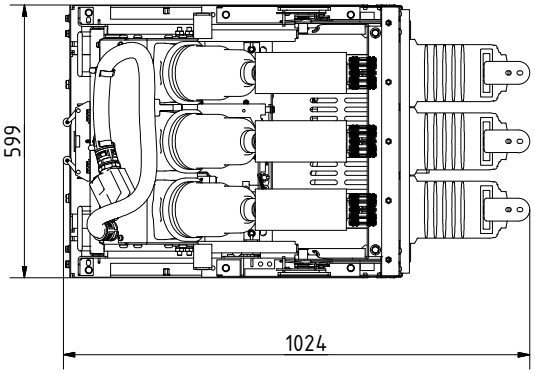
Appendix 3.
Overall Drawings

CR15_MD1_16D PCD 150 mm

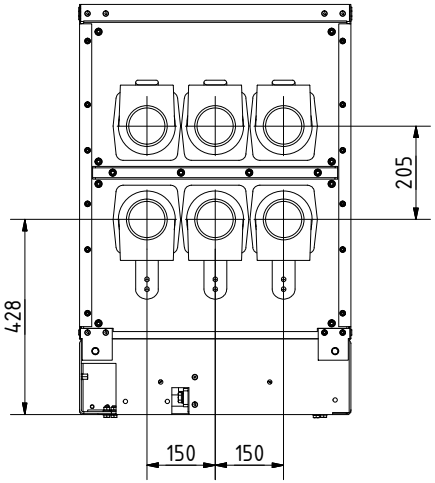








A



NOTES:
1. Dimensions are for reference only.
2. Dimensions are shown in mm.
3. Umbilical length for connecting secondary circuits – 800mm

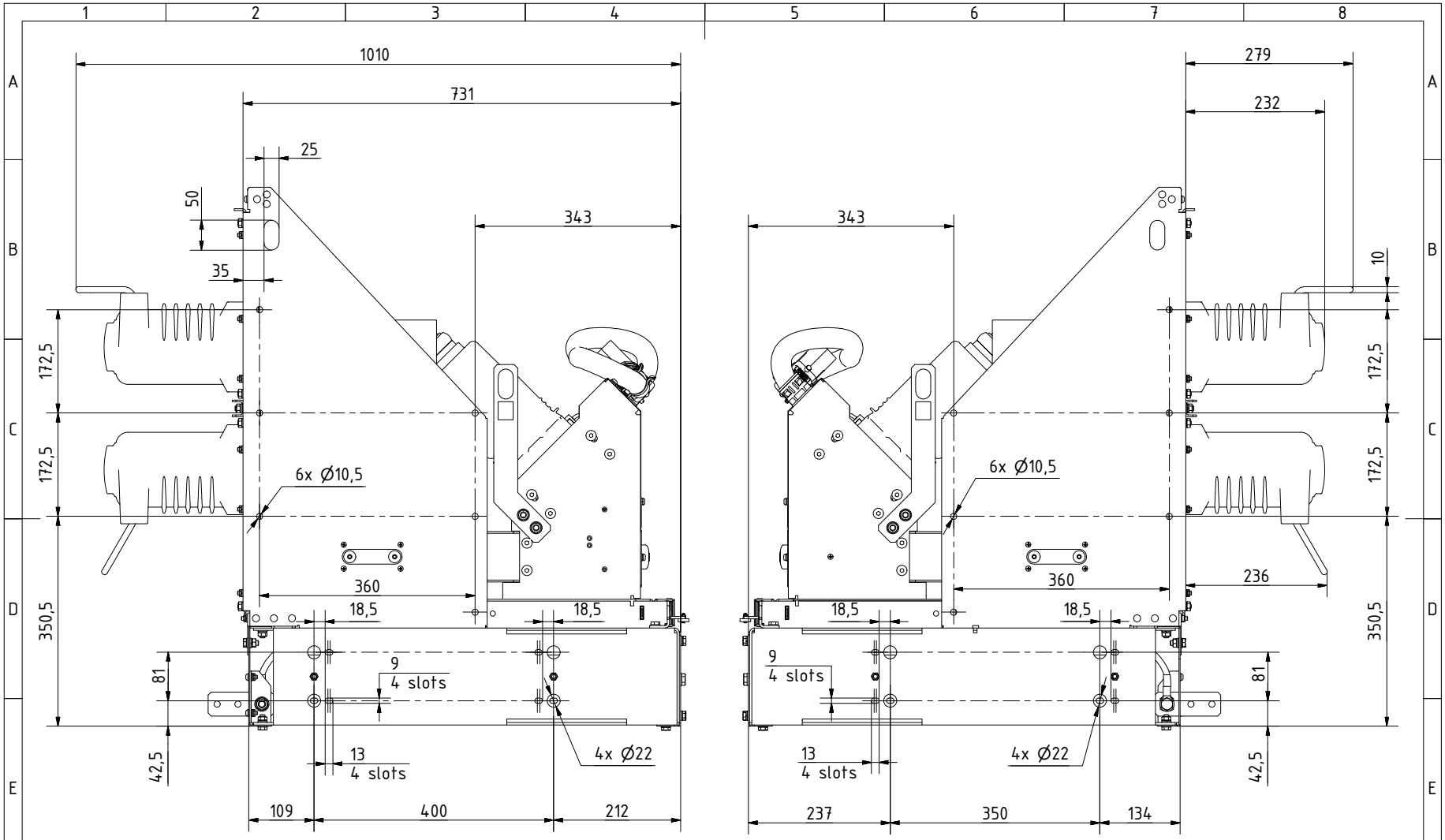
CR15_MD1_16D
15 kV, 1250 A, PCD: 150 mm,
weight: 143 kg

L_{max} = 1024 mm
W_{max} = 599 mm
H_{max} = 907 mm

Designed by	Date	Checked by	Approved by	Date	Weight	TEL ID
I.Markov	14.03.2024	A.Bushuev	V.Kirienko	14.03.2024	143,0 kg	B12QKE1111B

TAVRIDA ELECTRIC | TES_CR15_MD1_16D(1_1_1_1_1_1_1_2_3_2_1_1_3)

Vacuum circuit breaker | Scale 1 : 10 | Sheet 1 /2 | Revision 0 | A3



Designed by	Date	Checked by	Approved by	Date	Weight	TEL ID
I.Markov	14.03.2024	A.Bushuev	V.Kirienko	14.03.2024	143,0 kg	B12QKE1111B

