TAVRIDA ELECTRIC

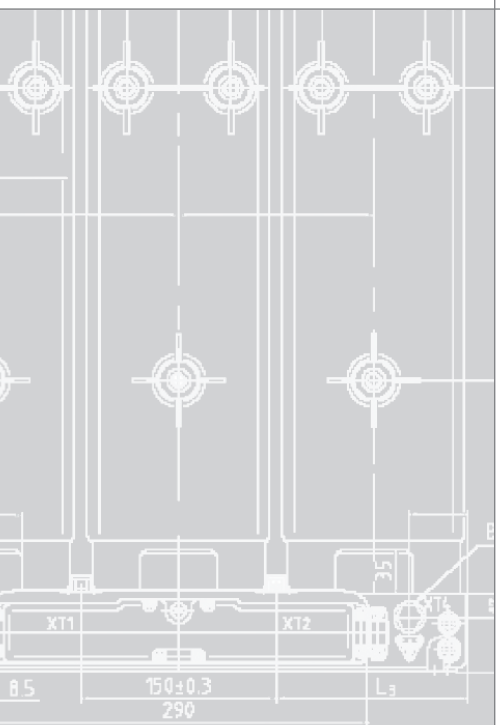
ISM Shell_2 Series

Vacuum Circuit Breaker

15kV, ...29kA, ...2000A

Applications Manual MAN5002239

Revision 4



The following installation and operating Instructions contain information necessary for the methods of use, installation, commissioning and operation. It is absolutely necessary for the proper use of the vacuum circuit breakers to read the Installation and Operating Instructions carefully before starting and to adhere to the instructions and the relevant regulations.

Safety first

· Check whether the installation position (distances, spatial separation, and the surroundings) is suitable for the switching devices.

· Installation, operation and maintenance shall only be carried out by trained and experienced personnel who are familiar with the equipment and the electrical safety requirements.

· During installation, commissioning, operation and maintenance of the equipment the relevant legal regulations, accident prevention regulations and the connecting conditions of the electric utilities shall be followed.

· Take note that during operation of the vacuum circuit breakers certain parts are subject to dangerous voltage. Mechanical parts, also remote-controlled, can move quickly. Failure to comply may result in death, severe personal injury or damage to equipment.

· Pay attention to the hazard statements located throughout this manual. 

· The operating conditions of the vacuum circuit breakers shall comply with the technical data specified in this manual.

· Personnel installing, operating and maintaining the equipment shall be familiar with this manual and its contents.

For special configurations please contact TAVRIDA ELECTRIC NA.

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6. Signalling

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Introduction

1

Applicability

This Technical Manual applies to a range of Indoor Circuit Breakers (ISM) manufactured by Tavrida Electric.
The following products are covered by this manual:

ISM15_Shell_2(150)
ISM15_Shell_2(210)
ISM15_Shell_2(275)

The model number is shown on the equipment rating plates. If your equipment does not correspond to this number then this manual is not applicable. Please contact your nearest Tavrida Electric office.

Every care has been taken in preparation of this manual. However, please note that not all the details or variations in the equipment or process being described can be covered. Neither is it expected to address all contingencies associated with the installation and operation of this equipment. For any further information please contact your nearest Tavrida Electric office.

Hazard Statements

This manual contains three types of hazard statements, as follows:

DANGER: Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation that, if not avoided, could result in personal injury or equipment damage.

Safety Instructions

General hazard statements applying to this equipment are described in this section. Statements relating to specific tasks or procedures are located throughout this manual.

DANGER: Contact with hazardous voltage will cause death or severe personal injury. Contact with Recloser or Control Cubicle terminals should only be undertaken when equipment is isolated from applicable sources of voltage.

WARNING: This equipment is not intended to protect human life. Follow all locally approved safety procedures when installing or operating this equipment. Failure to comply may result in death or severe personaly injury.

WARNING: Before working with equipment descriped in this manual carefully read and understand the contents of this manual. Improper handling, installation, operation or maintenance can result in death, severe personal injury or demage to equipment.

WARNING: Power distribution equipment must be properly selected for the intended operation. It must be installed, used and understand all relevant safety procedures. Failure to comply can result in death, personal injury or equipment damage.

Definitions

The following abbreviations are used in this operating manual:

AR	Automatic reclosing
CM	Control module
CO	Close open cycle
ISM	Indoor switching module
LED	Light emitting diode
MCB	Miniature circuit breaker
NC	Normally closed contact
NO	Normally open contact
PCD	Pole center distance
SCADA	Supervisory control and data aquisition
VCB	Vacuum circuit breaker
VI	Vacuum interrupter

Make time

The make time is the time period from the energising of the closing circuit to the time when the current begins to flow in the first pole.

Closing time

The closing time is the time period from the energising of the closing circuit to the time when all three poles make contact.

Pre-arcing time

Interval of time between the initiation of current flow in the first pole during a closing operation and the instant when the contacts touch in all poles for three-phase conditions or the instant when the contacts touch in the arcing pole for single-phase conditions.

Opening time

The opening time is the time period from energising of the closing circuit up to the time when all the switching poles are separated.

Break time

The break time is the time period from the energising of the closing circuit up to the time when the arcs of all the poles are extinguished.

Open-close time (during AR)

Interval of time between the instant when the arcing contacts have separated in all poles and the instant when the contacts touch in the first pole during a reclosing cycle.

Dead time (during AR)

Interval of time between final arc extinction in all poles in the opening operation and the first reestablishment of current in any pole in the subsequent closing operation.

General

In comparison to conventional circuit breakers, the Tavrida Electric vacuum circuit breakers comprise of two components:

· The ISM (Figure 1)

· The CM for controlling the ISM and monitoring both modules (Figure 2)

Both modules must only be operated together and are meant for indoor installations only. The possibility to choose ISM and CM separately allows any type of switchgear to be easily equipped with regard to its primary and auxiliary circuits.

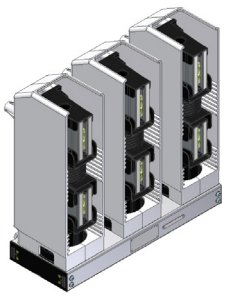

Figure 1

Figure 2

Compact design

Tavrida Electric develops and produces all vital parts of the circuit breakers themselves. The result of intensive inhouse fundamental and material research are extremely compact vacuum interrupter and magnetic actuators. Optimal selection of all components makes these the most compact and light weight vacuum circuit breaker in the world.

Long life

Contact erosion is minimised by use of axial magnetic field. All the switching elements are assembled axially and symmetrically in one straight line. This means that all the mechanical movements are exclusively direct and linear. 30 000 operating cycles can be achieved with rated current without replacing or adjusting any components.

Maintenance free

The ISM is maintenance-free over the expected life of at least 25 years.

Highest availability

In addition to minimising the number of failure-critical components, the Tavrida Electric circuit breaker monitors its status continuously. In the unlikely event that a fault occurs it is indicated and can be rectified before an unsuccessful switching attempt is made. This leads to higher availability of the electric power supply system.

Design and Method of Operation: ISM and CM

The ISM vacuum circuit breaker uses three single-coil magnetic actuators, one per pole. The three actuators are mounted in a steel frame and mechanically linked by a synchronizing shaft (Figure 3).

Indoor Switching Module (ISM)

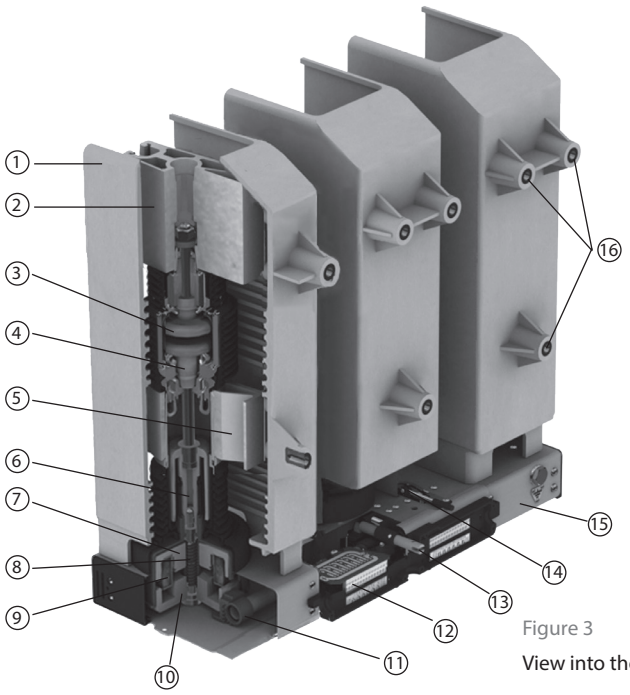

Figure 3
View into the ISM

1. Support insulator
2. Upper terminal
3. Vacuum interrupter
4. Movable contact with bellows
5. Lower terminal
6. Pulling insulator
7. Actuator stator
8. Opening and contact pressure springs
9. Actuator coil
10. Actuator armature
11. Synchronizing shaft
12. Auxiliary contacts
13. Interlocking shaft
14. Main contacts position indicator link
15. Frame
16. Fixing points

Control Module (CM)

Figure 4
Control Module

1. Terminals
2. LED indicators
3. Fastening holes
4. Grounding stud

Closing

In the open position the contacts are kept open by the force of the opening springs. To close the contacts the coils of the magnetic actuators are excited by a current impulse of the close capacitors of the CM. As a result the contacts close. At the same time the opening springs are compressed. In the closed position the contacts are kept closed by means of the magnetic force only. The ISM maintains the closed position without mechanical latching also in case of a failure of the auxiliary power supply (Figure 5).

Opening

To open the contacts a current impulse in the reverse polarity derived from the opening capacitors of the CM is injected in the coils of the magnetic actuators releasing the magnetic holding force. The compressed opening springs and contact pressure springs open the contacts (Figure 5).

Manual-Emergency-Tripping

The ISM can be tripped mechanically without auxiliary power supply (emergency trip). It may be opened manually by means of interlocking shaft rotating counter-clockwise. The interlocking cam of interlocking shaft act on the armature, when then starts to move (refer to chapter "Installation/Primary part/ Interlocking", page 24). As the air gap increases, the opening springs and contact pressure springs overcome any magnetic holding force and the module opens.

Manual Closing

The ISM can only be closed electrically via the CM. In the case of a failure of auxiliary power supply the contacts can be closed using an alternative auxiliary power supply such as a battery. Mechanical closing is not possible and leads to the destruction of the ISM.

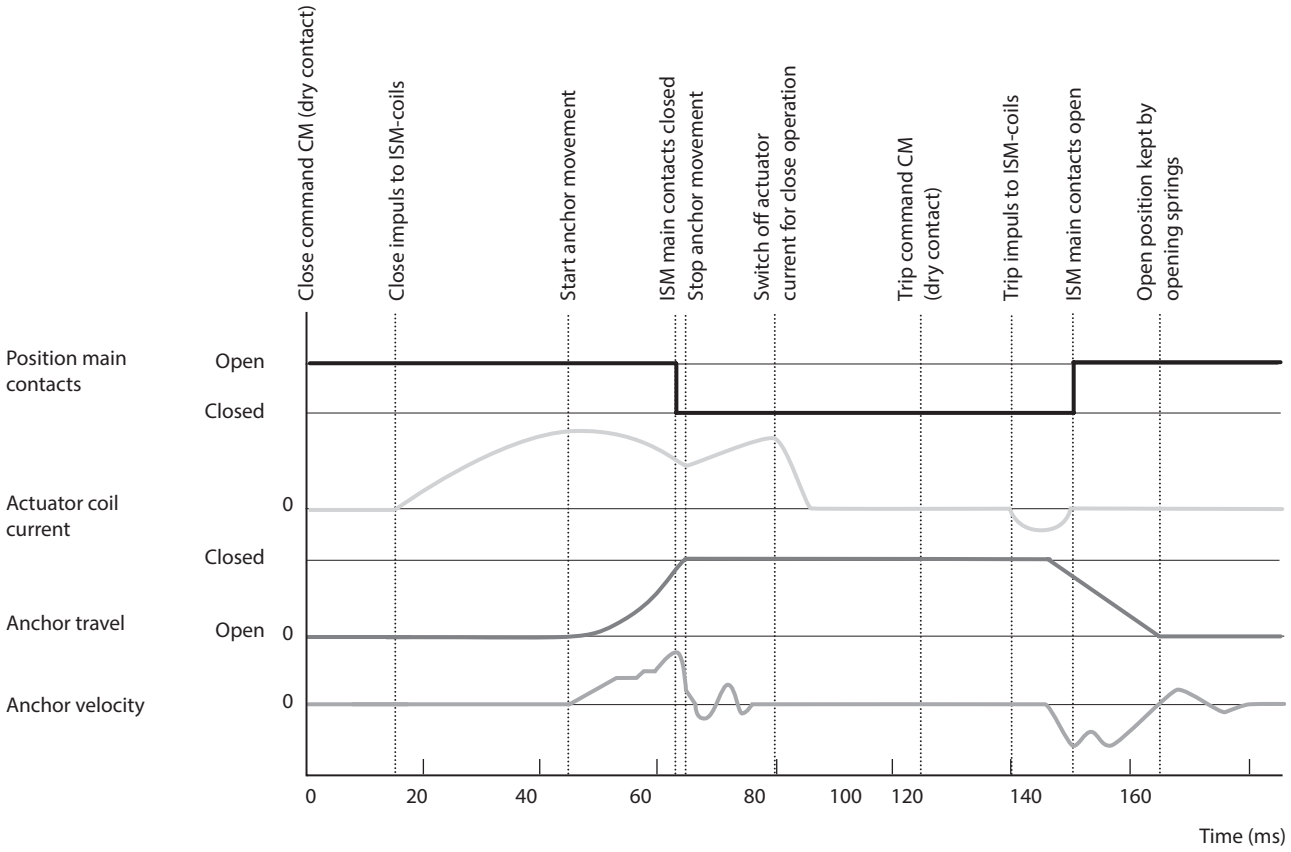

Figure 5

Typical oscillograms of ISM operation

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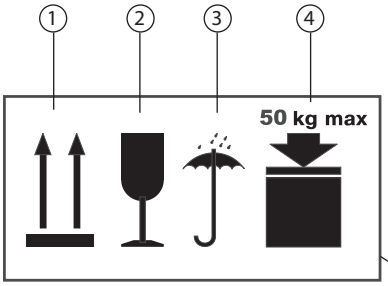
Receiving, Handling and Storage

Packing

The following information are provided on the ISM packing cartons (Figure 8):
· Handling symbols for transport and storage of the delivery unit (Figure 6)
· Label 1 for manufacturers´ and product information (Figure 7)
· Label 2 for logistics data (Figure 9)



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

Figure 6
Handling symbols

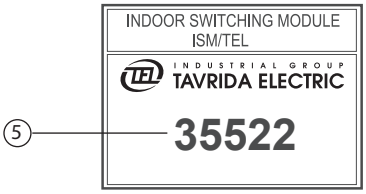


Figure 7
Label 1 for manufacturers´ and product information

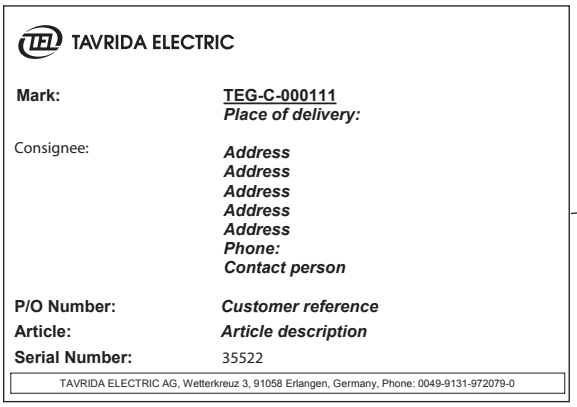


Figure 9
Label 2 Logistics data

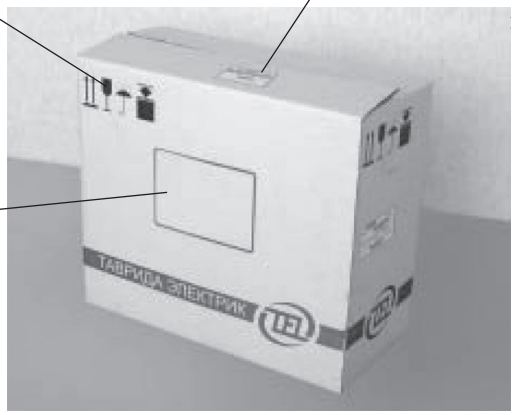
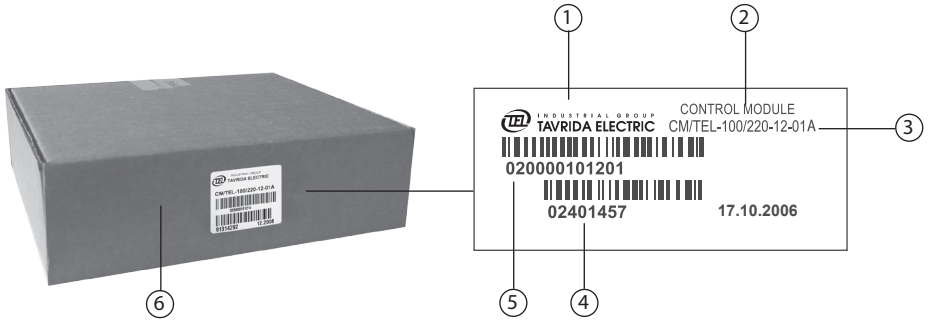


Figure 8
ISM carton package

A label with the following information is fixed on each CM carton package (Figure 10).



1. Manufacturer
2. Product name
3. Type of device
4. Serial number
5. Product code
6. Carton package for CM/TEL…-12-01A (265x220x55 mm)

Figure 10
CM carton package and label

A CM carton package must not have a weight of more than 30 kg applied to it.

Transport

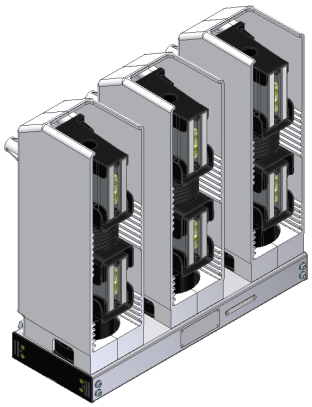
ISM and CM shall be transported in the original packing only. The packed goods shall be handled in accordance with the handling symbols. Loading procedures for ISM packing units shall be carried out only with fork lifts or cranes. If possible the ISM packing unit shall be placed on a palette. Lifting gear must not be attached to the support insulators. During transportation the ISM and CM must not be hit or dropped.