TAVRIDA ELECTRIC

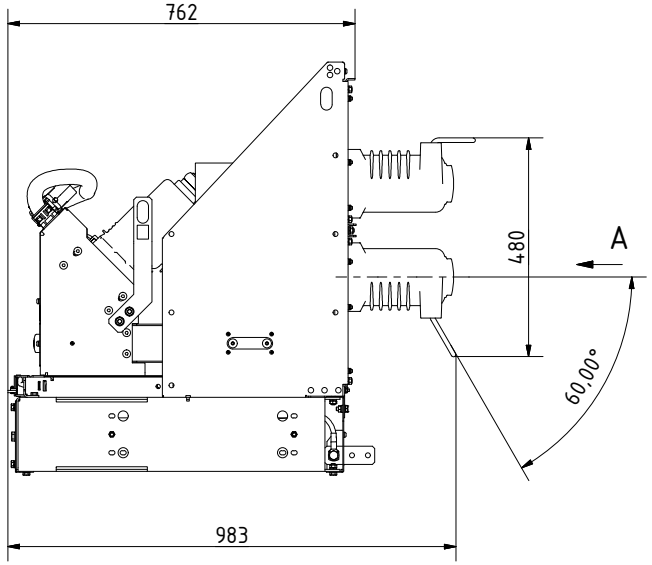
TES_CR15_MD1_16D(1_1_1_1_1_1_1_2_3_2_1_1_3)

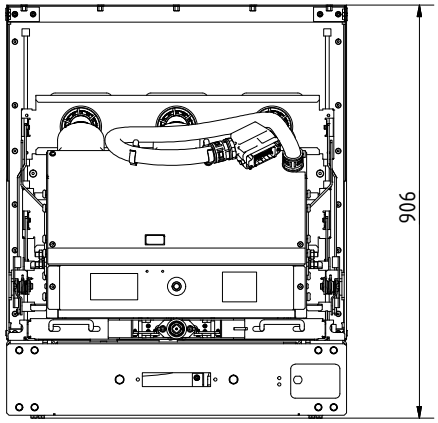
Vacuum circuit breaker

Scale	Sheet	Revision
1 : 10	2 /2	0

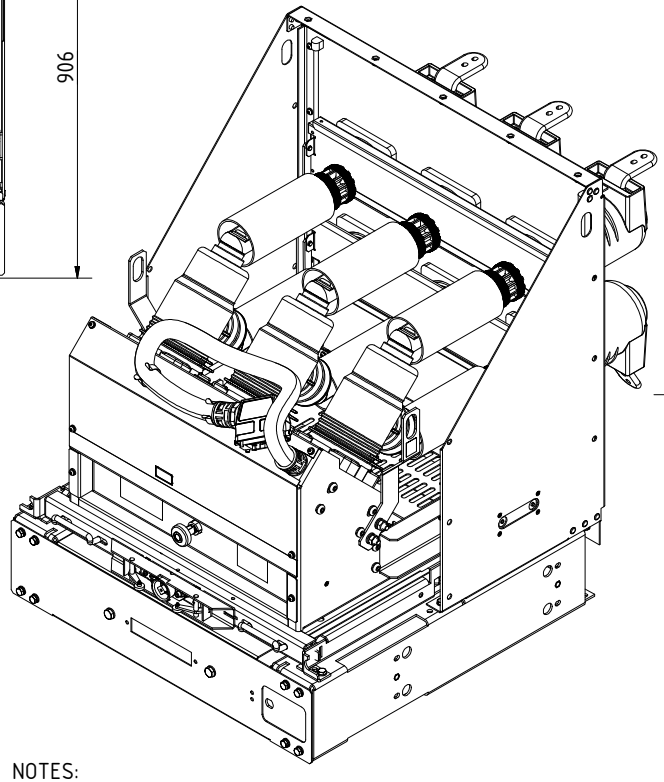
A3

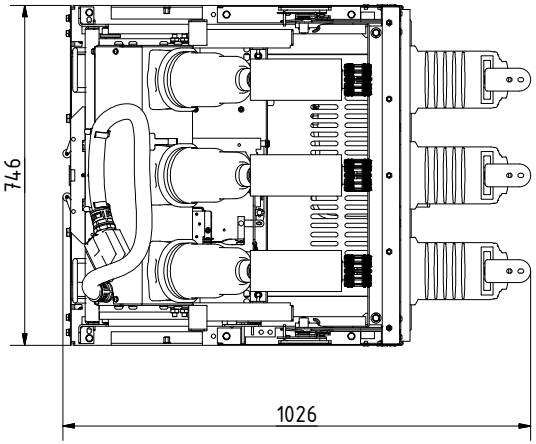
CR15_MD1_16D PCD 210 mm

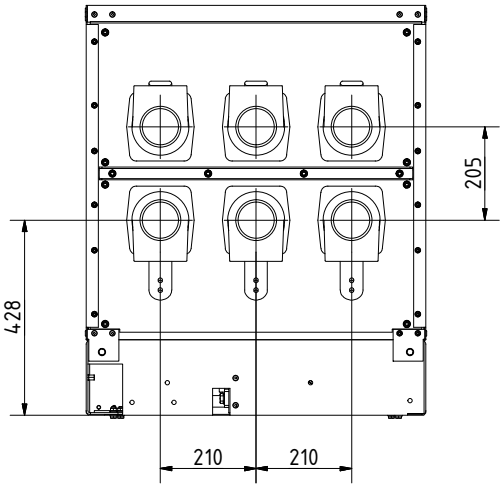




A







NOTES:
1. Dimensions are for reference only.
2. Dimensions are shown in mm.
3. Umbilical length for connecting secondary circuits – 800mm