Unpacking, Receiving Inspection

Before unpacking, please check the carton for damage and dampness. Removal of the products from the original packing must be carried out with due care. Every ISM and every CM shall be subject to a completeness control.

Scope of delivery for the ISM:

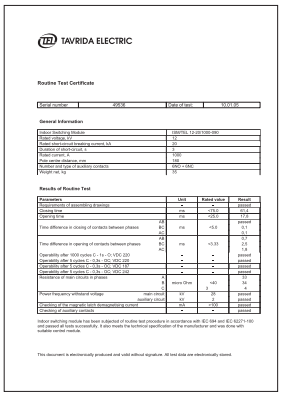
Figure 11



ISM

Screwdriver

Operating manual



Routine test certificate

1x Main contacts position indicator.
Length of flexible link is 1,0 m.
AXCA. 305449.002

Insulating caps optional

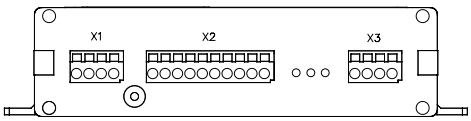
6x AXCA . 757559.014, for contact arms with 50mm diameter, lenght of the insulation cap is 176 mm

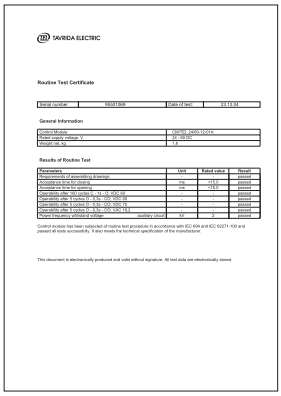
6x AXCA . 757559.015 for contact arms with 74 mm diameter

6x AXCA . 757559.016 for contact arms with 50 mm diameter, lenght of the insulation cap is 203 mm

Scope of delivery for the CM:

Figure 12





TAVRIDA ELECTRIC

Routine Test Certificate

Serial number	19081868	Date of test	23.12.24

General Information

Control Module	ISM/TEL 15/630-31.5-CA
Power supply voltage, V	110 - 125 DC
Weight net, kg	1.8

Results of Routine Test

Parameters	Unit	Rated value	Result
Requirements of assembling drawings	-	-	passed
Acceptance time for closing	ms	<150	passed
Acceptance time for opening	ms	<150	passed
Operability after 100 cycles O - 0.3s - CO -180 s	-	-	passed
Operability after 3 cycles O - 0.3s - CO -180 s	-	-	passed
Operability after 3 cycles O - 0.3s - CO -180 s	-	-	passed
Operability after 3 cycles O - 0.3s - CO -180 s	-	-	passed
Check Pressing (closing) voltage, auxiliary circuit	kV	2	passed

Control module has been subjected of routine test procedure in accordance with IEC 694 and IEC 62271-100 and passed all tests successfully. It also meets the technical specification of the manufacturer.

This document is electronically produced and valid without signature. All test data are electronically stored.

CM Screwdriver Routine test certificate

The devices should be checked visually for:

· Mechanical damage, scratches, discolouration, corrosion

· Damage to the seals (Figure 17, Figure 18)

Any transport damage must be reported immediately to the carrier in writing.
Cases of damage must be photographically documented.

Rating Plates, Warranty Seals

Please check that the rating plates of the delivered devices correspond to the data of the order. The rating plate for the ISM contains the following information (Figure 13):

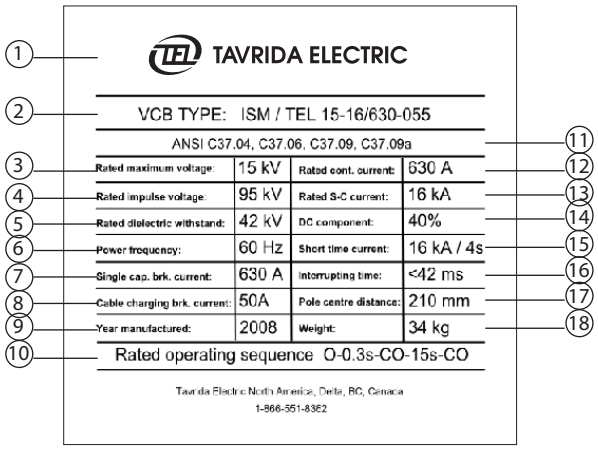


Figure 13
Rating plate

1. Manufacturer
2. Type of device
3. Rated maximum voltage
4. Rated impulse withstand voltage
5. Rated dielectric withstand voltage
6. Rated frequency
7. Single capacitor bank breaking current
8. Cable charging breaking current
9. Year manufactured
10. Rated operating sequence
11. Applicable ANSI standards
12. Rated continuous current
13. Rated short circuit current
14. DC component percentage
15. Rated short time current
16. Interrupting time
17. Pole centre distance
18. Weight

The rating plates for the CM1501 series contain the following information (Figure 14):

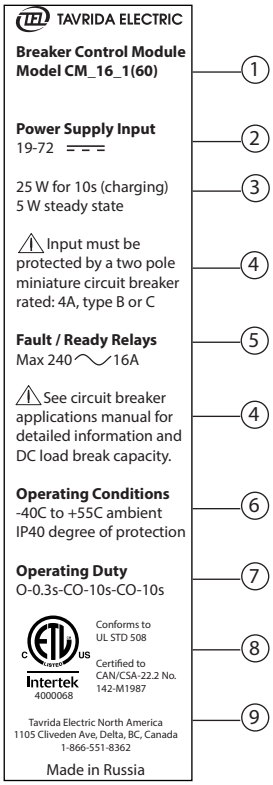


Figure 14

1. Model type
2. Auxiliary power supply min / max
3. Power consumption
4. Warning notes
5. Output contact maximum voltage / current
6. Operating conditions
7. Operating duty cycle
8. NRTL listing / conformance mark
9. Contact information

The rating plate for the CM16 series contain the following information (Figure 15):

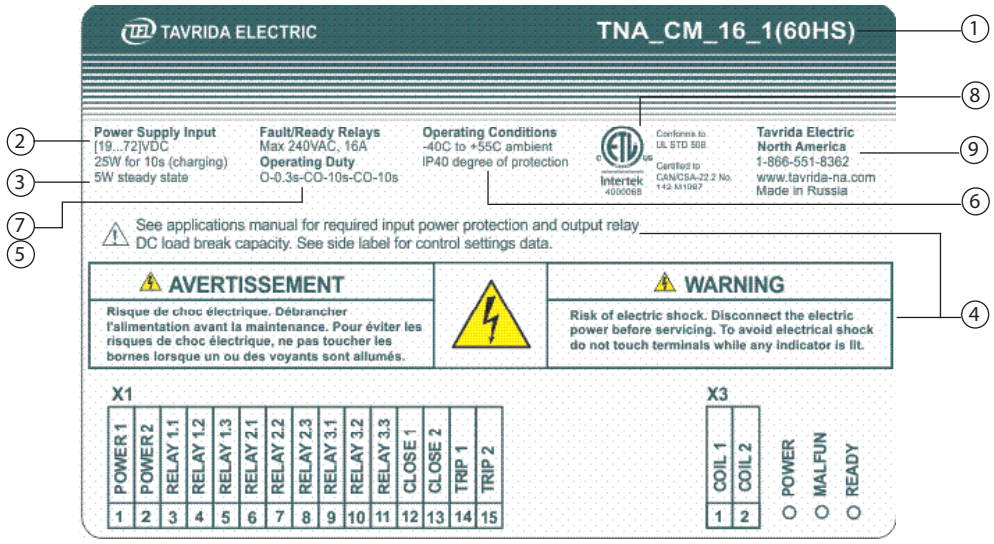


Figure 15

The CM_16 has an additional label for factory programmable settings (Figure 16); see page 32 for detailed information on the settings functions.

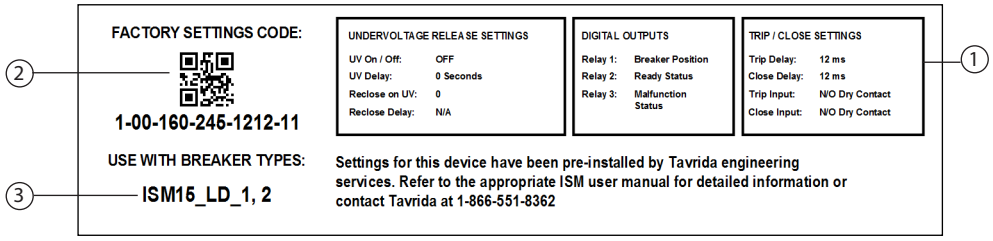


Figure 16

1. Settings
2. QR code (scannable settings code)
3. Applicable breaker type

Arrangement of the labels (Figures 16, 17):

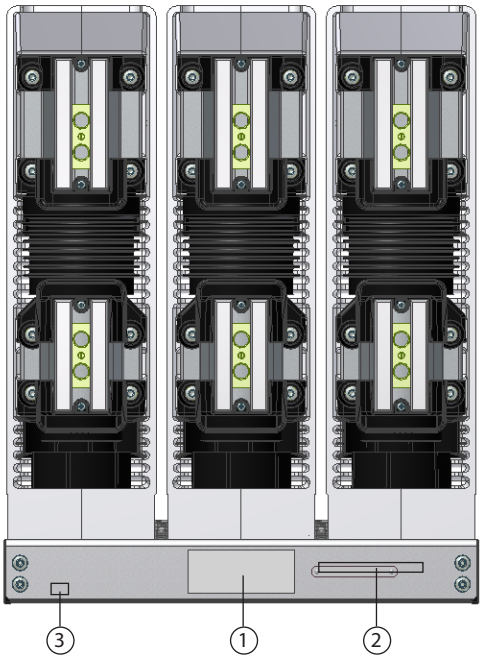


Figure 17
Labelling ISM

Figure 18
Labelling of the CM_16

ISM

1. Rating plate
2. Serial number
3. Seal

CM

1. Seal
2. Serial Number, date of manufacturing
3. Product code

The manufacturer accepts no warranty for a device if the seal is broken or has been removed.

Storage

Should immediate installation not be possible, the ISM and CM shall be stored in the original packing under the following conditions:
· The ISM is switched off.
· Dessicants must be placed in the packing.
· Storage must be dry, well ventilated and the room temperature should be between - 40°C and + 40°C (IEC694/ DIN VDE 0670 Part 1000).
· If several ISM are stacked a maximum of two layers is permitted.
· If several CM are stacked a maximum of 10 vertical layers is permitted.

If CM are stored longer than one year, the built-in capacitors shall be charged according to the following procedure before putting into operation:
· Switch On auxiliary power supply to CM for 20 seconds.
· Switch Off auxiliary power supply to CM for one minute.
· Repeat the described switching on and off procedure two times.
· Switch On auxiliary power supply to CM for at least 8 hours.

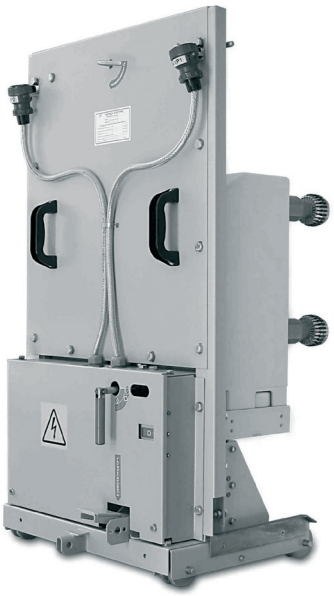
Installation 3

Primary part

General, Preparation

The following regulations must be adhered to during installation, commissioning and operation:
· IEC 60694/DIN VDE 0101, General specification for high-voltage switchgear and control gear standards.
· VDE 0105, Operation of electrical installations.
· DIN VDE 0141, Ground systems for electrical power installations with nominal voltages above 1 kV.
· All rules for accident prevention applicable in the respective countries.

Figure 19



Vertical installation
position of the ISM (draw out type)

The wearing of gloves for handling the parts during installation is recommended.

Insulating material surfaces must be cleaned with clean and dry rags. The contact surfaces of connections must be cleaned before installation. If the contacts have become oxidized during transport or storage then the following sequence must be followed:

· Clean contact surfaces with a rough, dry cloth.
· With hard oxidation, clean with a hard plastic sponge, the upper layer must not be removed.

For ISM fixing and terminal connections steel bolts according to EN ISO 898 class 8.8 (800 N/mm^2), nuts according to EN ISO 890 class 8 (880 N/mm^2), washers to DIN 125 and conical spring washers to DIN 6796 shall be used.

ISM mounting and connection shall be made with dynamometic wrench only.

Vertical installation
position of the ISM (draw out type)

Installation of the ISM

In any switchgear application, the ISM shall be installed with the actuator drive axis vertical (Figure 16). ISM may be installed in position “actuator up”, as well “actuator down” (for all types).

The ISM shall be installed at the place designated for it on a sufficiently stable frame. In order to prevent bending loads at the support insulators the poles must be fixed as shown in figure 20. The torque of all fixing points shall not exceed the values stated in figure 20.

Fixing points

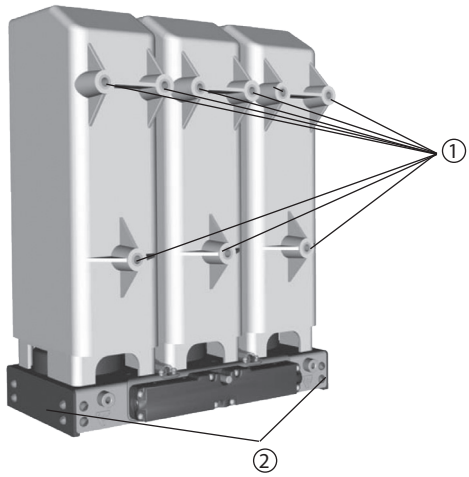


Figure 20

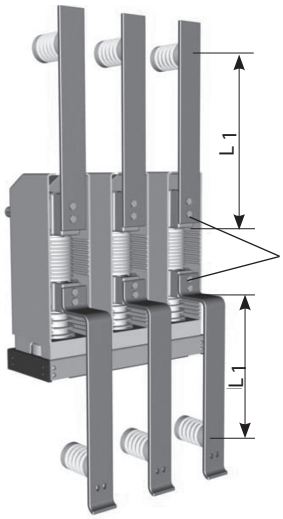
① Nine internal threads for obligatory ISM fixing, which are formed in the module support insulator (M12, maximal torque 40 ± 2 Nm)

② Eight internal threads on the side of frame for obligatory ISM fixing (M8, maximal torque is 10 ± 1 Nm)

Primary terminals connection

Bus bars and cables shall be connected with the primary terminals of ISM mechanically in a stress-free manner. No pressure, tension or torsion shall act on the ISM.

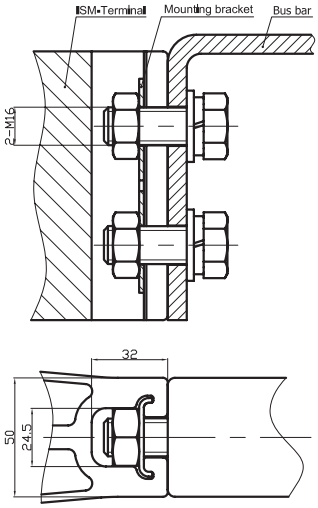
Both contact arms and rectangular bars can be connected to terminals. The level of fastening depends upon external connection. To fasten a contact arm or a bar, nuts or heads of bolts and mounting brackets shall be placed into vertical slots of the terminals, as shown on figures 21, 22, 23.



Each bus bar shall be tightened to terminals with two bolts M16, torque 60Nm.

Figure 21

ISM-terminals with busbars and support insulators.



Detail of standard connection ISM-terminal with busbar using the mounting bracket.

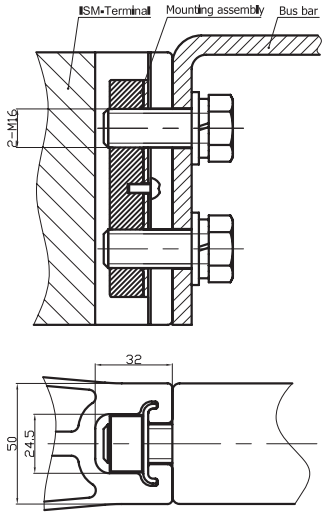


Figure 22

Detail of optional connection ISM-terminal with busbar using the mounting assembly.

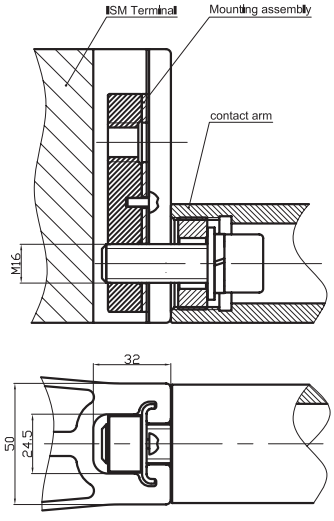


Figure 23

Detail of connection ISM-terminal with contact arm using the mounting assembly.

Additional support insulators

To avoid unacceptable high electrodynamic impact on the ISM, the bus bar connections shall rest on additional supporting insulators (Figure 25). Additional support insulators are necessary, if the length of unsupported busbars is more than specified in the table below.

Module	Short-circuit current, kA		
	20 kA	25 kA	31.5 kA
	L_1, mm		
ISM15_Shell_2(150)	700	450	300
ISM15_Shell_2(180)	840	540	360
ISM15_Shell_2(210)	980	630	420
ISM15_Shell_2(275)	1200	820	550

Note: Deviation from mounting requirements specified in the present section may lead to permanent damage of the module in short-circuit making current.

Minimum Clearances due to Rated Insulation Voltage

The minimum clearances between the blank phases and to ground shall be according to DIN EN 60071-1, VDE 0101 and VDE 0111.

Ur	Up	Minimum clearance (L_2)
15 kV	95 kV	120 mm

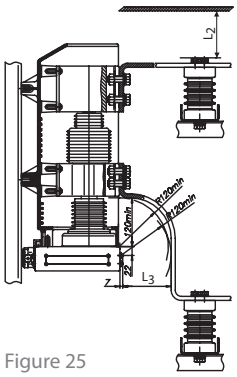


Figure 25

Additional insulating caps for ISM15_Shell_2(150)

Additional insulation of terminals is obligatory for ISM15_Shell_2(150). These shall used for other types of the switching module when air isolating distances between terminals and contacts arms, on the one hand, and grounded metallic frame and enclosure of switchboard, on the other, do not provide dielectric strength required for high-voltage tests.

The total arrangement of additional insulation is shown on figure 26. Terminals are covered with insulating caps. Bare parts of contact arms, i.e. parts not covered with this insulation, shall be imbedded into Raychem-type shrinkable tubes.

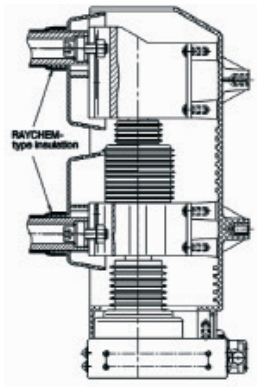


Figure 26

Insulating caps

Minimum clearances from ISM-surfaces to ground

Any switchboard, where switching module is expected to be used shall be designed so as to exceed minimal distances shown on figure 24. Values for terminals covered with insulating caps and Raychem-type tubes are bracketed.

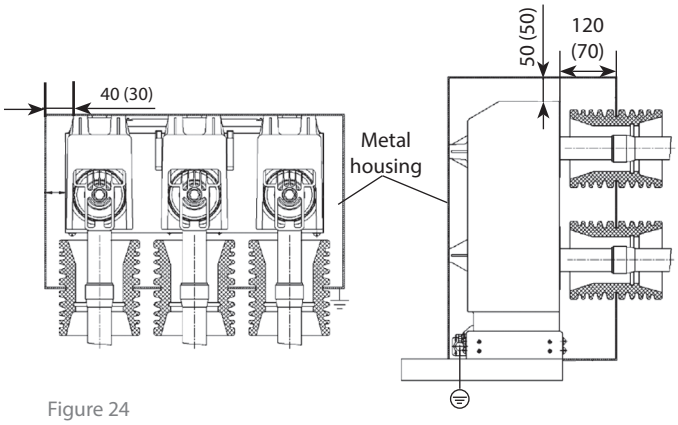


Figure 24

Minimum distances between parts of switching module and grounded metal enclosure of switchboard

Minimum Clearances due to Electromagnetic Influences

The following clearances must be adhered to (Figure 25):

ISM-Type	Short-circuit current, kA		
	20	25	31.5
	L_3, mm		
ISM15_Shell_2	120	150	190

Coordination of Minimum Clearances

In case the minimum clearance L_3 due to 25/31 kA short circuit current exceeds the minimum clearance L_2 due to the rated insulation level, the higher clearance between ISM-frame and adjacent busbars is to be selected.

Heating

The ISM are designed in such a manner that at the rated current specified on the rating plate of the ISM and at 40°C ambient temperature, with free surroundings, no impermissible high temperatures will arise at the hottest spots of the ISM. In order to decide whether for an ISM in the respective panel more intensive heat dissipation or a reduction of the rated current values are required, a temperature rise test according to the relevant standards is recommended.

Protective Grounding

For personnel protection the metal housing of the ISM must be connected according to the applicable regulations, such as DIN VDE 0141, DIN VDE 0151, IEC 6021-2 via the marked two ground screws of the ISM to the ground arrangement of the particular panel. One or both grounding bolts can be used. If two ground connections are used, at each grounding bolt the half total cross section shall be connected. The ground connections can be carried out with cables or flat copper bars. The cross section must be dimensioned such that a worst-case fault current (short circuit) does not cause a weakening of the ground connections (Figure 27).

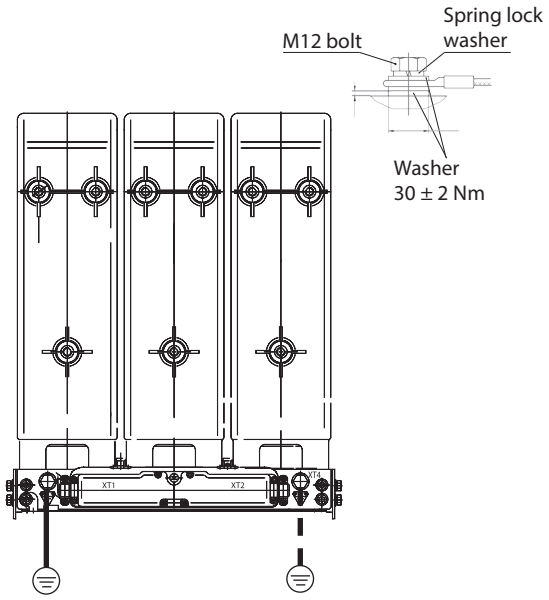


Figure 27

Reference values for total cross sections of ground connections (copper):

Duration of fault current (1 s)	Max. temperature of ground connection	Cross section ground connection
<10 kA/10 kA	300 °C	35-70 mm²
16 kA	300 °C	70-95 mm²
20 kA	300 °C	70-120 mm²
25 kA	300 °C	95-140 mm²
31.5 kA	300 °C	120-190 mm²

The area around the ground screws shall be cleaned before providing the ground connections. After the occurrence of a short circuit, the proper condition of the protective grounding must be checked.

Interlocking

Interlocking mechanism

Interlocking mechanism of the module is based on operation of an interlocking shaft that can be rotated clockwise or counter-clockwise. When the interlocking shaft is rotated clockwise the module becomes acceptable for "close" and "open" operations. Hereinafter this position of the module is called "unlatched". When the shaft is rotated in reverse direction, i.e. counter-clockwise, the module becomes "open and locked".

If the module is closed, rotation of the interlocking shaft from "unlatched" to "open and locked" position leads to the manual tripping of the module and afterwards to the mechanical blocking of the actuator.

Working principle of the mechanical interlocking mechanism (Figures 28, 29, 30, 31, 32).

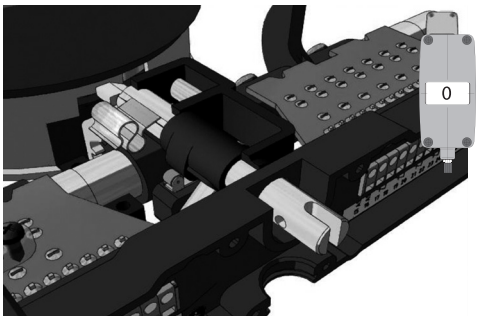


Figure 28

Interlocking shaft in unlatched position. ISM is open.

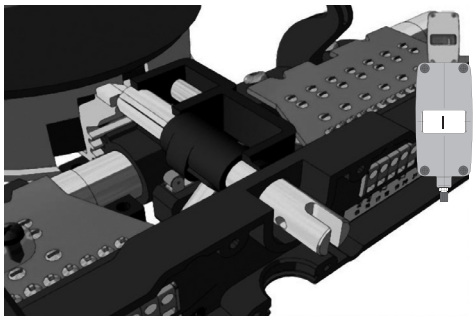


Figure 29

Interlocking shaft in unlatched position. ISM is closed.

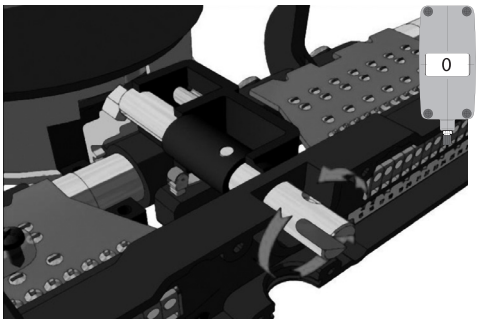


Figure 30

Initial state: ISM is closed. Turn interlocking shaft counter-clockwise to locked position (manual tripping).

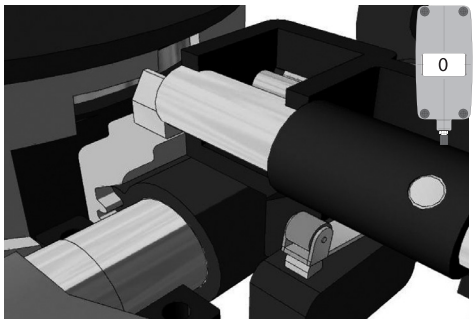


Figure 31

Interlocking shaft in locked position. ISM is open.

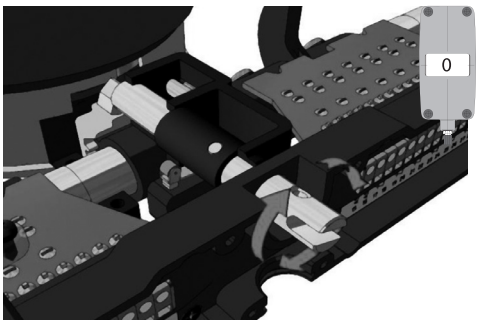


Figure 32

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

Mechanical interlocking depends on interlocking shaft rotation (refer to figures 28 to 32). The mechanical interface for the connection of mechanical interlocking is placed at the ISM frame between the terminal blocks XT1, XT2 (refer to figure 35). There is a slot on the visible face of the interlocking shaft. If the slot is directed vertically the module is in "unlatched" position. If the slot is directed horizontally the module is in "open and locked" position.

A handle connected directly to interlocking shaft via mating part is recommended. This handle shall be freely rotated up to 90 degrees in both directions. The handle operated by fingers shall be dimensioned so as to provide rotating force in accordance with local standards.

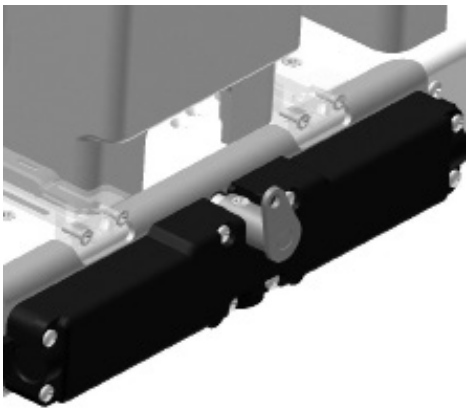


Figure 35
Interlocking shaft with mounted interlocking lever.

Possible tasks of the mechanical interlocking:
· Prevents operation of the disconnectors when switching module is closed (stationary type of switchboard)
· Prevents operation of the truck isolating mechanism when switching module is closed (draw out type)

Design of mechanical interlocking (by example of a draw out unit, figures 33, 34).

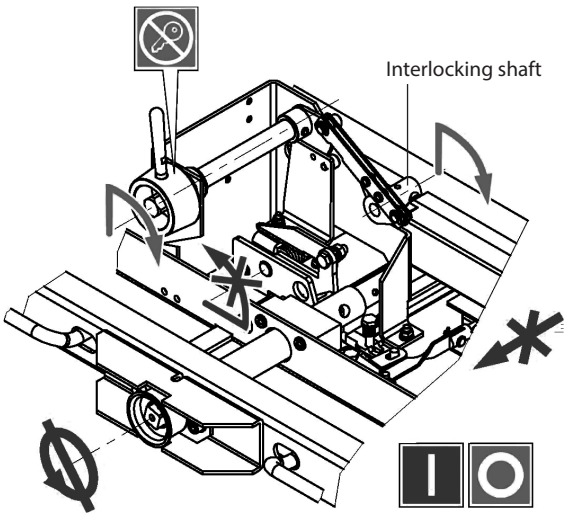


Figure 33
Interlocking shaft is unlatched.
ISM can be opened and closed.

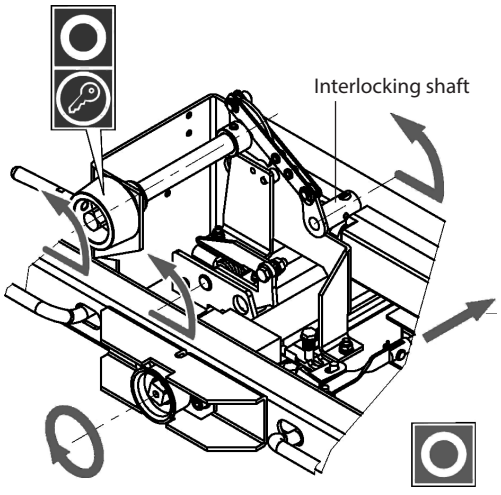


Figure 34
Interlocking shaft is in locked
position at opened ISM.

Load capacity of interlocking shaft

Interdependence between torque on the interlocking shaft and turning angle of the shaft when switching module has been previously switched off is presented on figure 36. Peak values of the torque are from 0.56 to 0.84 Nm. When shaft is rotated counter-clockwise the interlocking unit is moved from "Unlatched" position to "Open and locked" one, and otherwise. Operation zone of microswitch S14 when it becomes closed or open in "Unlatched" or "Open and Locked" positions respectively is hatched.

If switching module is closed before rotation of the interlocking shaft and manual trip operation is fulfilled the peak value of the torque can be up to 2Nm.

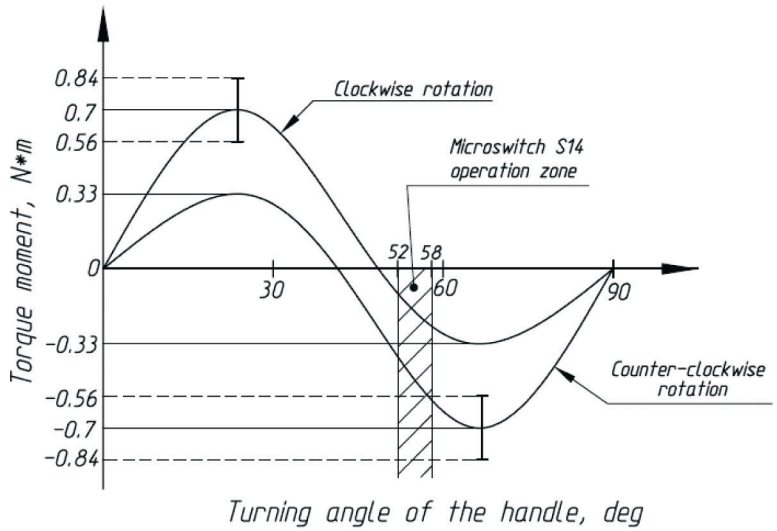


Figure 36

Torque on the interlocking shaft

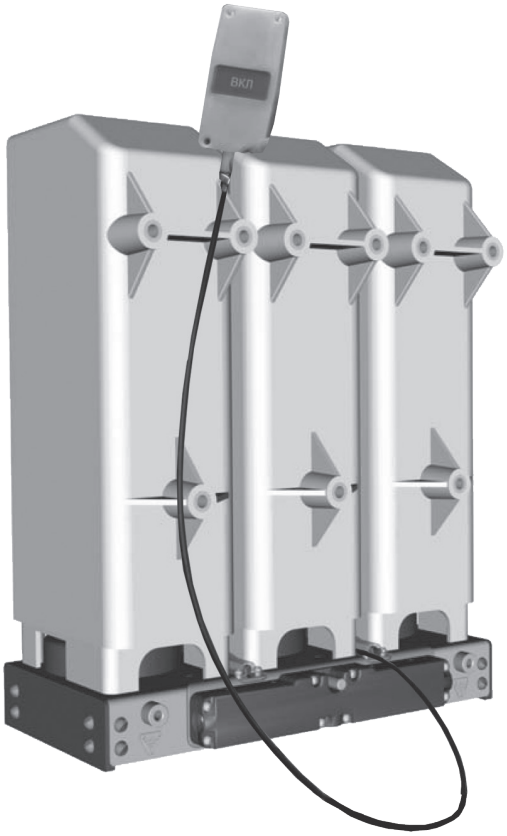
Electrical Interlocking

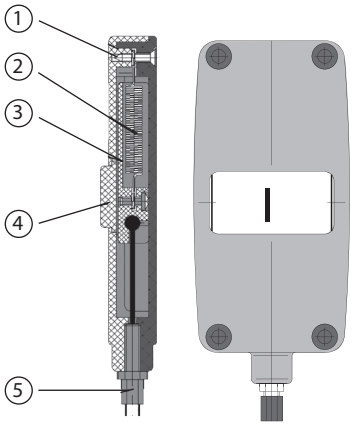
Electrical interlocking is also coupled with the interlocking shaft rotation (refer to chapter "Switching and control functions/Internal electrical interlock", page 38). If the mechanical interlocking is effective, then the electrical interlocking contact is activated synchronously. Electrical interlocking occurs during first 10 degree of interlocking shaft rotation whereby actuator coils are disconnected from the control module.

Main Contacts Position Indicator

The position indicator works as follows. There are two runners on the synchronizing shaft, any can be chosen to activate movable part of indicator, attached to wire. The movable part has a sticker with two printed symbols, one for Open position of the switching module, the other for Closed one. Connection of control wire to runner is described in "How position indicator can be attached and mounted" in detail.

When switching module comes to Open position the runner pulls the wire and corresponding symbol in inspection window becomes visible (see figure 44). When switching module comes to Close position the spring in the indicator provides reverse movement of the wire and symbol is changed to that one shown on figure 45.