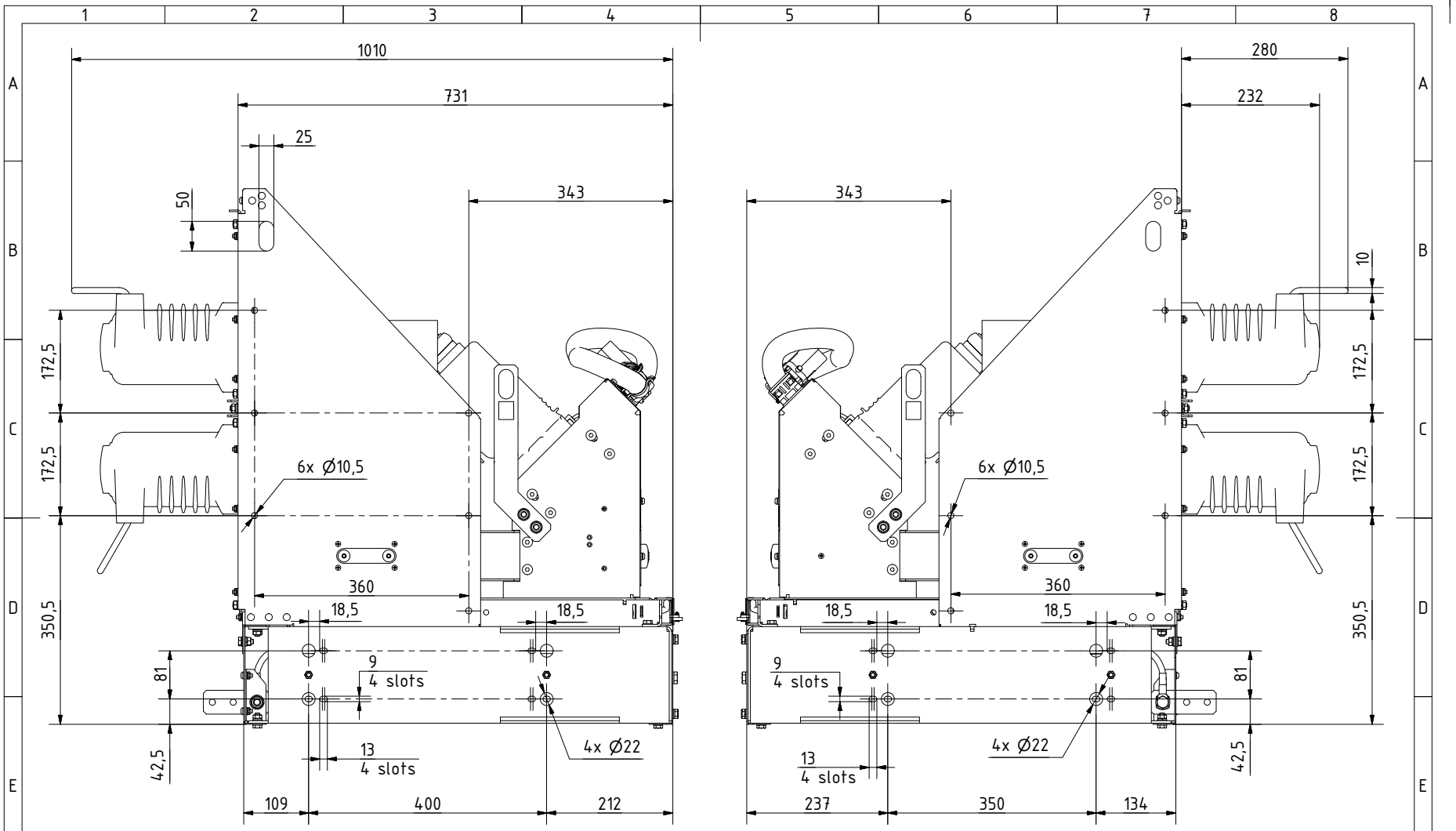
CR15_MD1_16D
15 kV, 1250 A, PCD: 210mm,
weight: 159.1 kg

L_{max} = 1026 mm
W_{max} = 746 mm
H_{max} = 906 mm

Designed by	Date	Checked by	Approved by	Date	Weight	TEL ID
I.Markov	15.03.2024	A.Bushuev	V.Kirienko	15.03.2024	159,1 kg	B12QKE1111C

TAVRIDA ELECTRIC | TES_CR15_MD1_16D(1_1_1_1_2_1_2_2_3_2_2_1_3)

Vacuum circuit breaker | Scale 1 : 10 | Sheet 1 /2 | Revision 0 | A3



Designed by	Date	Checked by	Approved by	Date	Weight	TEL ID
I.Markov	15.03.2024	A.Bushuev	V.Kirienko	15.03.2024	159,1 kg	B12QKE1111C

TAVRIDA ELECTRIC

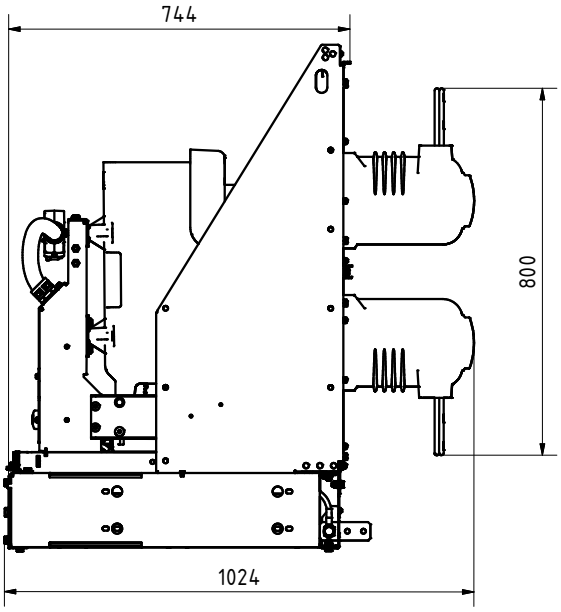
TES_CR15_MD1_16D(1_1_1_1_2_1_2_2_3_2_2_1_3)