① Frame
② Spring
③ Indicator plate
④ Window
⑤ Adjusting mechanism

Figure 37
Position indicator with flexible link

Indication of ISM-position by indicator plate depending on position of synchronizing shaft trunnion

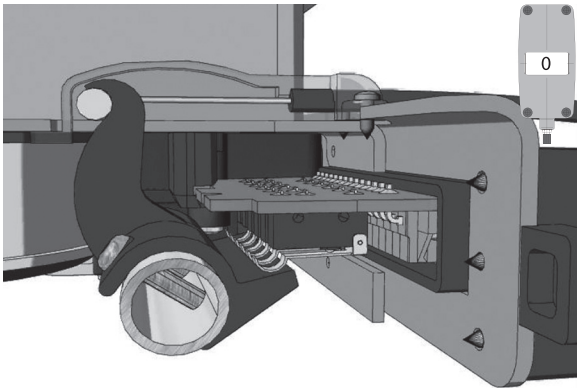


Figure 38
Position of trunnion at opened ISM

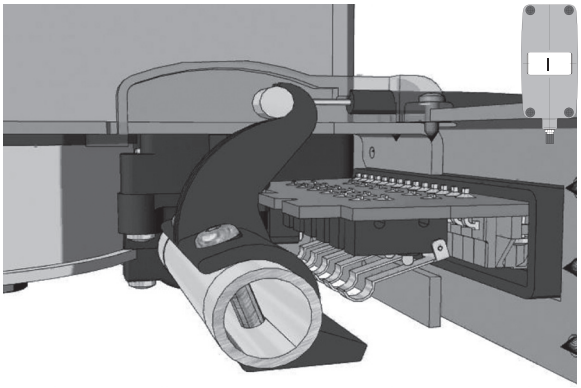


Figure 39
Position of trunnion at closed ISM

Position indicator mounting

Position indicator mounting is shown below step by step. (Figures 40, 41, 42, 43, 44, 45). ISM main contacts shall be in closed position.

Note: Bending radius of the position indicator flexible link shall be not less than 40 mm to prevent decreasing performance or malfunction.

There are two possibilities (left, right) to connect the flexible link of the position indicator.

Figure 40

Unscrew the self-tapping screws of transparent cover. Remove the cover.

Figure 41

Drop the boss of the wire horizontally into slot. Insert end of the sheath into V-shape spring contact. So the wire will be packed in groove between the slot and the spring.

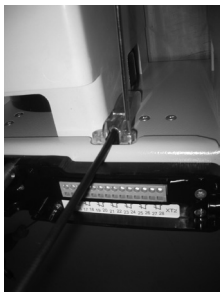


Figure 42

Return the cover to its place and fix it.

Figure 43

Fasten the indicator to front of switchboard and adjust it as shown here for both closed and opened states of the switching module.

Figure 44

Position indicator shows that main contacts are open

Figure 45

Position indicator shows that main contacts are closed

Secondary Part

Secondary Connections of the ISM

All ISM have the same terminals (Figure 46). Connected to the terminal blocks XT1 and XT2 are 13 auxiliary switches (6 "NO"- and 7 "NC"-contacts) and the magnetic actuator coils. Cables for terminal blocks XT1 and XT2 can be installed at right, left or bottom side as shown in figure 46.

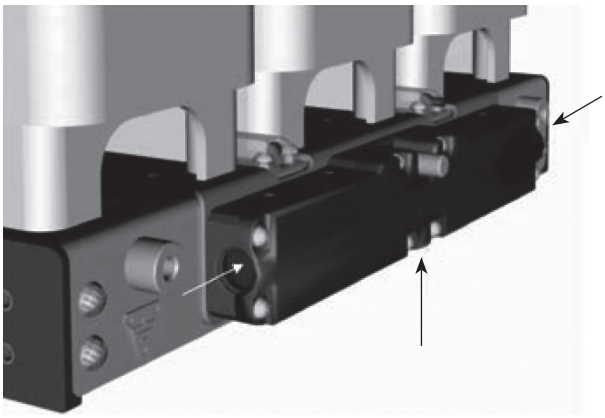
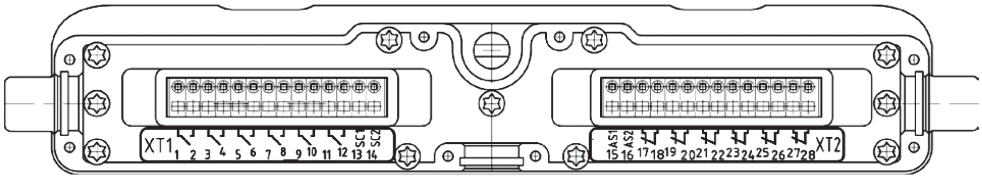


Figure 46
ISM cable entry points



Terminal arrangement ISM

XT1		XT2	
Terminal No.	Connection	Terminal No.	Connection
1	Auxiliary switch S 1 (1)	15	Auxiliary switch S13 (AS1)
2	Auxiliary switch S 1 (4)	16	Auxiliary switch S 13 (AS2)
3	Auxiliary switch S 2 (1)	17	Auxiliary switch S 7 (1)
4	Auxiliary switch S 2 (4)	18	Auxiliary switch S 7(2)
5	Auxiliary switch S 3 (1)	19	Auxiliary switch S 8 (1)
6	Auxiliary switch S 3 (4)	20	Auxiliary switch S 8 (2)
7	Auxiliary switch S 4 (1)	21	Auxiliary switch S 9 (1)
8	Auxiliary switch S 4 (4)	22	Auxiliary switch S 9 (2)
9	Auxiliary switch S 5 (1)	23	Auxiliary switch S 10 (1)
10	Auxiliary switch S 5 (4)	24	Auxiliary switch S 10 (2)
11	Auxiliary switch S 6 (1)	25	Auxiliary switch S 11 (1)
12	Auxiliary switch S 6 (4)	26	Auxiliary switch S 11 (2)
13	Actuator coil (SC1)	27	Auxiliary switch S 12 (1)
14	Actuator coil (SC2)	28	Auxiliary switch S 12 (2)

CM connections

The connections for basic and extended functions of all available CM can be seen from the following terminal arrangements (Figures 47, 48, and 49).

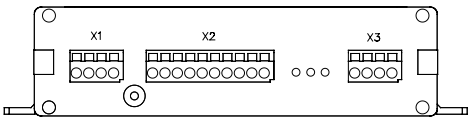


Figure 47
CM_1501_01 Terminal arrangement

X1		X2		X3	
Terminal No.	Connection	Terminal No.	Connection	Terminal No.	Connection
1	Auxiliary power supply input 1	1	Ready (NO)	1	Auxiliary switch ISM (AS1)
2	Auxiliary power supply input 1	2	Ready (COM)	2	Auxiliary switch ISM (AS2)
3	Auxiliary power supply input 2	3	Ready (NC)	3	Output actuator coil (SC1)
4	Auxiliary power supply input 2	4	Dry contact "Close"	4	Output actuator coil (SC2)
		5	Dry contact "Close"		
		6	Dry contact "Trip"		
		7	Dry contact "Trip"		
		8	Malfunction (NO)		
		9	Malfunction (COM)		
		10	Malfunction (NC)		

Warning

Power supply voltage can be applied between terminals X1:1,2 and X1:3,4 of CM_1501_01 only. Terminals X1:1, X1:2 short-circuited inside of CM_1501_01, and terminals X1:3, X1:4 also short-circuited inside of module.

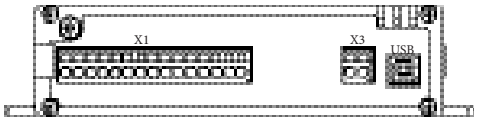


Figure 48

CM_16_1(60), CM_16_1(220) Terminal arrangement

Figure 49

CM_16_2(220) Terminal arrangement

X1		X2*		X3	
Terminal No.	Connection	Terminal No.	Connection	Terminal No.	Connection
1	Auxiliary power supply input 1	1	CT input 1	1	Output actuator coil (SC1)
2	Auxiliary power supply input 2	2	CT input 1	2	Output actuator coil (SC2)
3	Digital output 1 (NO)	3	CT input 2		
4	Digital output 1 (COM)	4	CT input 2		
5	Digital output 1 (NC)				
6	Digital output 2 (NO)				
7	Digital output 2 (COM)				
8	Digital output 2 (NC)				
9	Digital output 3 (NO)				
10	Digital output 3 (COM)				
11	Digital output 3 (NC)				
12	Dry contact “Close”				
13	Dry contact “Close”				
14	Dry contact “Trip”				
15	Dry contact “Trip”				

* Note: X2 terminal block only present on CM_16_2(220) modules.

CM_16 Series Factory Programmable Options

The CM_16 series is a flexible control module option with an array of factory programmable settings for optimizing control of the ISM breakers. When ordering a CM_16, the model code along with the pre-programmed settings code should be submitted to Tavrida. Use the table on page 33 for configuration of a settings code based on the following options guide:

Breaker Type

3

To optimize the closing and trip pulses to the ISM actuators, this option sets various features of the CM_16 output power algorithm. Each model type of the ISM_Shell series breakers can be selected. Note that connection to an ISM other than the one selected will produce a malfunction signal.

Undervoltage Functions

The CM_16 series has an option for automatic trip of the ISM on loss of auxiliary supply. The CM_16 will issue a trip command when the auxiliary supply drops below its minimum threshold (6VDC for the CM_16_1(60) and 60VAC / VDC for the CM_16_1(220) or CM_16_2(220)).

When set to "ON", the undervoltage delay parameter becomes active. This can be set from 0 to 60 seconds delay before the CM issues a trip command after loss of auxiliary power.

Similary, the undervoltage reclosing function becomes active. If set to "2", the breaker will automatically close when auxiliary power is restored with a delay time as set by the undervoltage reclosing delay parameter.

Digital Outputs

The CM_16 series has x3 output relays for external signalling such as lamps or relay alarm inputs. Each output has five settings options. The output can be disabled; signal close / open position of the breaker primary contacts; signal a loss of auxiliary supply; signal ready for operation; or signal a malfunction.

Trip / Close Delays

The ISM breaker series have high speed actuators for trip and close operations. The CM_16 by default is set for a 12ms trip and close delay time for normal breaker operations. For arc flash mitigation, fast transfer, or other unique applications, this delay time can be adjusted for trip and close independantly from 4ms to 40ms in 1ms increments. Note that for delay times less than 12ms the fault interrupting rating of the ISM may need to be reduced; consult Tavrida Applications Engineering for information.

Trip / Close Inputs

The CM_16 series use dry contact trip and close inputs, using any normally open contact by default as the trigger. For some applications such as mining, a normally closed loop is required for the trip circuit whereby any break in the trip connection will cause the breaker to open. For this purpose the CM_16 close and trip inputs can be set independantly for either NO or NC triggers.

Pre-Programmed Settings Code Designations Table

Parameter	Settings Option	Code
Breaker Type	ISM15_Shell_2	3
Undervoltage	UV On	0
	UV Off	1
UV Delay	Undervoltage delay (0 - 60 s)	0 - 60
UV Reclosing	Reclosing trips to lockout	1
		2
UV Reclosing Delay	Reclosing Delay (15 - 60 s)	15 - 60
Digital Output 1	Disabled	1
	Close / Open Position	2
	Loss of Supply	3
	Driver Ready	4
	Malfunction	5
Digital Output 2	Disabled	1
	Close / Open Position	2
	Loss of Supply	3
	Driver Ready	4
	Malfunction	5
Digital Output 3	Disabled	1
	Close / Open Position	2
	Loss of Supply	3
	Driver Ready	4
	Malfunction	5
Trip Delay	Trip delay (4 - 40 ms)	4 - 40
Close Delay	Close delay (4 - 40 ms)	4 - 40
Trip Input	By closing the contact	1
	By opening the contact	2
Close Input	By closing the contact	1
	By opening the contact	2

Example

For a control module programmed with breaker type ISM15_Shell_2, UV on, UV delay of zero seconds, 1 trip to lockout with 60 second reclosing delay, DO1 = Close / Open Position, DO2 = Driver Ready, DO3 = Malfunction, trip delay of 12ms, close delay of 12ms, trip input = By opening the contact, close input = By opening the contact:

Settings code = 3-10-160-245-1212-21

Trip and / or close delays below 12ms will ship with an HS suffix model code. For example the CM_16_1 with 4ms trip delay for 120VAC operation will ship with model code CM_16_1(220HS).

Installation of the CM

The installation of the CM is carried out according to the panel design either on the draw out unit or in the low voltage compartment of the switchboard. It must be separated from the high voltage compartment. The CM shall be installed in an grounded mild steel box with a thickness of not less than 1 mm.

The CM can operate in any mounting position. Care must be taken for good access and visibility of the terminals, LEDs and setting elements for operation and maintenance. Basically the ambient conditions as described in chapter “Regulations and ambient conditions” (page 73) shall apply.

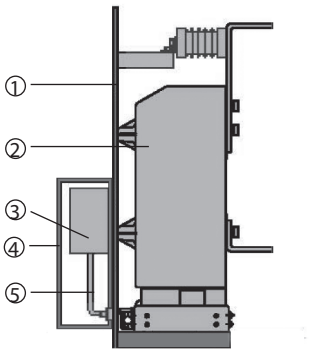


Figure 50
Stationary type installation

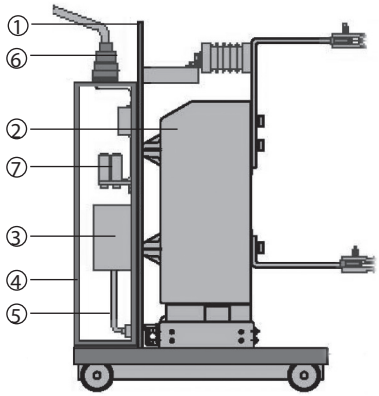


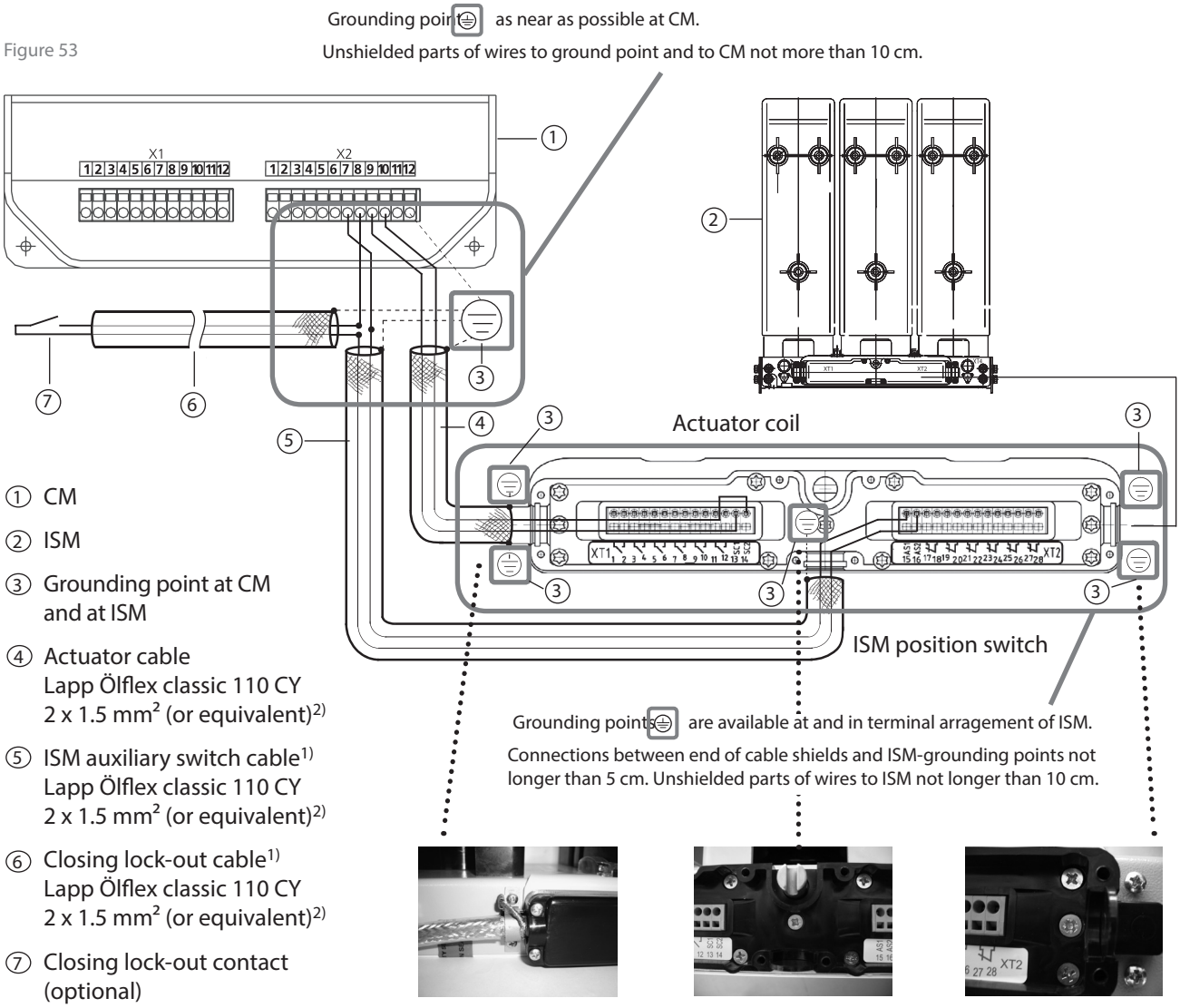
Figure 51
Draw out type installation

① Steel plate > 1 mm thick
② ISM
③ CM
④ Closed steel box > 1 mm thick
⑤ Shielded cable
⑥ Secondary circuit plug
⑦ Secondary components

Installation of Secondary Cables between ISM and CM

The installation of secondary cables between ISM and CM shall be performed regarding the subsequent connecting diagram and indications (figure 53). These instructions are required to achieve best possible protection against electromagnetic influence.

Figure 53



① CM

② ISM

③ Grounding point at CM and at ISM

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

⑤ ISM auxiliary switch cable[1)]
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[2)]

⑥ Closing lock-out cable[1)]
Lapp Ölflex classic 110 CY
2 x 1.5 mm² (or equivalent)[2)]

⑦ Closing lock-out contact (optional)

[1)] For ISM auxiliary switch cable and closing lock-out cable the cross section can be chosen smaller up to 0.5 mm².

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

As a additional measure it is recommended to install the shielded cables between ISM and CM in an grounded metal hose or an enclosed metal

The cables are fixed with a special screwdriver supplied with every ISM and CM (Figure 48). Solid or multi-wire cables with or without sleeves with a cross section of 0.5 to 2.5 mm² can be connected to the terminals. The bare ends of the cables shall be 8 to 9 mm.