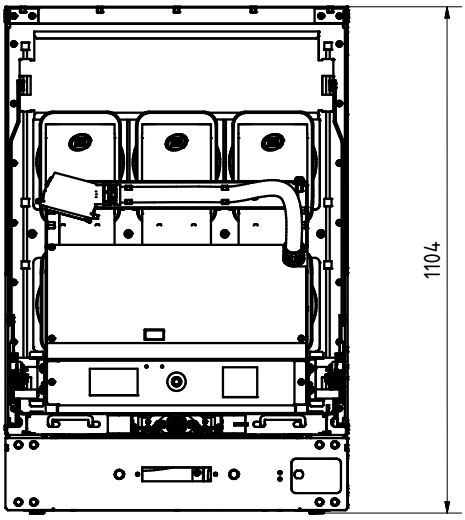
Vacuum circuit breaker

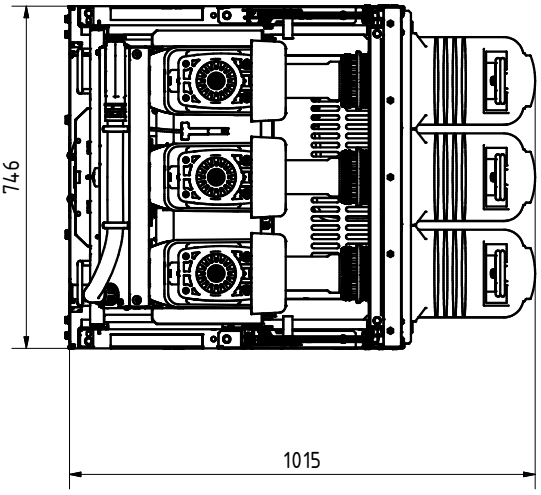
Scale	Sheet	Revision
1 : 10	2 /2	0

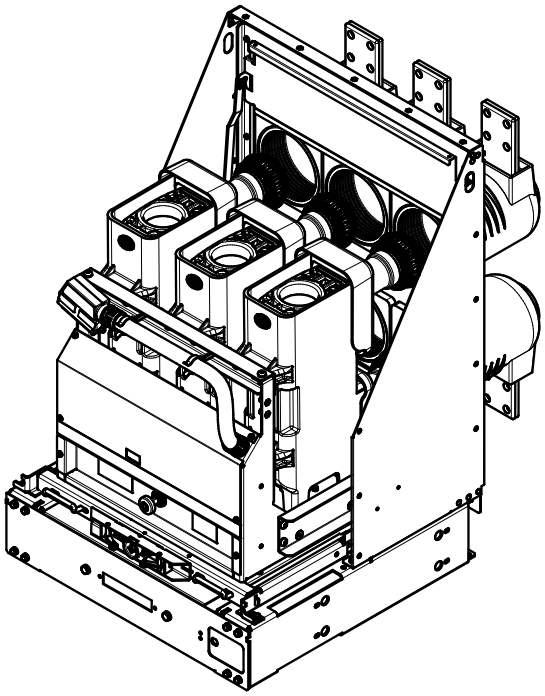
A3

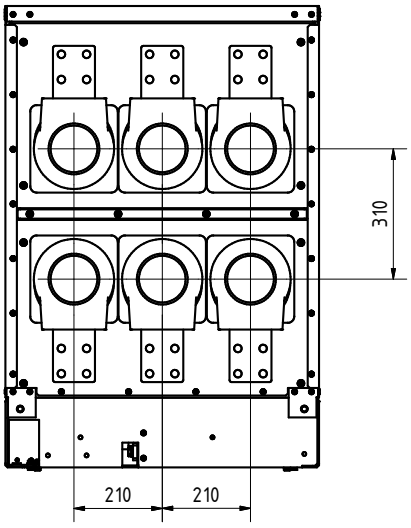
CR15_HD1_16D PCD 210 mm





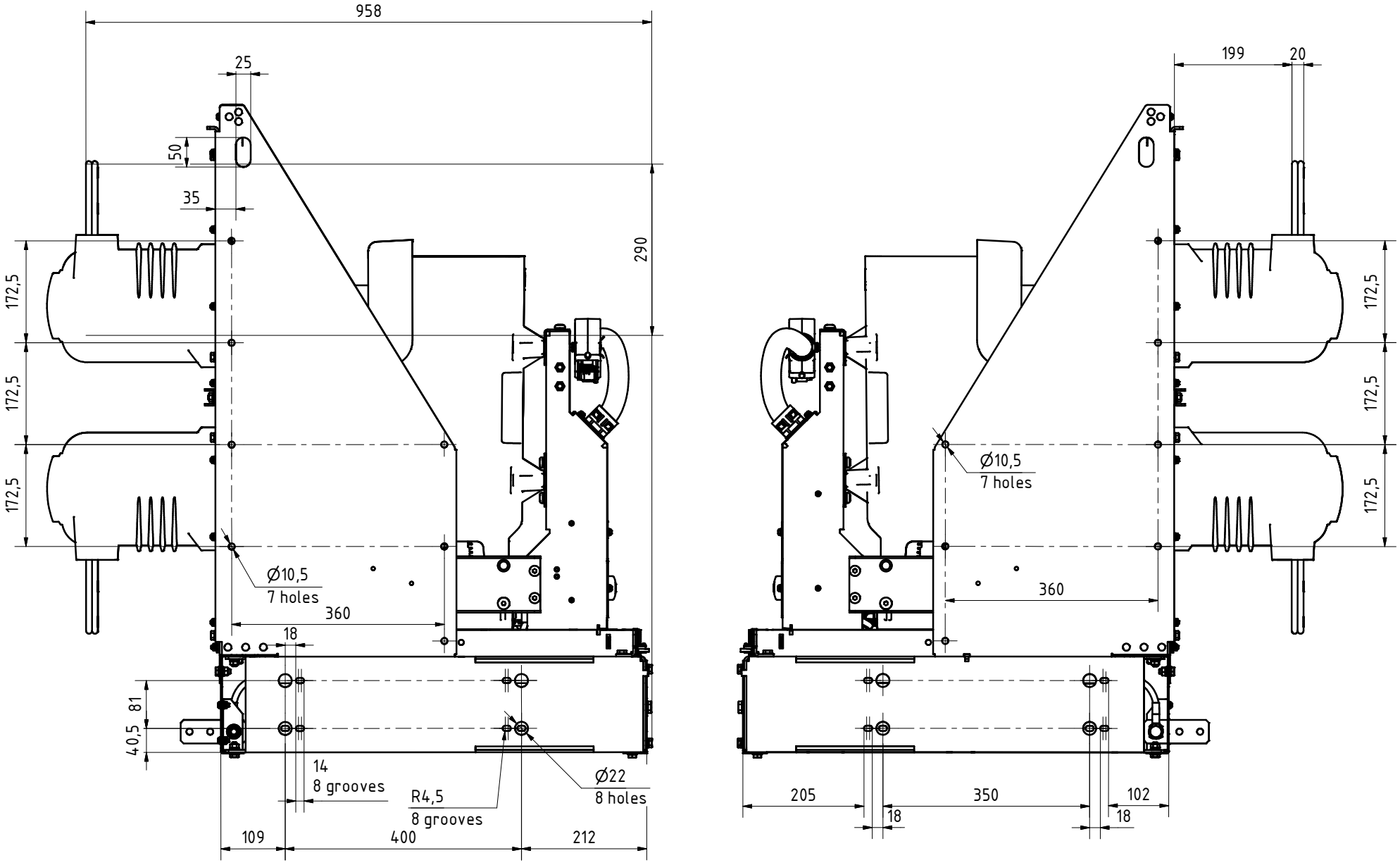




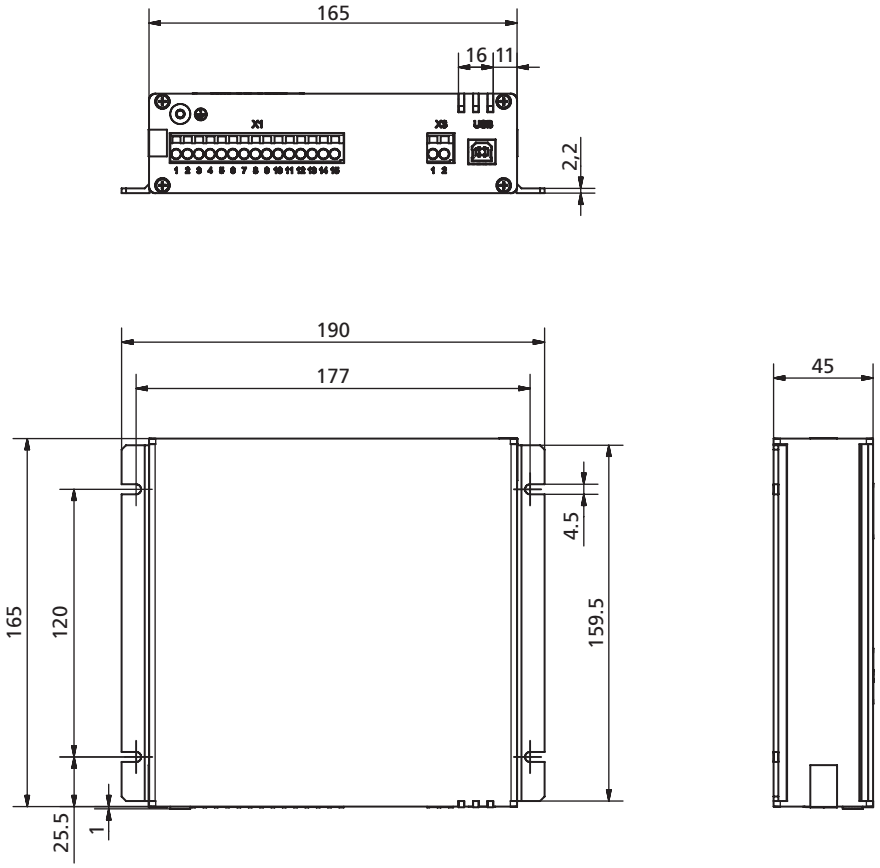


CR15_HD1_16D
15 kV, 2500 A, PCD: 210 mm,
weight: 143 kg