1- Insert screwdriver into the rectangular hole and press the contact spring.
2- Insert wire into the corresponding round hole.
3- Remove the screwdriver and pull the wire slightly to check the reliability connection

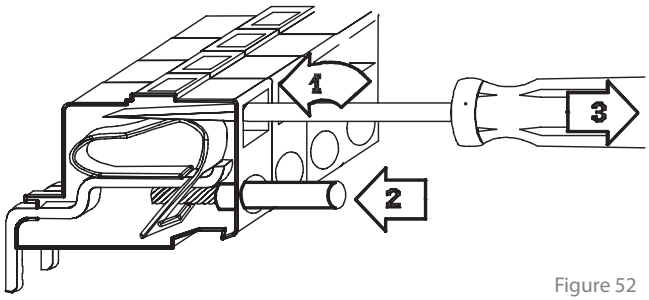


Figure 52

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Switching and Control Functions

Basic functions for all control modules

Charging of the Capacitors

Closing and trip capacitors of the CM are charged when CM is applied to the auxiliary power supply. The charged closing capacitors correspond with the charged springs of a conventional circuit breaker. After the failure of auxiliary power supply any pending trip or any trip command arriving to the CM up to 30s after failure of auxiliary power supply will be executed.

Ready-LED and Ready-Relay Output

While charging the capacitors, the Ready-LED blinks. When the capacitors are charged the Ready-LED is continuously lit and the Ready-relay output contact is closed. With a blinking or extinguished Ready-LED, the Ready-relay output contact is open. The Ready-relay output can be used as a permissive, such as the release condition for a breaker control.

Malfunction-LED and Malfunction-Relay Output

If the CM detects an internal or external malfunction, the Malfunction-LED will blink according to the type of malfunction (see the "Signalling" chapter of this manual). At the same time the Malfunction-relay output contact will close. In this way a CM-Malfunction state can be transmitted to an alarm or SCADA system. In the case of a malfunction the Ready-LED is extinguished and the Ready-relay output contact is opened. The Malfunction-relay output contact is closed if the CM is powered off.

Switching the ISM On and Off via the Dry Contact Inputs of the CM

The ISM can only be closed electrically via the CM. Dry contact inputs are available on all CMs for close and trip operations. Each of these inputs can be connected with one or more parallel-switched dry contacts. Under no circumstances shall external voltage be applied to these inputs as this will destroy the CM.

Electrical Closing Lock-Out

When the ISM manual trip hub is rotated to the locked position, an internal microswitch prevents close operation of the breaker. As the hub is rotated counter-clockwise, the ISM is mechanically tripped (if closed) followed by the microswitch disengaging the actuator connections. This prevents the breaker from closing until the trip hub is rotated back to the unlocked position.

ISM Forced Trip by an Undervoltage Relay (Optional - CM_1501 Series)

In cases where the ISM is required to trip when the auxiliary power supply voltage drops below the minimum value an additional undervoltage relay is required (not part of the scope of supply). The trip contact of the undervoltage relay shall be integrated into the dry contact trip command circuit of the CM. If the CM was ready for operation before the voltage dropped below the minimum value, tripping of the ISM is possible within 30 s after the voltage dropped below the minimum level.

Note that for undervoltage trip functions it is recommended to use the CM_16 series where possible due to the more flexible capability it provides for reclosing and UV trip delay.

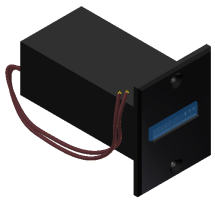
Output to Magnetic Actuator and Input for ISM Position Indication

The cables between the ISM and CMnas well as the coils of the magnetic actuator are monitored permanently (see malfunction indication table, page 43). Internally at the auxiliary switch inputs of the CM_1501 230 V DC is applied for the ISM auxiliary switch S13. The CM_16 series does not utilize the auxiliary switch; instead the impedence of the actuator coils is monitored for position of the breaker as well as loss of connection.

Operations Counter

Depending on site or switchgear requirements, a method of recording circuit breaker close / open operations may be needed. The preferred method of tracking operations is to utilize the breaker wear monitor available on most modern didgitical relays, which will calculate the remaining lifetime based on number of operations and switching interruptions. Alternatively, a pulse counter per the table below can be ordered from Tavrida that will indicate the number of mechanical operations. These counters can be wired to any of the 52a auxiliary contacts on the breaker.

Auxiliary Voltage	Pulse Counter Part Number
24VDC	5RSI62.2 24C
48VDC	5RSI62.2 48C
120VAC	5RSI62.2 110
125VDC	5RSI62.2 110C
220VAC	5RSI62.2 220



Antipumping Duty

For close and trip inputs the following rule is applicable: During close operation, if a trip instruction is received before the close instruction becomes passive then the close instruction will be blocked. For the next close operation the close instruction must be reapplied after the trip instruction has become passive (Figure 54).

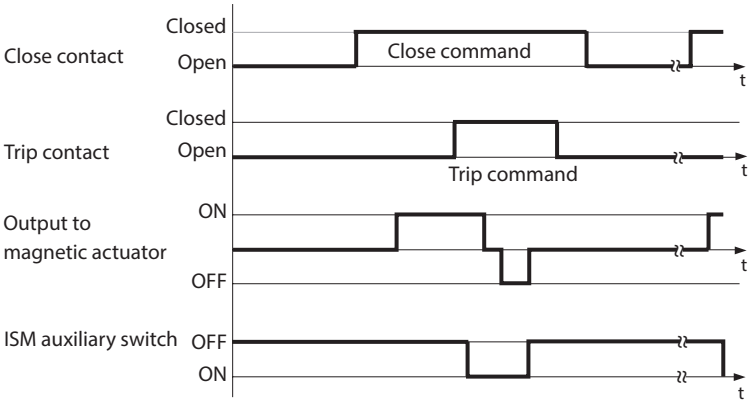


Figure 54

Blocking Duty

For close and trip inputs the following rule is applicable: If a close instruction is received whilst a trip instruction remains active then the close instruction is blocked. For the next close operation the close instruction must be reapplied after the trip instruction has become passive (Figure 55).

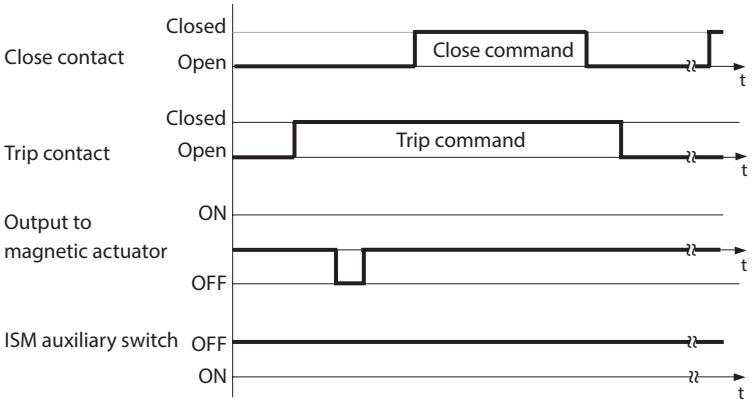


Figure 55

Combined Blocking and Antipumping Duty

A close command during a pending trip command is not executed (blocking duty) even it is pending longer than the trip command (antipumping duty) (Figure 56).

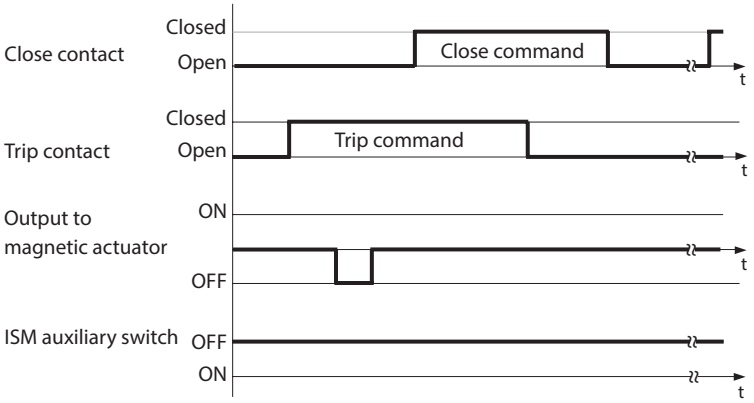


Figure 56

Output to Magnetic Actuator and Input for ISM Position Indication

The cables between the ISM and CM and the coils of the magnetic actuator are monitored permanently (see malfunction indication table, page 47). Internally at the inputs of the CM_1501 230 V DC is applied for the ISM auxiliary switch S13.

Commissioning, Maintenance

General

Caution
Danger!

Commissioning, operation and maintenance is only permitted for qualified and trained personnel.

Insofar as installation, commissioning or retrofit is carried out on energized equipment, the relevant safety regulations for local and national standards must be adhered to.

When designing and mounting a panel for the first time an acceptance of the equipment must be carried out together with Tavrida Electric in order to ensure the installation conditions.

The ISM must always be tested and operated together with the CM. Individual testing is not possible and may lead to the destruction of the ISM.

Commissioning Primary Part

Tests at end of installation shall include at least:
· Operating conditions of ISM shall comply with requirements of the rating plate.
· Check for damage, remove dirt or contamination
· Unsupported busbar length according to page 21, 22
· Fixing points according to page 21
· Check bolts and torques to pages 20, 21, 23
· Minimum clearances due to rated insulation voltage according to page 22
· Minimum clearances due to electromagnetic influence according to page 23
· Protective grounding according to page 23
· Free air circulation around the ISM

Testing the rated insulation level to ANSI C37.06:
· For applications from 5 to 15 kV ISM the rated power frequency test voltage is 36 kV
· For applications below 5 kV ISM the rated power frequency test voltage is 19 kV

Commissioning Secondary Part

Preparation before testing the functionality shall include at least:
· Installation of CM according to page 30.
· Availability of the CM auxiliary power supply. It is recommended to use the same auxiliary power supply as that for protection and control devices.
· Type of voltage (AC or DC) and voltage level according to selected CM type.
· Polarity of auxiliary power supply and selection of MCB according to page 32.
· Connection between CM and ISM acccording to pages 29 - 35, 63, 64.
· Checking that all secondary connections have been fastened correctly per electrical code standards

Operating test

Disconnect the breaker from the high voltage source before functional testing.

· Turn on the CM auxiliary power supply and check the following operating indications:
  - The POWER LED must light up immediately.
  - The READY LED must blink during charging of capacitors and light up continuously within 15 s after switching on. The READY relay contact (X2:1,2) must close within 15 s.
  - The READY relay contact (X2:1,2) must close within 15 s.
  - The MALFUNCTION LED must not light up.
· Check of all basic and extended functions (if any) according to the chapters "Switching and Control Functions" and "Signalling".

Caution
Danger!

· During operation both CM-actuator voltage (on CM X2:9,10 and ISM XT2:13,14) and internal auxiliary voltage for ISM auxiliary switch S13 (on CM X2:7,8 and ISM XT2:15,16) amounts to approximately 230 V DC.
· After switching off the CM, there is still a voltage at the terminals of the capacitors. Only after the MALFUNCTION LED is extinguished the voltage has dropped to a safe value.

In the factory the magnetic actuator coils are connected and tested according to the existing circuit diagram. If the actuator coil is connected with reversed polarity it is possible that the first operations cannot be performed successfully. This is no failure of the ISM and after a few switching operations this possible effect disappears permanently (unless the polarity is changed again).

After above listed functionality tests are performed succesfully the ISM can be tested under high voltage and with load connected.

Maintenance

Under normal operating conditions (see chapter "Regulations and ambient conditions, Ambient conditions", page 73) the ISM is maintenance free for a period of at least 25 years or until it has reached the permissible number of operating cycles. Nevertheless the surface of the ISM must be kept clean. Deposits of any kind must be removed.

Non-Conformity

If during installation, commissioning, operation or maintenance any non-conformity occurs, action shall be taken in accordance with the non-conformity report on page 78.

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Signalling 6

LED Indicators and Dry Contacts

Functionality	Results	LED indicators		Dry contacts	
CM_1501_01		Ready	Malfunction	Ready	Malfunction
Switch on auxiliary power supply	Power supply on	BLINKING	OFF	OFF	OFF
CM is ready to carryout close command	Operational readiness	ON	OFF	ON	OFF
Malfunction CM or ISM	Malfunction	OFF	ON	OFF	ON

See wiring diagram on page 63 for details on CM_1501_01 external signalling contacts NO/NC positions. CM_16 maintains the same LED indicator patterns as the CM_1501_01.

The CM_16 series control modules have three latching output relays in an SPDT configuration. Each relay can be factory programmed for one of three functions per the chart below. See the settings code label on the right side of the CM_16 module for as-shipped relay configuration.

The relays will change state from unasserted to asserted based on the firmware logic as outlined in the chart below. Note that as the relays are latching types they will retain their last state (asserted or unasserted) after power loss and complete discharge of the module capacitor bank.

Relay Programmed Function	Relay Reaction to Control / Breaker Events				
	Breaker Open	Breaker Closed	Malfunction	Trip on LS	Ready to Close
Breaker Position Indication [Indication if breaker is open or closed]	Unasserted	Asserted	No Effect	Unasserted	No Effect
Ready [Indication that the control module is ready to perform a close operation]	No Effect	No Effect	Unasserted	No Effect	Asserted
Malfunction [Indication that there is an error; all close operations blocked until corrected]	No Effect	No Effect	Asserted	No Effect	Unasserted
UV Active [Indication that trip on loss of supply occurred. Available if UV is set to "On"]	No Effect	No Effect	No Effect	Asserted	No Effect
Disabled [Relays disabled and will not change state for any event]	No Effect	No Effect	No Effect	No Effect	No Effect

LED indicators are situated on the front of the CM1501_01 and the CM_16. CM_16 have additional visibility of the LED's from the top.

Malfunction Indication Table

The self-monitoring system inside the CM detects eventual malfunctions and report them via the MALFUNCTION LED with various blink signals. The meaning of the blink codes and the variations per type of malfunction are shown in the following table.

Error group	Malfunction LED blinks	Function, type of malfunction	Description of malfunction variants	Recommendation for malfunction elimination	Affected CM
External error	1 blink signal, then 1.5 s pause, periodic (about 4 mi	The power supply has failed for >1.5 s	The operating range of the power supply of the CM, depending on the type of voltage, its value and switch command, is between 65-70% and 125% (Trip commands) and 80-125% (Close commands) of the nominal voltage. With continuous failure of the power supply, the blink signals continue until the capacitors are unloaded.	- Switch on MCB - Check for cable break - Check terminal connections	All CM
	2 blink signals, then 1.5 s pause, periodic	The Close or Trip-command of the CM is carried out but the corresponding ISM position signal is missing.	Malfunction variant 1: The Close command of the CM is carried out by the ISM. The normally open ISM auxiliary switch S13 has been bridged already due to a malfunction before the Close command was given (despite the existing malfunction, the ISM can be switched off again by the CM. This deletes the malfunction indication although the malfunction still exists).	- Check for short circuit in the cable - Check for short circuited terminals - Check ISM position switch S13	All CM
			Malfunction variant 2: The Trip command of the CM is carried out by the ISM. The normally closed ISM auxiliary switch S13 has been interrupted due to a malfunction (the ISM can only be placed in the close position after the malfunction has been eliminated).	- Check for cable break - Check terminal connections - Check ISM position switch S13	
		The Close command of the CM is not carried out as the ISM is electrically locked in OFF position.	Malfunction variant 3: The Close command of the CM is not carried out by the ISM as the closing lock-out contact in ISM S13 auxiliary switch circuit is open. The malfunction indication has been purposely taken into account.	Closing of the ISM is only possible if closing lock-out contact is closed.	
		The Close or Trip command of the CM is not carried out by the ISM as the ISM is mechanically locked in the particular position.	Malfunction variant 4: The Close command of the CM is not carried out by the ISM as it is mechanically locked in the OFF position.	Delete malfunction with Trip command. The ISM can only be closed when the mechanical lock has been removed.	
			Malfunction variant 5: The Trip command of the CM is not carried out by the ISM as it is mechanically locked in the ON position.	Remove the mechanical lock of the ISM.	

Error group	Malfunction LED blinks	Function, type of malfunction	Description of malfunction variants	Recommendation for malfunction elimination	Affected CM
External error	3 blink signals, then 1.5 s pause, periodic	The magnetic actuator coil circuit is interrupted.	Malfunction variant 1: Possible causes: cable break, loose terminal connections, defect magnetic actuator coils.	- Check for cable break - Check terminal connections	All CM
		CM-internal malfunction.	Malfunction variant 2: CM-defect.	- CM must be replaced	
	4 blink signals, then 1.5 s pause, periodic	The magnetic actuator coil circuit is short circuited.	Possible causes: Short circuited cable strands, short circuited terminal connections.	- Check for short circuit in the cable - Check for short circuited terminals	All CM
	5 blink signals, then 1.5 s pause, periodic	without CM command, the ISM trips.	Malfunction variant 1: Mechanical emergency trip.	Delete the malfunction indication with the CM Trip command.	All CM
		ISM is closed, a trip is simulated.	Malfunction variant 2: The ISM was properly closed by the CM and the close position feedback exists. Then a malfunction occurres in the ISM auxiliary switch S13 circuit in which the normally open switch S13 is bridged (the ISM can still be tripped again via the CM despite the existing malfunction. This deletes the malfunction indication but the cause of the indication is still there).	- Check for short circuit in the cable - Check for short circuited terminals - Check ISM position switch S13	
Internal error	17 or more blink signals, then 1.5 s pause, periodic	Various internal malfunction of the CM.		- CM must be replaced	All CM

Explanatory notes to malfunction indications and operational readiness

· If the ISM is in OFF position and malfunction indications exist, ISM can be closed only after all malfunctions have been eliminated.

· If several malfunctions appear at the same time malfunctions regarding the magnetic actuator are indicated with priority otherwise the last malfunction that occurred.

· Usually failures need to be fixed to stop malfunction indication.
During several malfunction variants of 2- or 5- blink failures, the malfunction indication will disappear with a trip CM command.

· In case of internal CM failures please contact your nearest Tavrida Electric partner.

Special Applications: Fast Switching

Fast Transfer Switching

Sensitive loads in industrial processes are often configured with a secondary primary feed from the utility for backup and reserve power. For sectors such as oil & gas, slow transfer times from traditional switching solutions result in motor stoppages and lost production time while processes are brought back on-line.

The high closing and opening speeds of the ISM15_Shell_2 series allow for a packaged solution. The VCB_FTS system is comprised of specially selected ISM15_Shell_2 breakers, control modules with a faster command recognition speed, and optional automatic transfer relays.