L_{max} = 1024 mm
W_{max} = 746 mm
H_{max} = 1104 mm


958
25
50
35
290
172,5
172,5
172,5
Ø10,5
7 holes
360
18
81
40,5
14
8 grooves
R4,5
8 grooves
Ø22
8 holes
109
400
212
199
20
172,5
172,5
172,5
Ø10,5
7 holes
360
205
18
350
102
18

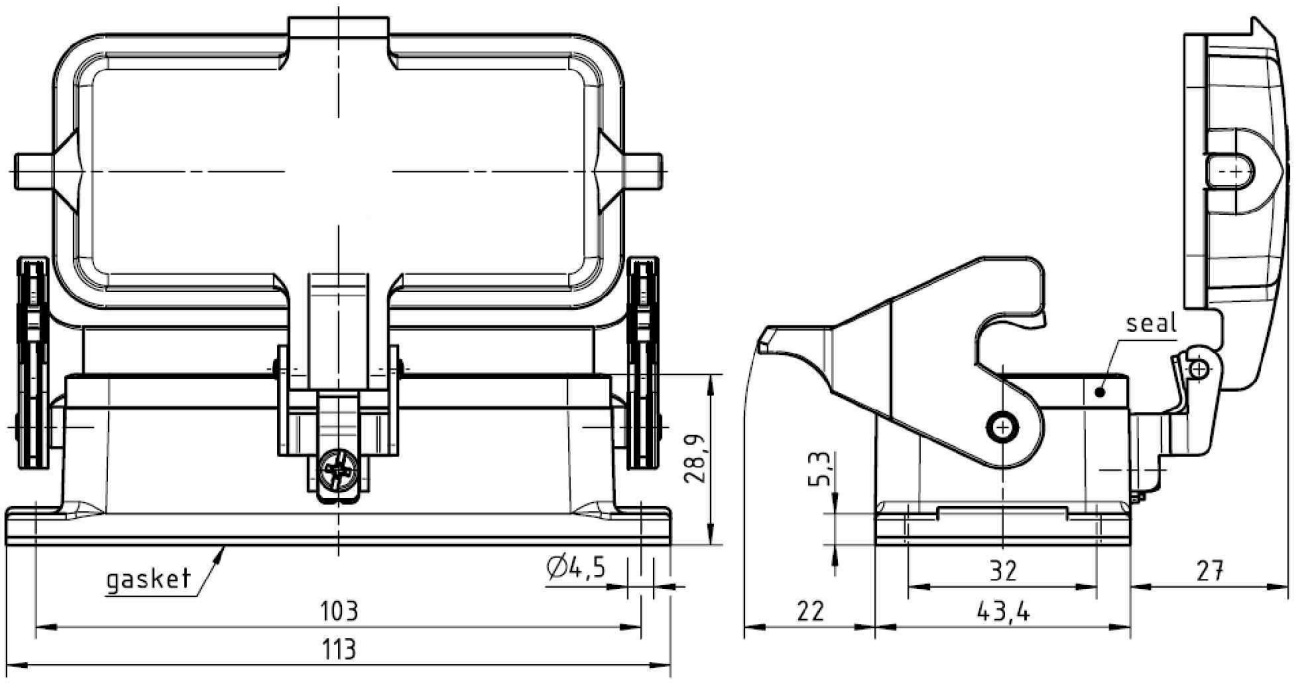
Dimensions of Control Module



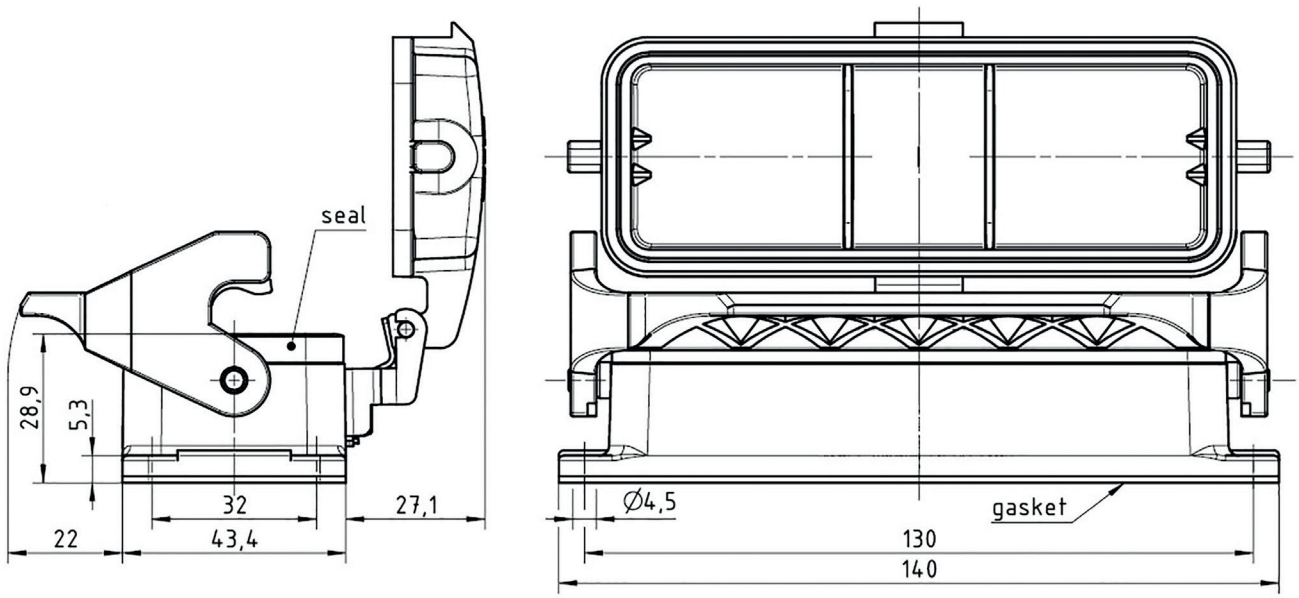
CM_16_1(Par1_Par2_Par3_Par4_Par5)
Weight: 1 kg