Transfer speed can be delineated by two transition types:

1. Closed transition - the backup power line is connected by closing the breaker before the main line is interrupted (make before break).

2. Open transition - the backup power line is connect by closing the breaker after the main line is interrupted (break before make).

The timing of the system can therefore be broken down by the following table, using the SEL-451 relay as an example of total timing calculation:

Product Parameters	Designation	Response Time
ISM15_Shell_2 opening time (including CM)	Topen	12 ms
ISM15_Shell_2 interrupting time (including CM)	Tinterrupt	20 ms
ISM15_Shell_2 closing time (including CM)	Tclose	26 ms
SEL-451 open phase detection logic trip time	Tsel451	10 ms
Closed transition with SEL-451 open phase detection logic trip time	Tsel451 + Tclose	36 ms
Open transition with SEL-451 open phase detection logic trip time	Tsel451 + Tclose + Topen	48 ms

Arc Flash Mitigation

A high concern for the electrical industry are incidents of arc flash, whereby a fault is initiated that causes damage to the equipment or serious injury to operators. These faults can be caused by many factors such as poor maintenance, equipment failure, or operator error.

In recognition of this many relay manufacturers have produced arc detection features. These generally include the standard relay functions plus an instantaneous trip driven by arc-detecting fiber optic cables within switchgear cubicles.

The purpose of these relays is to interrupt the arc fault through instant tripping of upstream devices. The faster the arc is suppressed, the lower the energy output and therefore less damage to equipment plus improved operator safety.

Tavrida ISM_Shell_2 series breakers unique high speed opening characteristics allow for a packaged solution. The VCB_FAS system is comprised of specially selected ISM15_Shell_2 breakers, control modules with a faster command recognition speed, and optional arc mitigation relays.

The timing of the system can be broken down by the following table, using the SEL-751 relay as an example of total timing calculation:

Product Parameters	Designation	Response Time
ISM15_Shell_2 opening time (including CM)	Topen	12 ms
ISM15_Shell_2 interrupting time (including CM)	Tinterrupt	20 ms
ISM15_Shell_2 closing time (including CM)	Tclose	26 ms
SEL-751 arc flash detection time	Tsel751	4 ms
Interruption time after arc initiation	Tsel751 + Tinterrupt	24.3 ms

Type	VCB15_Shell2_FTS (150...210...275) VCB15_Shell2_FAS (150...210...275)
Rated data	
Rated voltage (U_r)	15 kV
Rated current (I_r)	to 2000 [1] A (210, 275mm PCD) to 1200 [1] A (150 mm PCD)
Rated power frequency withstand voltage (U_d)	36 kV
Rated lightning impulse withstand voltage (peak) (U_p)	95 [2] kV
Rated short-circuit breaking current (I_{sc})	to 25 kA @ 15 kV to 28 kA @ 5 kV
Rated peak withstand current (I_p)	to 80 kA
Rated short-time withstand current (I_k)	to 31.5 kA
Rated duration of short circuit (t_k)	4 s
Rated frequency (f_r)	50/60 Hz
Switching performance	
Mechanical life [4] (CO-cycles)	30 000
Operating cycles [4], rated current (CO-cycles)	30 000
Operating cycles [4], rated–short circuit breaking current (O-operations)	50
Closing time [3]	22 ms
Opening time [3], not more than	12 ms
Break time [3], not more than	20.3 ms
Rated operating sequence (CM_1501_01(12))	O-0.3s-CO-10s-CO
Standards	
Design class with regard to severity of service conditions in accordance with IEC 60932	Class 1
Applicable Standards	IEC 62271-100 GB 1984-2003 ANS C37.09
Mechanical vibration withstand capability according to IEC 60271, IEC 60068	Class 4M4

Note

[1] In open air

[2] For ISM15_Shell_2(150)
with additional insulation
caps for contact terminals only

[3] In combination with CM_1501_01(4) or specially programmed CM_16_1

[4] See Figure 57

Product Line

7

Indoor switching modules (ISM)

Type	Rated Voltage	Rated Short Circuit	Rated Continuous Current	Pole Center Distance
ISM15_Shell_2(150)	15 kV	31.5 kA (5 kV) 29 kA (15 kV)	1200 A	150 mm
ISM15_Shell_2(210)	15 kV	31.5 kA (5 kV) 29 kA (15 kV)	2000 A	210 mm
ISM15_Shell_2(275)	15 kV	31.5 kA (5 kV) 29 kA (15 kV)	2000 A	275 mm

Control modules (CM15 Series)

Type	Former Product Code	Rated Voltage	General Functionality
CM_1501_01(12)	N/A	100 - 270 VAC / VDC	Basic functionality, 12 ms trip delay time
CM_1501_01(4)	N/A	100 - 270 VAC / VDC	Basic functionality, 4 ms trip delay time[1)]

Control modules (CM16 Series)

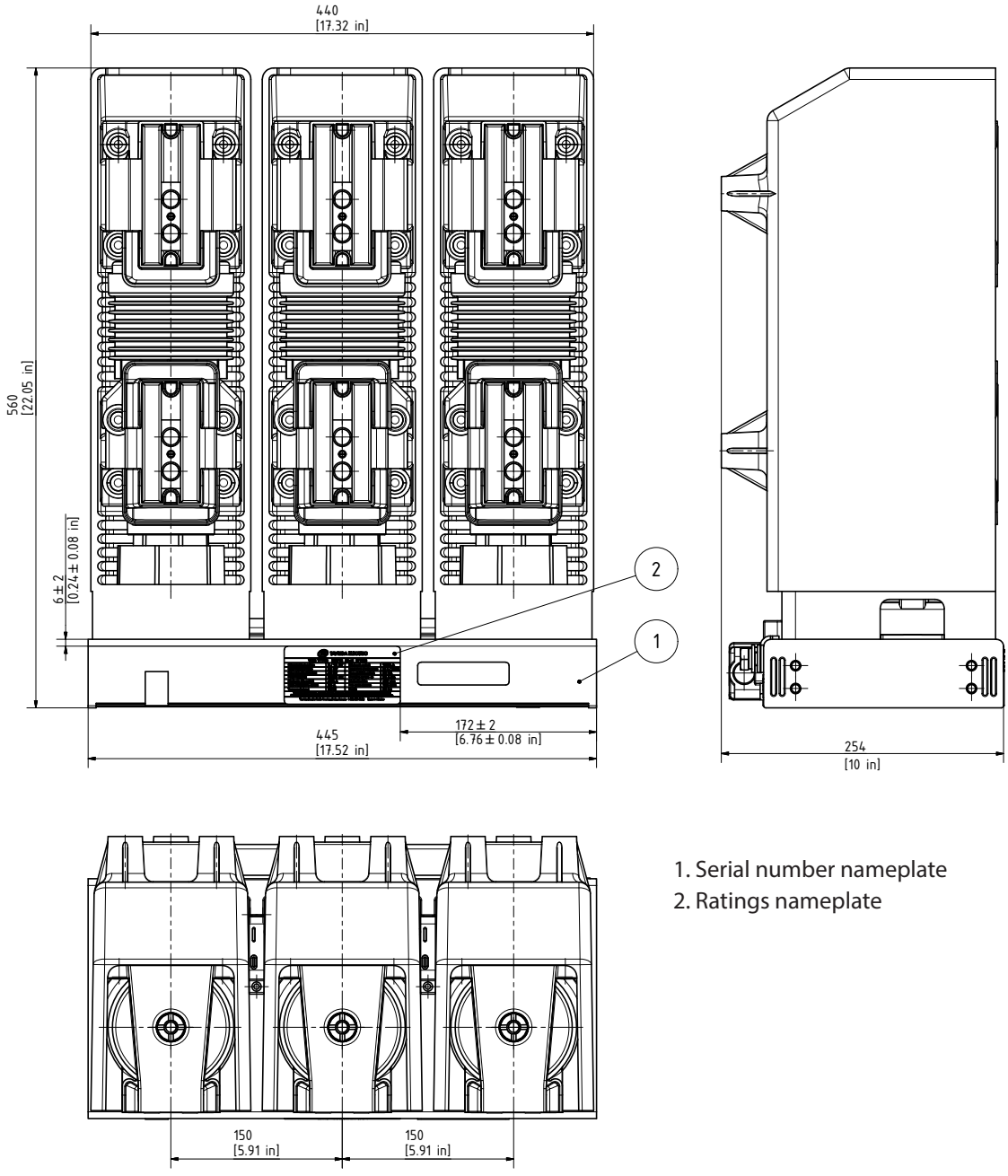
Type	Former Product Code	Rated Voltage	General Functionality
CM_16_1(60) CM_16_1(60HS)[2)]	N/A	24 - 60 VDC	Basic functionality + factory programmable options
CM_16_1(220) CM_16_1(220HS)[2)]	N/A	100 - 270 VAC / VDC	Basic functionality + factory programmable options
CM_16_2(220) CM_16_2(220HS)[2)]	N/A	100 - 270 VAC / VDC	Basic functionality, CT power supply + factory programmable options

[1)] Faster operating control modules of the CM15 series can be ordered for special applications. [2)] HS version of CM_16 control modules can be factory set for fast operation (4 - 11 ms acceptance time).

Dimensions and Weights

8

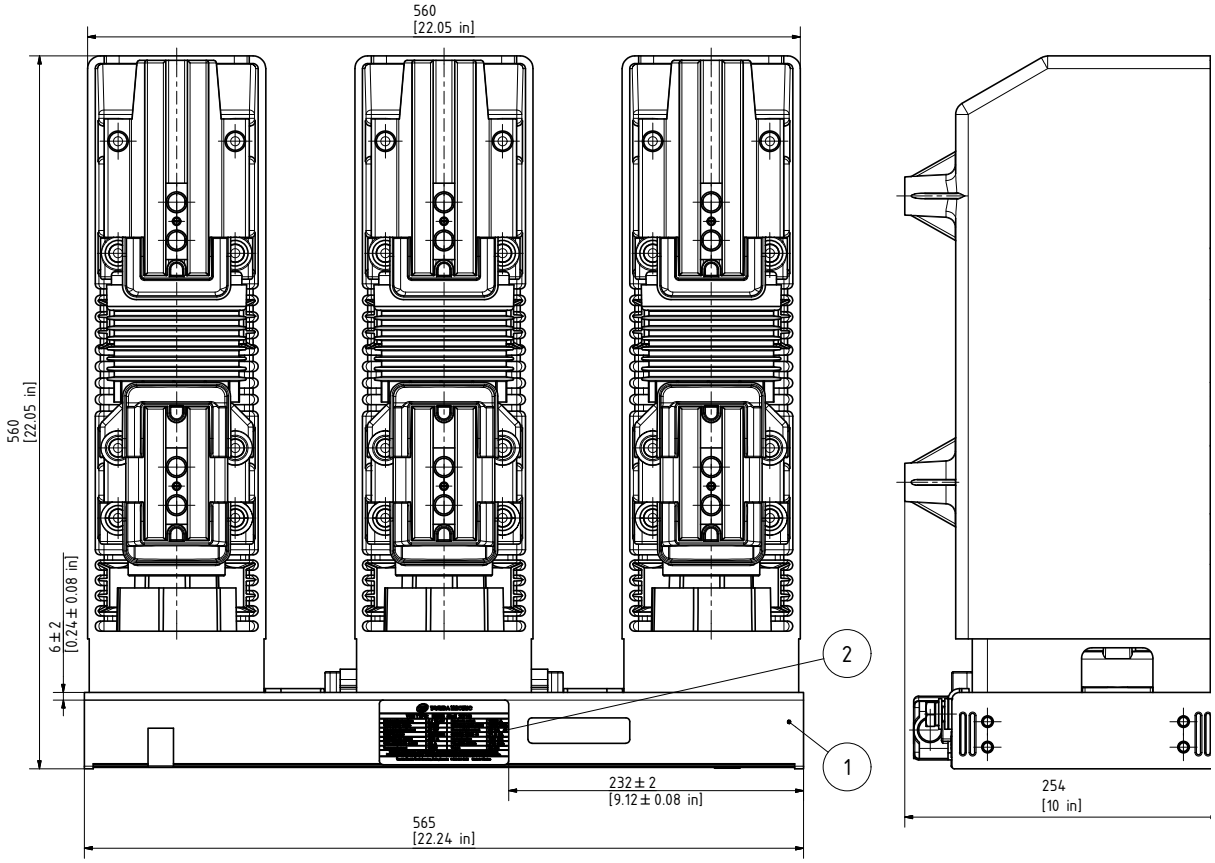
Dimensions and Weights of the ISM



1. Serial number nameplate
2. Ratings nameplate

5 / 15 kV VCB, PCD 150 mm, Weight: 51

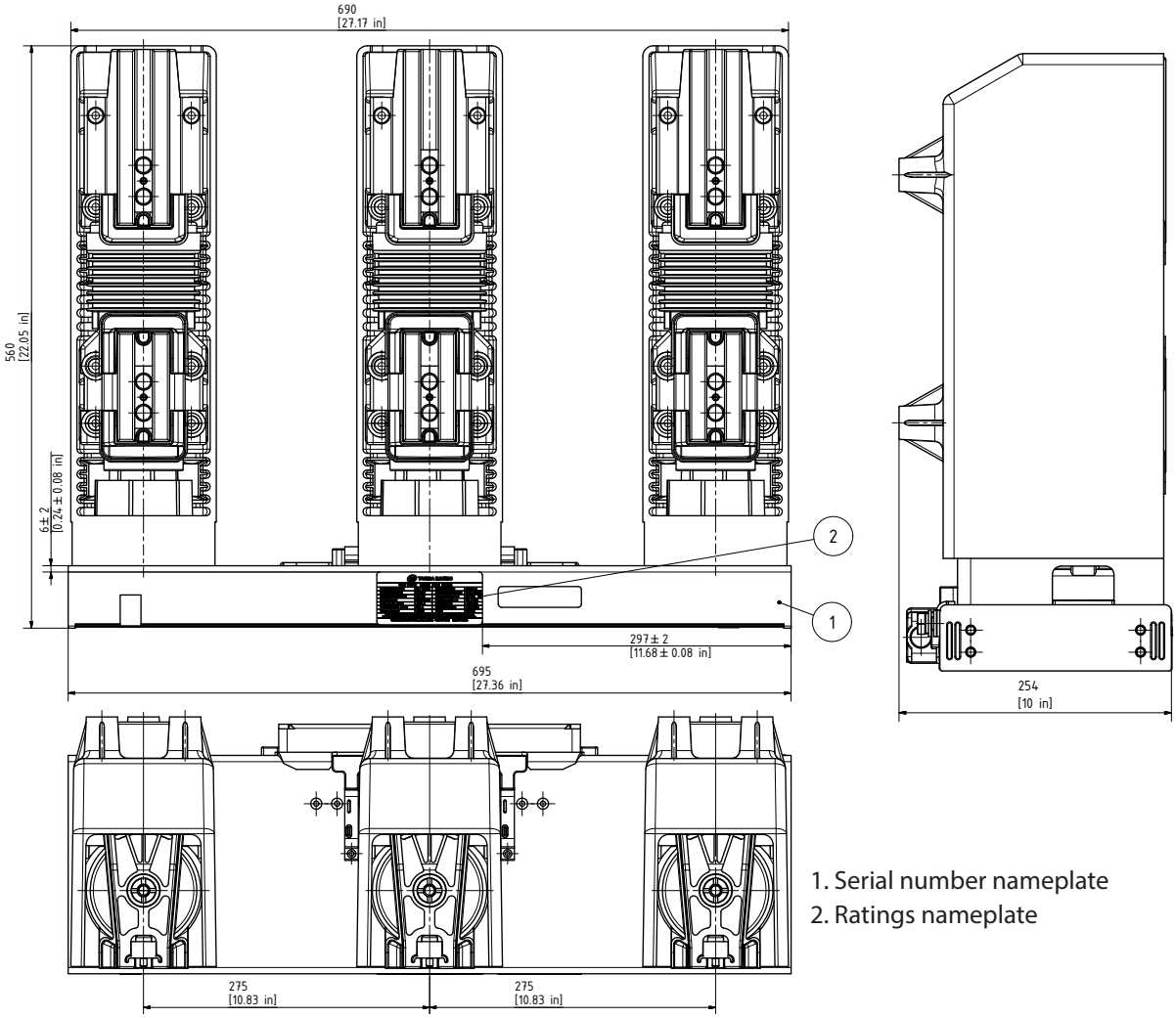
ISM15_Shell_2(150)



1. Serial number nameplate
2. Ratings nameplate

5 / 15 kV VCB, PCD 210 mm, Weight: 48 [illegible]

ISM15_Shell_2(210)

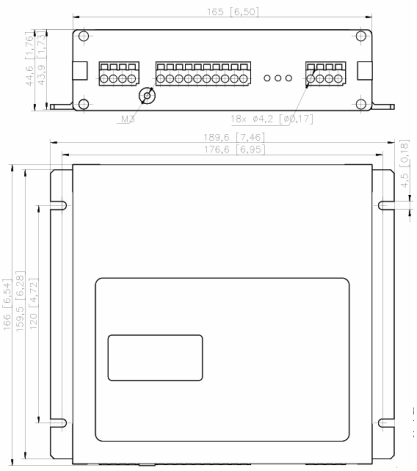


1. Serial number nameplate
2. Ratings nameplate

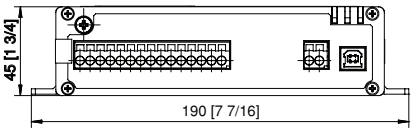
5 / 15 kV VCB, PCD 275 mm, Weight: 54.5

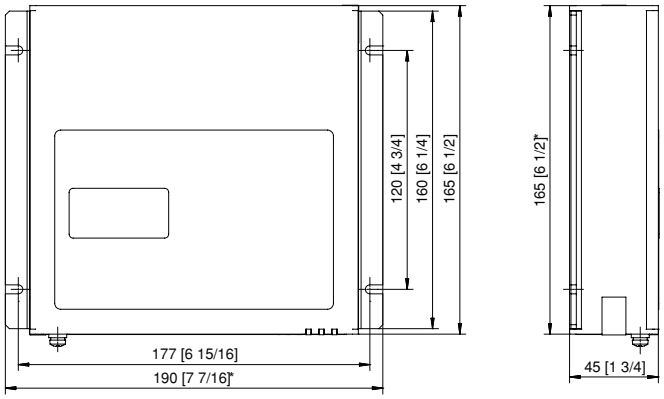
ISM15_Shell_2(275)

Dimensions and Weights of the CM

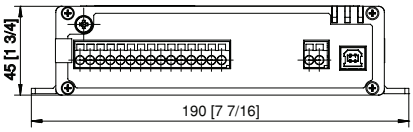


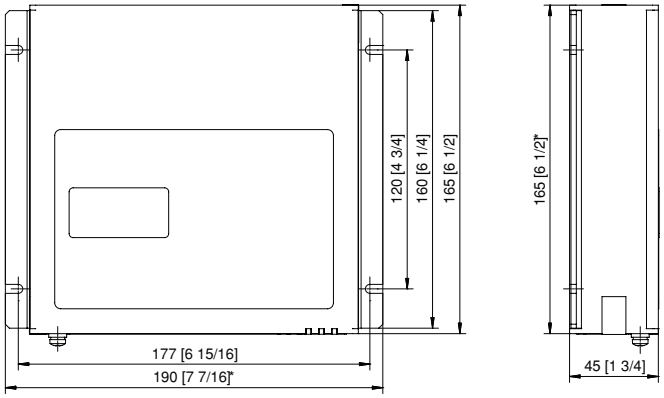
CM_1501_01
Weight: 1.5 kg
CM_1501_01(12)
CM_1501_01(4)





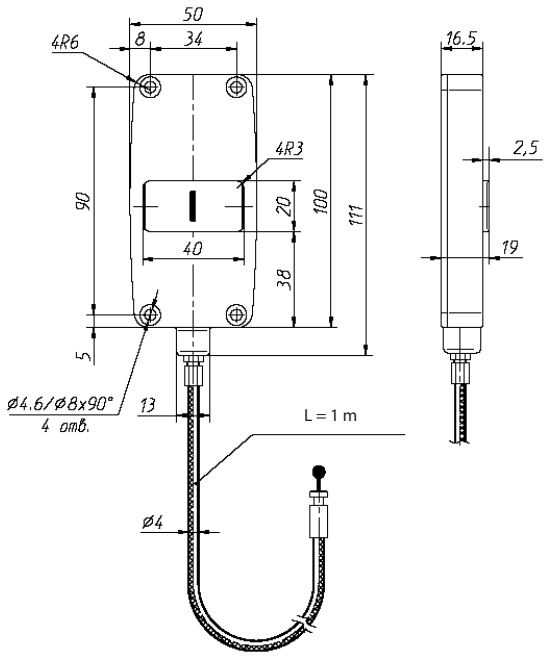
CM_16_1
Weight: 1.5 kg
CM_16_1(60)
CM_16_1(220)
CM_16_1(60HS)
CM_16_1(220HS)



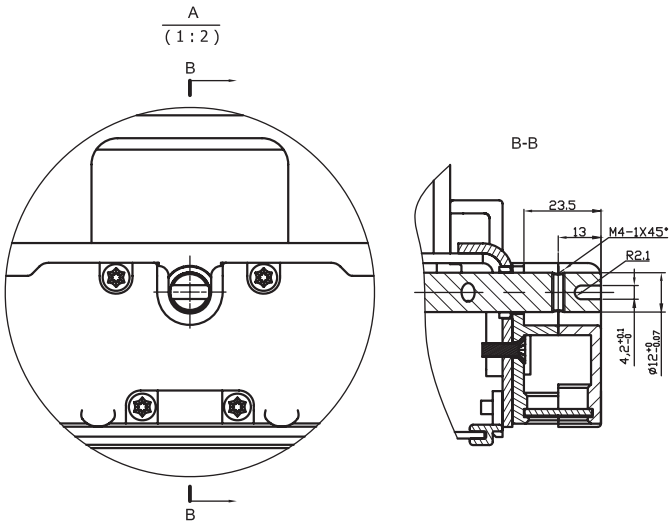


CM_16_2
Weight: 1.5 kg
CM_16_2(220)
CM_16_2(220HS)

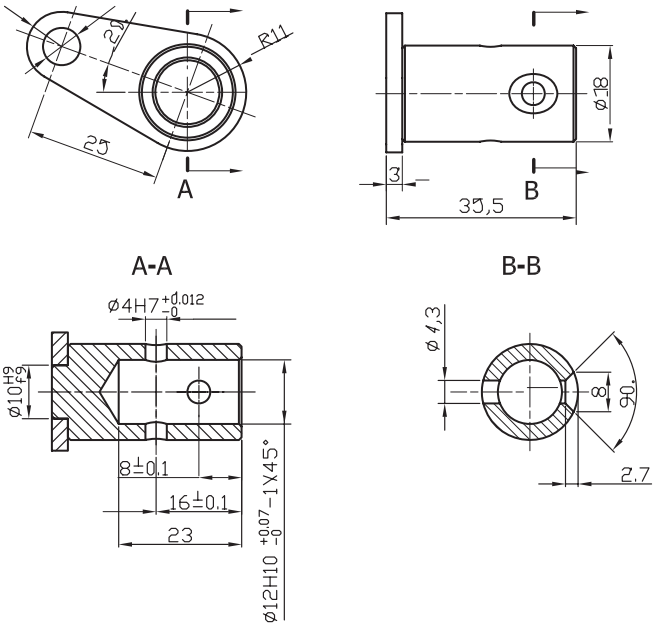
Dimensions of the Position Indicator



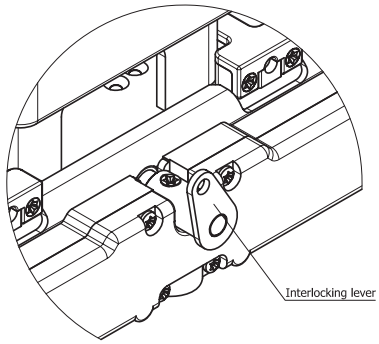
Dimensions of Mating Part for Interlocking Shaft



Dimensions of interlocking shaft



Mating part with interlocking lever

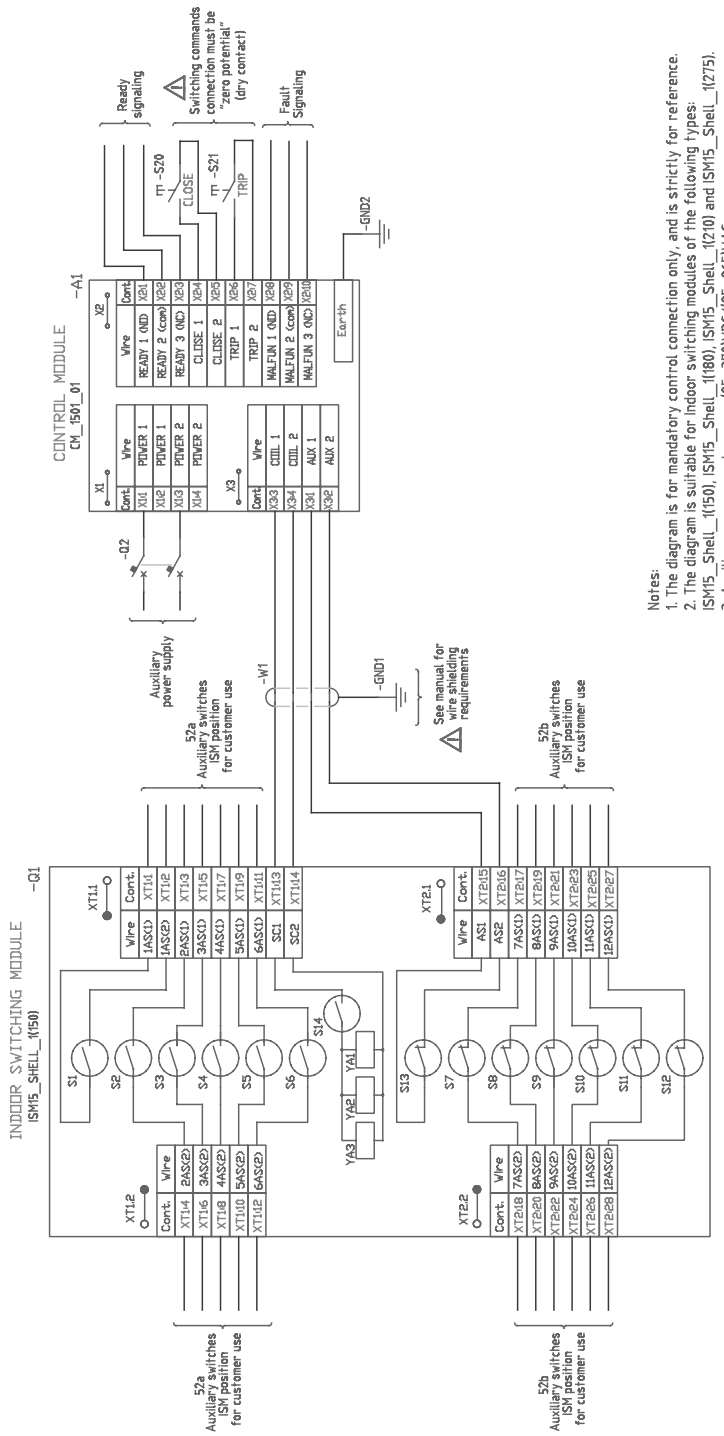


Interlocking shaft with mounted interlocking lever

9

Circuit Diagrams

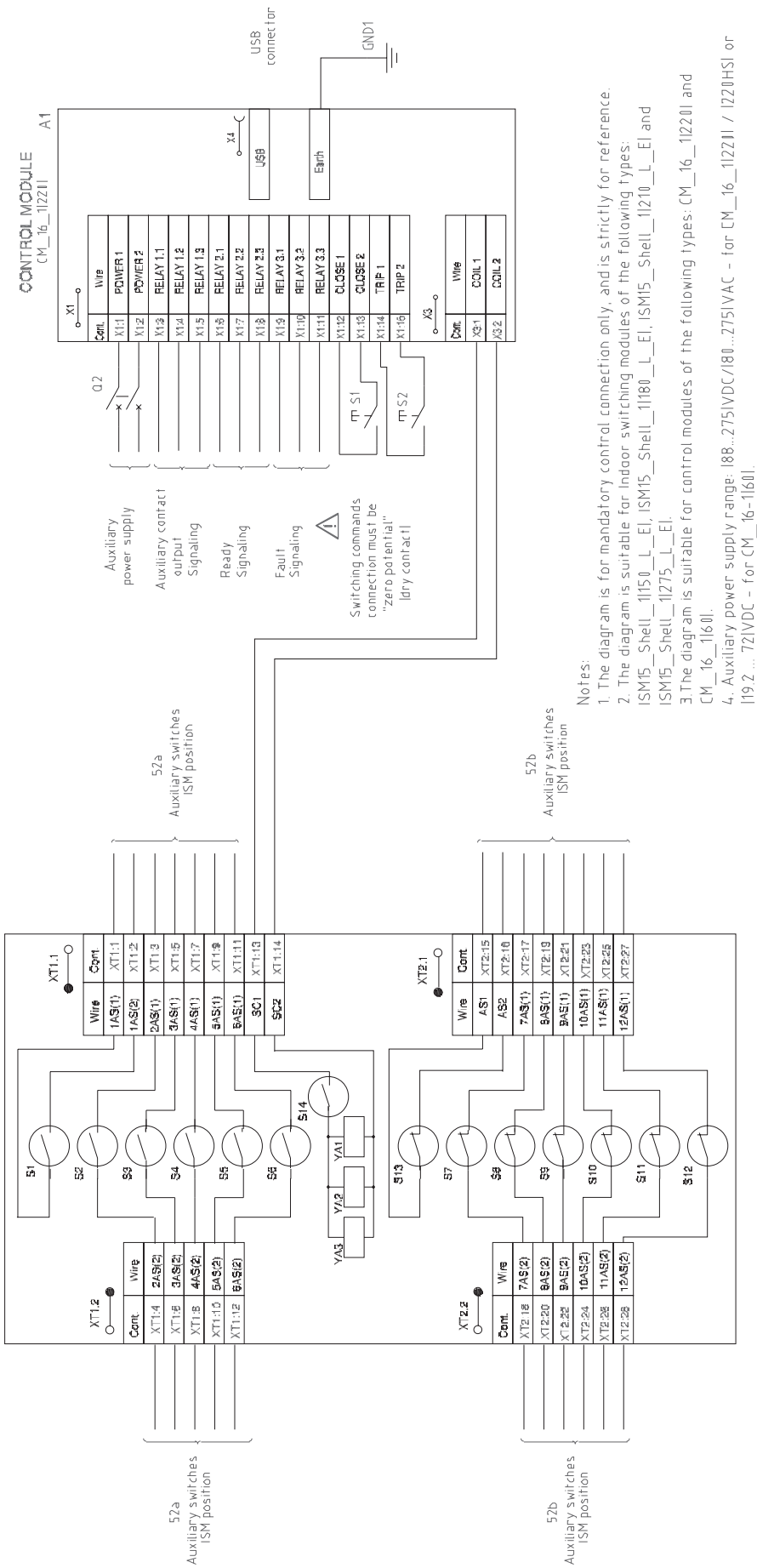
ISM15_Shell_2 with CM_1501_01



Notes:
1. The diagram is for mandatory control connection only, and is strictly for reference.
2. The diagram is suitable for indoor switching modules of the following types:
ISM15_Shell_1(150), ISM15_Shell_1(180), ISM15_Shell_1(210) and ISM15_Shell_1(275).
3. Auxiliary power supply range: (85...370)VDC/(85...265)VAC.
4. For further technical details see appropriate Manuals.

Explanation of designations:
YA1, YA2, YA3 – magnetic actuator coils.
S13 – 52b reserved for control module feedback.
S14– coil disconnect, driven by manual trip.
Q2 – miniature circuit breaker. Recommended rating: 1A, class C or B.
Supplied by customer.
S20 – push button close. Supplied by customer.
S21 – push button trip. Supplied by customer.

ISM15_Shell_2 with CM_16_1



Explanation of designations:
A1- control module
Q1 - vacuum circuit breaker:
YA1, YA2, YA3 – magnetic actuator coils
S1-S6, S7-S12 – 52a/52b breaker contact
S13 – 52b reserved for control module feedback
S14– coil disconnect, driven by manual trip
Q2 - miniature circuit breaker. Recommended rating: 2A, class C or D for CM_16_1122II;10A, class D for CM_16_1160I. Supplied by customer.
S21 - push button close. Supplied by customer.
S22 - push button trip. Supplied by customer.

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10

Technical Data

Indoor Switching Modules (ISM)

Type	ISM15_Shell_2 (150...180...210...275)
Rated data	
Rated voltage (U_r)	15 kV
Rated current (I_r)	to 2000 [1] A (210, 275mm PCD) to 2000 [1] A (150 mm PCD)
Rated power frequency withstand voltage (U_d)	36 (42) [6] kV
Rated lightning impulse withstand voltage (peak) (U_p)	95 [2] kV
Rated short-circuit breaking current (I_{sc})	to 29 kA @ 15 kV to 31.5 kA @ 5 kV
Rated peak withstand current (I_p)	to 80 kA
Rated short-time withstand current (I_k)	to 31.5 kA
Rated duration of short circuit (t_k)	4 s
Rated frequency (f_r)	50/60 Hz
Switching performance	
Mechanical life [4] (CO-cycles)	30 000
Operating cycles [4], rated current (CO-cycles)	30 000
Operating cycles [4], rated–short circuit breaking current (O-operations)	50
Closing time [3]	32 ms
Opening time [3], not more than	20 ms
Break time [3], not more than	28 ms
Rated operating sequence (CM_1501_01(12))	O-0.3s-CO-10s-CO
Standards	
Design class with regard to severity of service conditions in accordance with IEC 60932	Class 1
Standards	IEC 62271-100 GB 1984-2003 ANS C37.09
Mechanical vibration withstand capability according to IEC 60271, IEC 60068	Class 4M4
Other data	
Resistance of main circuit	< 22 µOhm
Weight (depending on PCD) for ISM	49 ... 51 kg
Type of driving mechanism	Monostable magnetic actuator
Design, switching capacity of auxiliary contacts	
Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC
Rated power frequency test voltage	2 kV
Minimum current for 12 VAC / VDC, ohmic load	100 mA
Minimum current for 12 VAC / VDC, inductive load (t=20 ms, cosj =0.3)	100 mA
Maximum current for 30 VDC, ohmic load	5 A
Maximum current for 30 VDC, inductive load (t=20 ms)	3 A
Maximum current for 50 VDC, ohmic load	1 A
Maximum current for 50 VDC, inductive load (t=20 ms)	1 A
Maximum current for 125 VDC, ohmic load	0.5 A
Maximum current for 125 VDC, inductive load (t=20 ms)	0.03 A
Maximum current for 250 VDC, ohmic load	0.25 A
Maximum current for 250 VDC, inductive load (t=20 ms)	0.03 A
Maximum current for 125 or 250 VAC, ohmic load	5 A
Maximum current for 125 or 250 VAC, inductive load (cosj =0,3)	5 A

Control Modules

Type	CM_1501_01	CM_16_1(60)	CM_16_1(220) CM_16_2(220)
Type of operation			
Rated operating sequence	O-0.1s-CO-10s-CO-10s-CO	O-0.3s-CO-10s-CO-10s-CO	O-0.3s-CO-10s-CO-10s-CO
Maximum CO operating cycles per hour	100	100	100
Auxiliary power supply 24/60	N/A	19 - 72VDC	N/A
Auxiliary power supply 100/220 - DC	85VDC to 370VDC	N/A	85VDC to 265VCD
Auxiliary power supply 100/220 - AC	85VAC to 275VAC	N/A	85VAC to 265VAC
Power consumption			
Charging the close and trip capacitors (max 10s)	≤20 W/25 VA	≤25 W	≤42 W
Peak charging power (<1ms, power supply dependent)	120 A	120 A	120 A
Permanent power consumption (standby)	≤5 W/8 VA	≤5 W	≤7 W
Reaction times			
Preparation time for the operation of the CM after switching on the auxiliary power supply, not more than	15 s	15s	15s
Preparation time for the close operation of the CM after a previous close operation, at most	10 s	10s	10s
Preparation time for the trip operation of the CM after switching on the auxiliary power supply , not more than	0.5 s	0.1s	0.1s
Trip capability after failure of the auxiliary power supply, at least	60 s		
Under voltage sensor trip threshold	N/A	6VDC	60VDC
Electric strength			
Power-frequency withstand voltage, 1 min (to IEC 60 255-5)	2 kV	2 kV	2 kV
Lightning impulse withstand voltage, 1.2 µs/ 50 µs/ 0.5 J (according to IEC 60 255-5)	5 kV	5 kV	5 kV
Insulation resistance at 1000 V DC at most 1 min at 2000 V DC (according to IEC 60 255-5)	> 5 MOhm	> 5 MOhm	> 5 MOhm