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

Control Wiring Plug Counterparts



Control wiring metal plug 72 pins counterpart

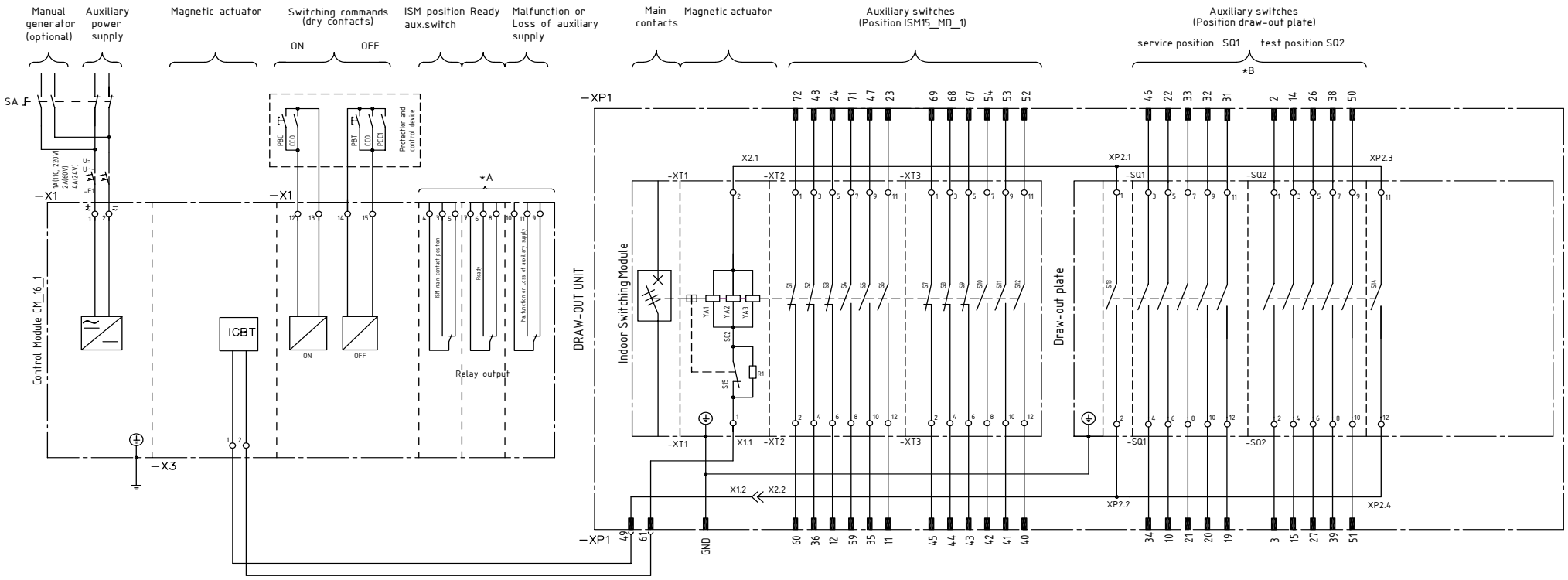


Control wiring metal plug 108 pins counterpart

Appendix 4.
Secondary Schemes

CR15_MD1_16D with Metal Plug (72 pins)

CR15_MD1_16D
Standard circuit breaker application (CB)



Legend:

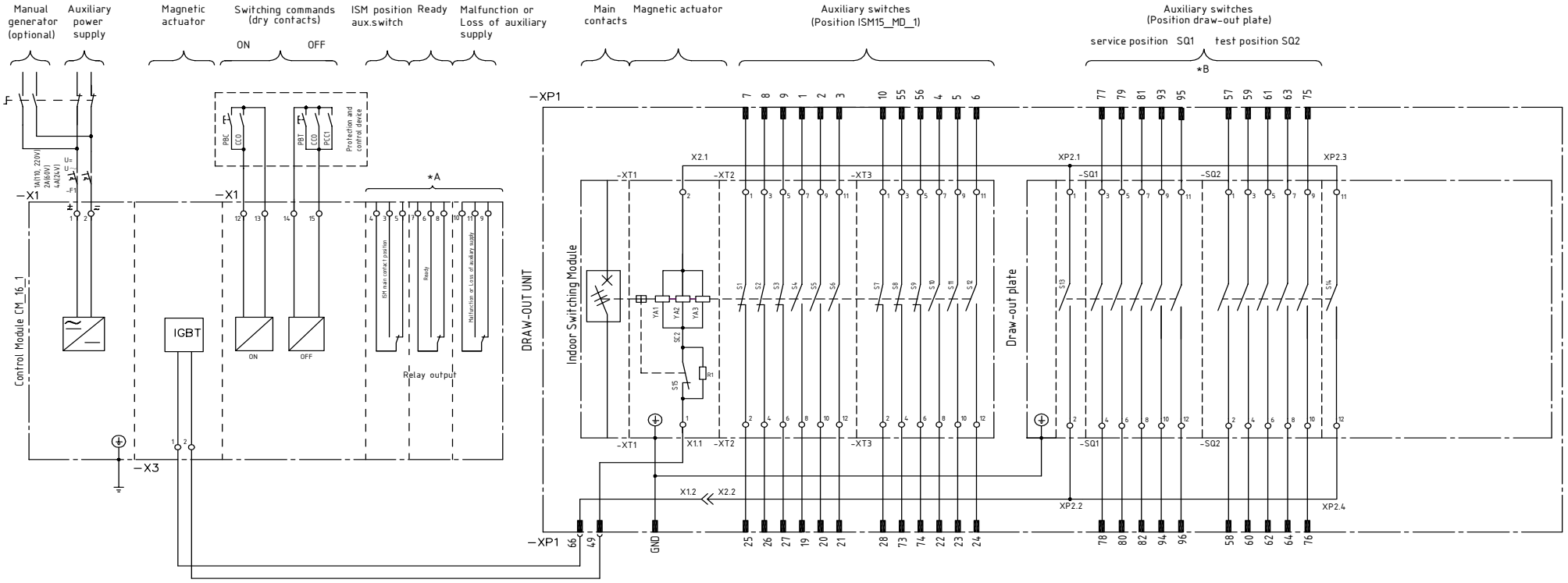
*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	YA1, YA2, YA3	Actuator coils;	PBC	Push button close;
*B	SQ1,SQ2 are show in free position SQ1 is pressed at service position SQ2 is pressed at test position;	X1, X3	Terminal block of Control module;	PBT	Push button open; Control command ON, OFF;
ISM	Indoor switching module;	XP1	Plug connector for DOU;	CCO	
IGBT	Transistor bridge (coils control);	X1.1, X1.2, X2.1, X2.2, XP2.1, XP2.2, XP2.3, XP2.4	Intermediate wiring connectors	PCC1	Protection control contact;
S1~S12	Auxiliary switch of ISM;			R1	Resistor 22kOhm;
S13, S14	Auxiliary switch for ISM electrical interlock S13, S14 are at inactivated position;	SQ1, SQ2	Auxiliary switches of DOU position		
S15	Auxiliary switch for ISM interlock S15 is at inactivated position, is not used in DOU.	F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand Control module inrush current levels given in VCB Product Guide;		

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.
State of the auxiliary switches S1-S12 is shown at ISM open state.

Designed by: A. Ishchenko	Checked by: A. Migunov	Approved by: V. Minaev	Date: 18.02.2020	Filename: MD1_16D_2_ED5	Date: 18.02.2020	Weight: -	Scale:
Projection: Dimensions in mm	TAVRIDA ELECTRIC	Switching module Electrical Interconnection Diagram					
		MD1_16D_2_ED5			Edition: A	Sheet: 1 / 1	

CR15_MD1_16D with Metal Plug (108 pins)

CR15_MD1_16D
Standard circuit breaker application (CB)



Legend:

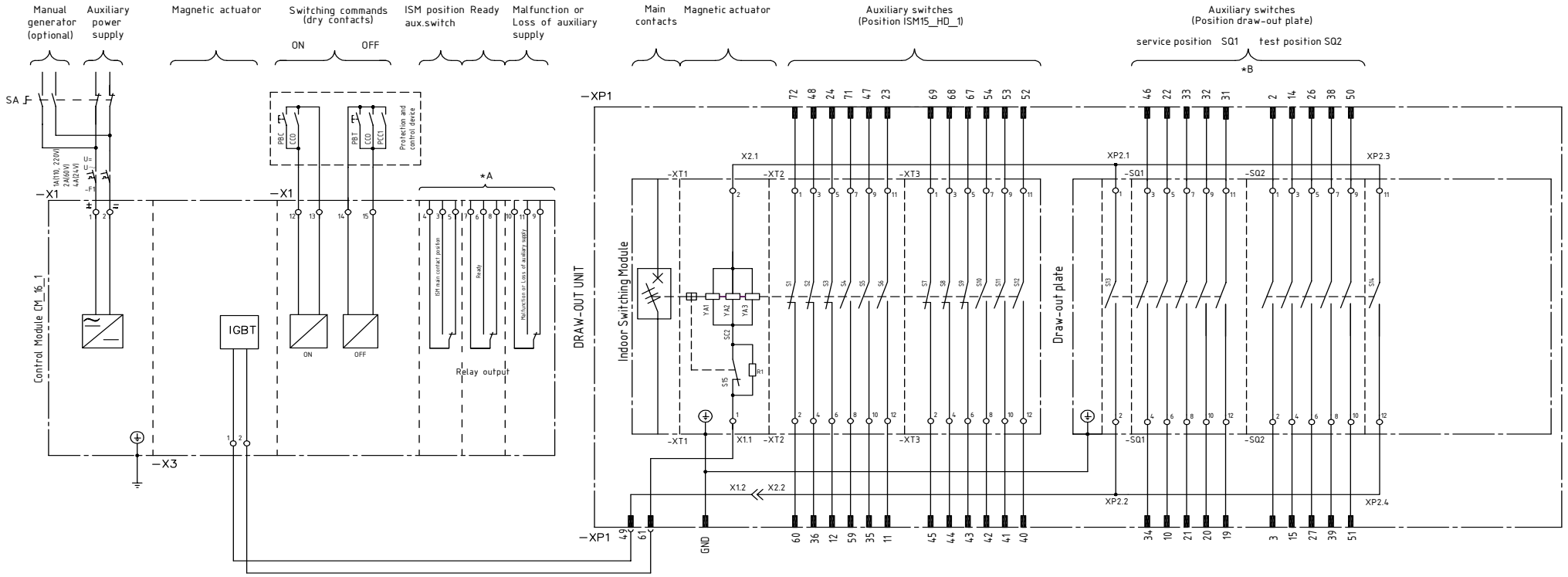
*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	YA1, YA2, YA3	Actuator coils;	PBC	Push button close;
*B	SQ1,SQ2 are show in free position SQ1 is pressed at service position SQ2 is pressed at test position;	X1, X3	Terminal block of Control module;	PBT	Push button open;
		XP1	Plug connector for DOU;	CCO	Control command ON, OFF;
		X1.1, X1.2, X2.1, X2.2, XP2.1, XP2.2, XP2.3, XP2.4, XP3.1, XP3.2, XP5.1, XP5.2, XS1.1, XS1.2, XS3.1, XS3.2	Intermediate wiring connectors	PCC1	Protection control contact;
ISM	Indoor switching module;			R1	Resistor 22kOhm;
IGBT	Transistor bridge (coils control);			YA4	Interlocking solenoid;
S1~S12	Auxiliary switch of ISM;	SQ1, SQ2	Auxiliary switches of DOU position	VD1	Diode bridge
S13, S14	Auxiliary switch for ISM electrical interlock S13, S14 are at inactivated position;	F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand Control module inrush current levels given in VCB Product Guide;		
S15	Auxiliary switch for ISM interlock S15 is at inactivated position, is not used in DOU.				

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.
State of the auxiliary switches S1-S12 is shown at ISM open state.