	CM_1501_01, CM_16_1, CM_16_2
Electromagnetic compatibility	
Interference immunity to voltage dips short inter-ruptions and voltage swings in accor-dance with IEC 61000-4-11, Class V (A)	Voltage oscillations of 15% for a period of 2 to 3 s, periodic for 5 to 10 s
Interference immunity to fast electrical transi-ents/bursts to IEC 61 000-4-4, Class IV (A)	4 kV
Interference immunity to periodic oscillations to IEC 61 000-4-12 and taking into account IEC 60 255-22-1, Class III (A)	2.5 kV 1 MHz to ground 1 kV 1 MHz between the inputs
Surge immunity to IEC 61 000-4-5, Class IV (A)	4 kV 1.2/50 µs to ground 2 kV 1.2/50 µs between the inputs
Interference immunity to magnetic fields to IEC 61 000-4-8, Class V (A)	100 A/m for duration of 60 s 1000 A/m for duration of 2 s
Interference immunity to pulsed magnetic fields to IEC 61 000-4-9, Class V (A)	1000 A/m
Interference immunity to damped oscillations of the magnetic fields to IEC 61 000-4-10, Class V (B)	100 A/m 0.1 MHz 100 A/m 1 MHz, Class V (A)
Other data	
Weight	1.5 kg
Degree of protection	IP40
Life cycle of CM close and trip capacitors	see Figure 59 / page 61
Switching capacity of output relay contacts	
Minimum current at 12 V	≥10 mA
Maximum breaking direct current at 250 V DC and t = 1 ms	≤0.35 A
Maximum breaking alternative current at 250 V AC and cosj = 0.3	≤16 A
Inputs for dry type close and trip commands	
Control command (close or trip) acceptance time	≤12 ms
CM generated voltage at the dry type inputs	≥30 V
Current at the time of closing the input current circuit	≥100 mA
Time constants for power failure	≥10 ms
Continuous current value	≥5 mA

	CM_16_2
Input for CT power supply	
Operating current range	2-300 A
Power consumption per phase during charging trip capacitors	
- at 2 A	5 VA
- at 5 A	12 VA
- at 10 A	25 VA
- at 30 A	120 VA
- at 300 A	8 kVA
Preparation time for trip operation (charging of the trip capacitor [1]), not more than	
- at 2 A	1000 ms
- at 5 A	400 ms
- at 10 A	150 ms
- at 30 A	110 ms
- at 300 A	100 ms
Current carrying capacity, not less	
- at 5 A	∞
- at 10 A	100 s
- at 30 A	10 s
- at 150 A	1 s
- at 300 A	0.1 s

Life cycle of ISM

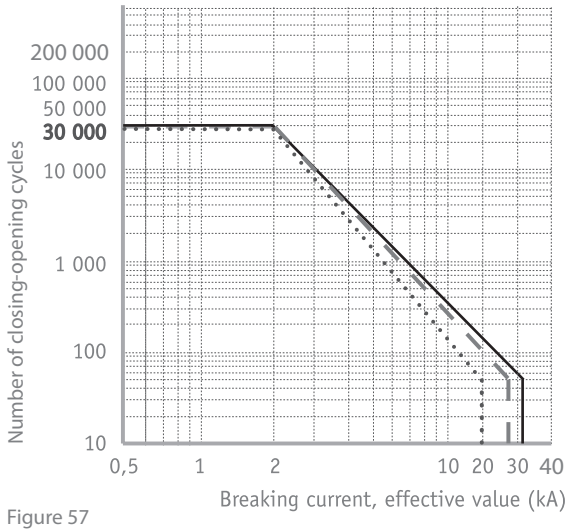

Figure 57

ISM15_Shell_2 at 20kA breaking current
ISM15_Shell_2 at 25kA breaking current
ISM15_Shell_2 at 31.5kA breaking current

Life cycle of CM close and trip capacitors

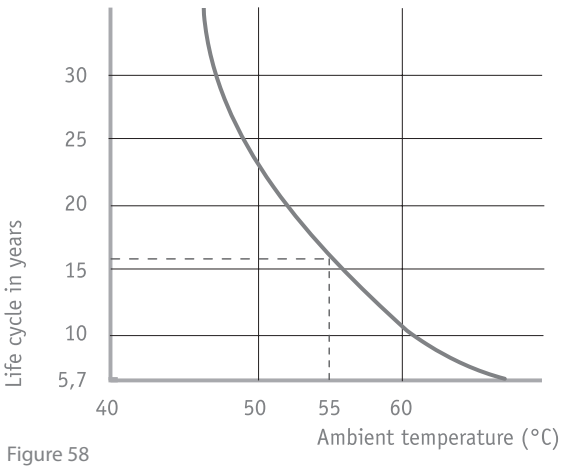

Figure 58

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11

Regulations and Ambient Conditions

Regulations

The ISM complies with the following standards:

· DIN VDE 0670, Teil 1000	Germany
· IEC 60056	International standard
· IEC 62271-100, -200	International standard
· IEC 60 694	International standard
· GB 1984-2003	China
· GOST 687-78	Russian Federation
· ANSI C37.09	North America
· ANSI C37.09a	North America

CE The EMC Directive 89/336/EEC.
The Low Voltage Directive 73/23/EEC.

Ambient Conditions

Highest value ambient temperature	+ 55 °C
Average temperature over 24 hours	+ 35 °C
Lowest ambient temperature	- 40 °C
Relative humidity in 24 hours	max 98%
Relative humidity over 1 month	max 90%
Average water vapour pressure over 24 hours	max 2.2 kPa
Average water vapour pressure over 1 month	max 1.8 kPa

Installation altitude

Up to an installation altitude of 1000 m above sea level, the acceptance need not take the dielectric strength of the air into account. Above 1000 m, the external insulation measurement of the ISM must be increased by the atmospheric correction factor Ka according to IEC 62271-1 compared to the insulation measurement at sea level (Figure 59).

Example:

Installation altitude:	2500 m
Operating voltage:	12 kV
Rated power frequency withstand voltage:	28 kV
Rated impulse withstand voltage	75 kV
Ka factor from diagram	1.2

At sea level the installation must resist the following test voltage values:

Corrected rated power frequency withstand voltage: 28 kV x 1.2 = 33.6 kV
Corrected rated impulse withstand voltage: 75 kV x 1.2 = 90 kV

Please coordinate the necessarily actions with Tavrida Electric AG.

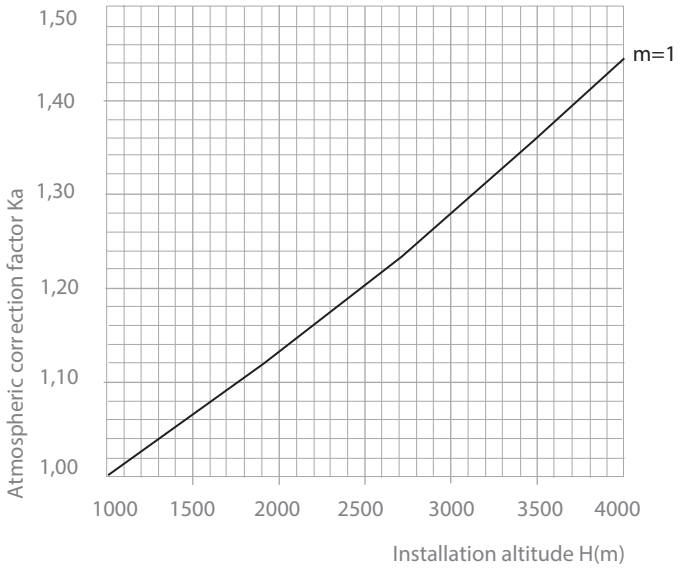

Figure 59

Correction factor (Ka) for installation altitude (H) m = 1 correction curve for the rated power frequency withstand voltage and rated lightning impulse voltage.

12

Legal Information

Warranty

Unless otherwise stated in the contract, the warranty period is 5 years from date of invoice. If agreed to otherwise, the contract conditions apply. No warranty is given in the case of …

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

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

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

d) … the device has not been properly installed, such as incorrect connection voltages.

Quality Regulations

All manufacturing facilities of the company have been certified by KEMA in the Netherlands and comply with (DIN EN) ISO 9001:2000.

All technical data of the vacuum circuit breaker are stored in an electronic database for each step of the manufacturing process. Testing of the circuit breakers is carried out in accordance with the relevant standards and beyond that the following test are carried out:

· 1000 C-O cycles

· Insulation strength of the primary and auxiliary circuits at operating frequency

· Measurement of the resistance of the main circuit

· All test results are automatically stored

KEMA

CERTIFICATE

Number: 75954

The management system of:

Industrial Group Tavrida Electric
Moscow, Russian Federation
Sevastopol, Ukraine

including the implementation meets the requirements of the standard:

ISO 9001:2000

Scope:
the general management, design, projecting, testing, production, sales, retrofitting and service of indoor and outdoor medium voltage switchgear, vacuum circuit breakers, surge arresters, low voltage vacuum circuit breakers (max. 1kV) and retrofit kits and control devices for switchgear, including components parts for this equipment, in the organisations as listed in the addendum

The file that forms the basis of this certificate:
75954-QUA

This certificate is valid until: January 1, 2010

Issued for the first time: February 1, 1998

KEMA Quality B.V.

ir. P.J.J.G. Nabuurs
Managing Director

A.J.M. van Outheusden
Certification Manager

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Integral publication of this certificate and adjoining reports is allowed.

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Experience you can trust.

Complaints and Transport Damage

All products are shipped exclusively with original packing to ensure safe transport and avoid transport damage (see Packing, Goods Received).

Tavrida Electric will not accept any claims for damages caused by improper transport, storage as well as unpacking. Obvious transport damage must be reported in writing to the supplier as soon as it is discovered. The warranty forms are to be used for this purpose. A period of maximum 3 weeks after receipt is allowed for this.

For legitimate claims Tavrida Electric will supply replacement equipment free of charge according to our warranty regulations. Tavrida Electric reserves the right to verify any claim.

Environmental Friendliness

The modules are manufactured from environmentally friendly material. Therefore, special disposal is not required.

Non-Conformity Report

In order to be able to exchange or repair the device, we kindly ask you to fill the accompanied "Non-conformity report" and send it to our regional representative or directly to us.

Please note:
Your request can only be fulfilled if the accompanying report is properly filled out and includes the name and address as well as a copy of the invoice.
For queries please contact your Tavrida Electric partner.

TAVRIDA ELECTRIC NA

Service Department
1105 Cliveden Avenue
Delta, BC, Canada
V3M 6G9

Phone: (604)-540-6600
Fax: (604)-240-6604
E-Mail: service@tavrida-na.com
Web: www.tavrida.com

Liability

Damages and demands for reimbursement of expenses incurred by the customer (in the following: compensation) for whatever legal reasons, especially due to non-compliance of obligations of the contractual obligations and for unauthorized actions, are excluded. This does not apply, insofar as there is a compulsory liability such as according to the product liability law in cases of malice, gross negligence, because of damage to life, the body or health, because of damage to important contractual obligations.

Compensation for damage to important contractual obligations, however, is limited to the damage which can be predicted as typical of the contract insofar as there is no malice or gross negligence, because of damage to life, the body or health. A change of the obligation to provide proof to the disadvantage of the customer is not connected with these regulations.

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The present documentation was produced with the greatest care. However, we are not liable for possible errors in this information text, incorrect interpretation and/or for consequences arising therefrom.

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TAVRIDA ELECTRIC NA

Service Department
1105 Cliveden Avenue
Delta, BC, Canada
V3M 6G9
E-Mail: service@tavrida-na.com
Web: www.tavrida-na.com

NON-CONFORMITY REPORT

From:		To:	TAVRIDA ELECTRIC NA Service Department
Address:		Address:	1105 Cliveden Avenue
			Delta, BC
Name:			
Phone:		Phone:	604-540-6600
Fax:		Fax:	604-540-6604
E-Mail:		E-Mail:	service@tavrida-na.com

Type designation ISM/TEL -	Serial No.:
Type designation CM/TEL -	Serial No.:
Date when non-conformity was noticed:	Date of commissioning:
When did the non-conformity occur: ○Incoming inspection ○Installation/Commissioning ○Service	Place of installation of CM/TEL: ○Low voltage compartment of panel ○High voltage compartment of panel ○Separate control cubicle ○Draw-out unit

Does your installation comply with the requirements of the Technical Manual:	
Primary Part (ISM): ○Operating conditions of ISM comply with technical data specified in Technical Manual ○Unsupported busbar length (page 21) ○Fixing points (page 21) ○Bolts and torques (pages 20, 21, 23) ○Minimum clearances due to rated insulation voltage (page 22) ○Minimum clearances due to electromagnetic influence (page 23) ○Protective grounding (page 23)	Secondary part (CM): ○Installation of CM (page 30) ○Type of voltage and voltage level according to selected CM-type ○Polarity of auxiliary power supply and selection of MCB (page 32) ○Connection between CM and ISM (pages 33, 59, 60) ○Selection and connection of interference suppressing filters (pages 33, 60)

Description of non-conformity:

How many blinks occured on Malfunction-LED of CM?

○1x ○2x ○3x ○4x ○5x ___○ If other, how many blinks ○No blink signal ○Undefined signal

Did you investigate the reason of malfunction blink signal with the help of malfunction indication table (page 44) ?

○Yes ○No

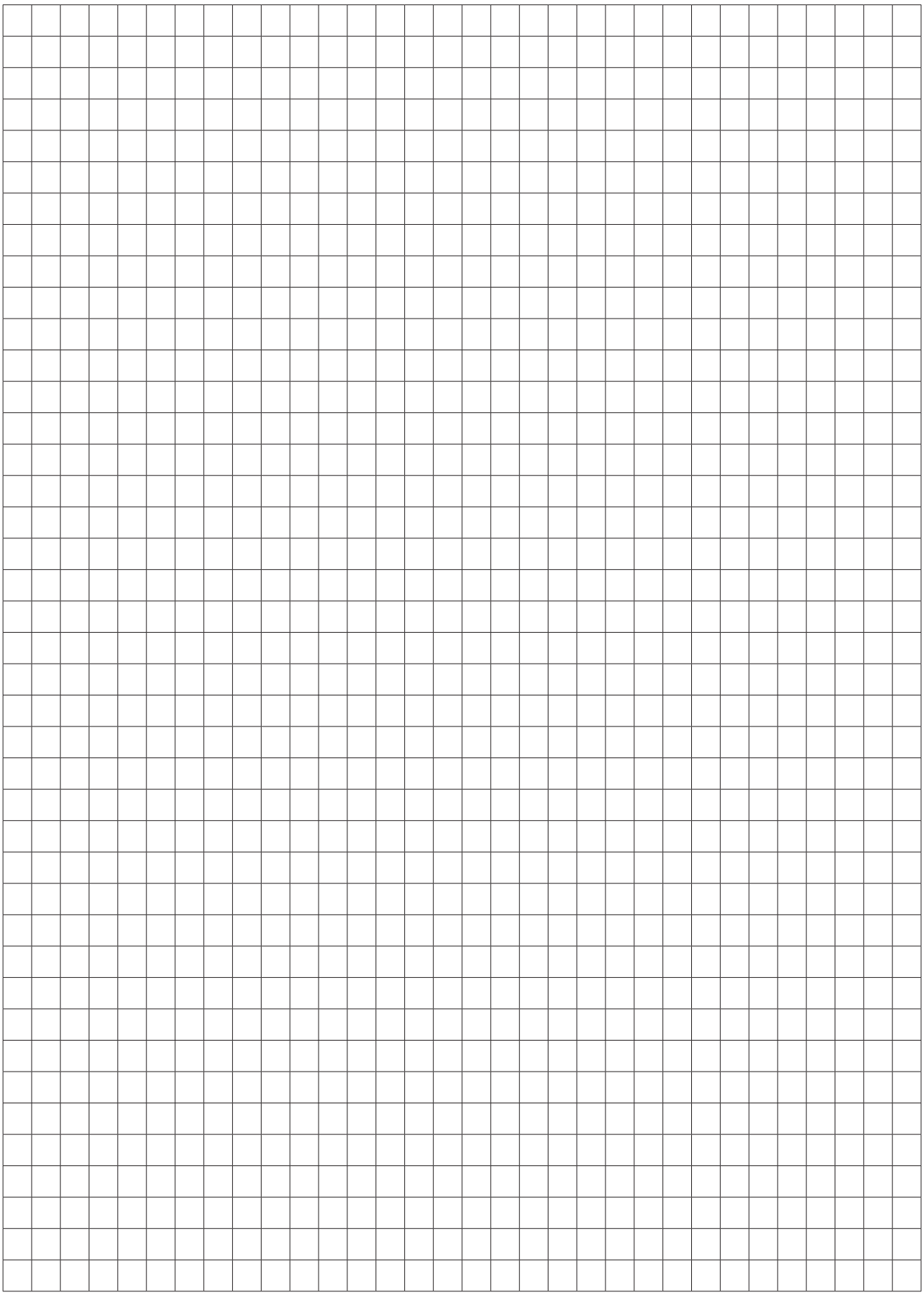
Non-conformity report issued by:

Date:	Name:	Signature:

Your warranty claim can only be handled if this non-conformity report is filled in completely including your name and address.

Date: _____

Date: _____



Date: _____

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TAVRIDA ELECTRIC

Applicable for the following types:

ISM15_Shell_2(150)
ISM15_Shell_2(210)
ISM15_Shell_2(275)

North America

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Delta, BC, Canada
V3M6G9
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Web: www.tavrida.com