Designed by A. Ishchenko	Checked by A. Migunov	Approved by V. Minaev	Date 17.02.2022	Filename MD1_16D_3_ED5	Date 17.02.2022	Weight –	Scale
Projection Dimensions in mm	TAVRIDA ELECTRIC	Switching module Electrical Interconnection Diagram					
		MD1_16D_3_ED5			Edition A	Sheet 1 / 2	

CR15_HD1_16D with Metal Plug (72 pins)

CR15_HD1_16D
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;
*B	SQ1,SQ2 are show in free position SQ1 is pressed at service position SQ2 is pressed at test position;
ISM	Indoor switching module;
IGBT	Transistor bridge (coils control);
S1~S12	Auxiliary switch of ISM;
S13, S14	Auxiliary switch for ISM electrical interlock S13, S14 are at inactivated position;
S15	Auxiliary switch for ISM interlock S15 is at inactivated position, is not used in DOU.
YA1, YA2, YA3	Actuator coils;
X1, X3	Terminal block of Control module;
XP1	Plug connector for DOU;
X1.1, X1.2, X2.1, X2.2, XP2.1, XP2.2, XP2.3, XP2.4, XP3.1, XP3.2, XS1.1, XS1.2	Intermediate wiring connectors
SQ1, SQ2	Auxiliary switches of DOU position
F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand Control module inrush current levels given in VCB Product Guide;
PBC	Push button close;
PBT	Push button open;
CCO	Control command ON, OFF;
PCC1	Protection control contact;
R1	Resistor 22kOhm;
YA4	Interlocking solenoid;
VD1	Diode bridge

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.
State of the auxiliary switches S1-S12 is shown at ISM open state.

Designed by: A. Ishchenko	Checked by: A. Migunov	Approved by: V. Minaev	Date: 29.06.2020	Filename: HD1_16D_2_ED5	Date: 29.06.2020	Weight: –	Scale

Projection: Dimensions in mm

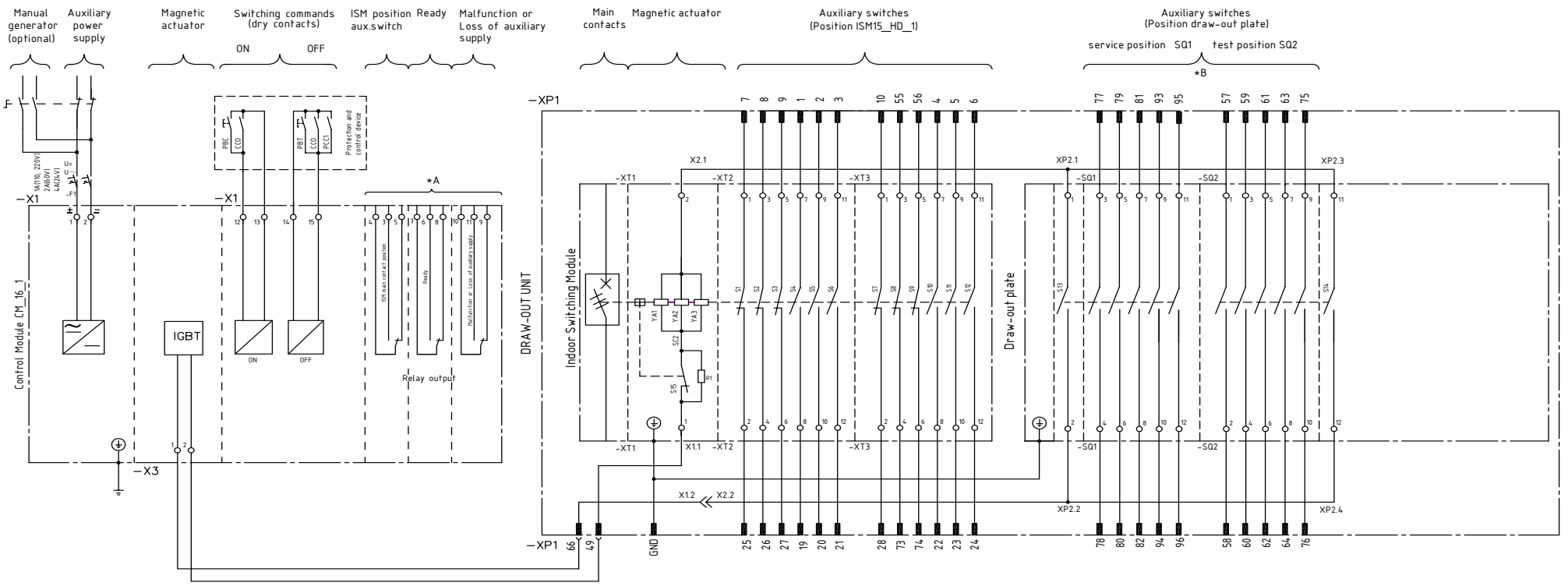
TAVRIDA ELECTRIC

Switching module
Electrical Interconnection Diagram

HD1_16D_2_ED5 | Edition: A | Sheet: 1 / 2

CR15_HD1_16D with Metal Plug (108 pins)

CR15_HD1_16D
Standard circuit breaker application (CB)



Legend:

*A	Wiring of auxiliary switches, relay outputs, according to customer specification;	YA1, YA2, YA3	Actuator coils;	PBC	Push button close;
*B	SQ1,SQ2 are show in free position SQ1 is pressed at service position SQ2 is pressed at test position;	X1, X3	Terminal block of Control module;	PBT	Push button open;
		XP1	Plug connector for DOU;	CCO	Control command ON, OFF;
		X1.1, X1.2, X2.1, X2.2, XP2.1, XP2.2, XP2.3, XP2.4, XP3.1, XP3.2, XP5.1, XP5.2, XS1.1, XS1.2, XS3.1, XS3.2	Intermediate wiring connectors	PCC1	Protection control contact;
ISM	Indoor switching module;			R1	Resistor 22kOhm;
IGBT	Transistor bridge (coils control);	SQ1, SQ2	Auxiliary switches of DOU position	YA4	Interlocking solenoid;
S1~S12	Auxiliary switch of ISM;	F1	Miniature protective circuit breaker (MPCB); F1 should be selected to withstand Control module inrush current levels given in VCB Product Guide;	VD1	Diode bridge
S13, S14	Auxiliary switch for ISM electrical interlock S13, S14 are at inactivated position;				
S15	Auxiliary switch for ISM interlock S15 is at inactivated position, is not used in DOU.				

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.
State of the auxiliary switches S1-S12 is shown at ISM open state.

Designed by	Checked by	Approved by	Date	Filename	Date	Weight	Scale
A. Ishchenko	A. Migunov	V. Minaev	17.02.2022	HD1_16D_3_ED5	17.02.2022	–	

Projection: Dimensions in mm

TAVRIDA ELECTRIC

Switching module
Electrical Interconnection Diagram

	Edition	Sheet
HD1_16D_3_ED5	A	1 / 2

List of Changes

Documents Version	Change Date	Scope of Change	Reason of Change	Version Author
1	28.02.2023	Document Creation	Products Development	mariy
2	03.10.2023	Errors correction	Request	mariy
2.1	11.04.2024	Table - CM_16_1 terminal arrangement TNA_CMdet_Label_16(1_EN.TR_220.2)	-	mariy
2.2	11.02.2024	Edits Cross-references Created VCB Accessories Unpacking and Check (not in the Scope of Supply) section Edits in the Interlocks section	Update	mariy

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