

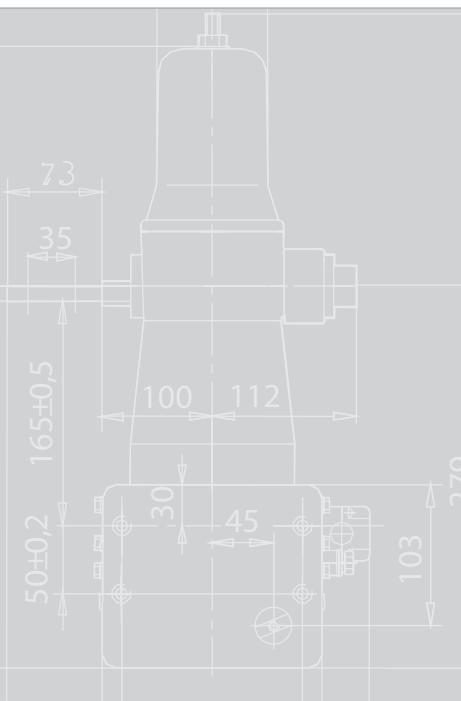


ISM_LD Series

Vacuum Circuit Breakers
15kV, ...20kA, ...1000A
27kV, ...16kA, ...800A

With CM_1501 and CM_16 Series Control Modules

Application Guide MAN5002252
Revision 2



The following application guide contains information necessary for the methods of use, installation, commissioning and operation of the ISM_LD series of breakers.

It is absolutely necessary for the proper use of the vacuum circuit breakers to read this guide carefully before starting and to adhere to the instructions as well as 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 NORTH AMERICA.

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Introduction

Glossary

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 acquisition
SF6:	Insulating gas sulfur hexafluoride
VCB:	Vacuum circuit breaker
VI:	Vacuum interruptor

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 have contact.

Pre-arching 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 and 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.

Scope

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

- The ISM (Figure 1)
- The CM for controlling the ISM (Figure 2)

1

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

This guide contains information on the operation, installation, commissioning and testing of the Tavrida ISM_LD series of breaker products.



Figure 1
ISM_LD type circuit breaker



Figure 2
CM Module

Design and Method of Operation: ISM and CM

Indoor Switching Module (ISM)

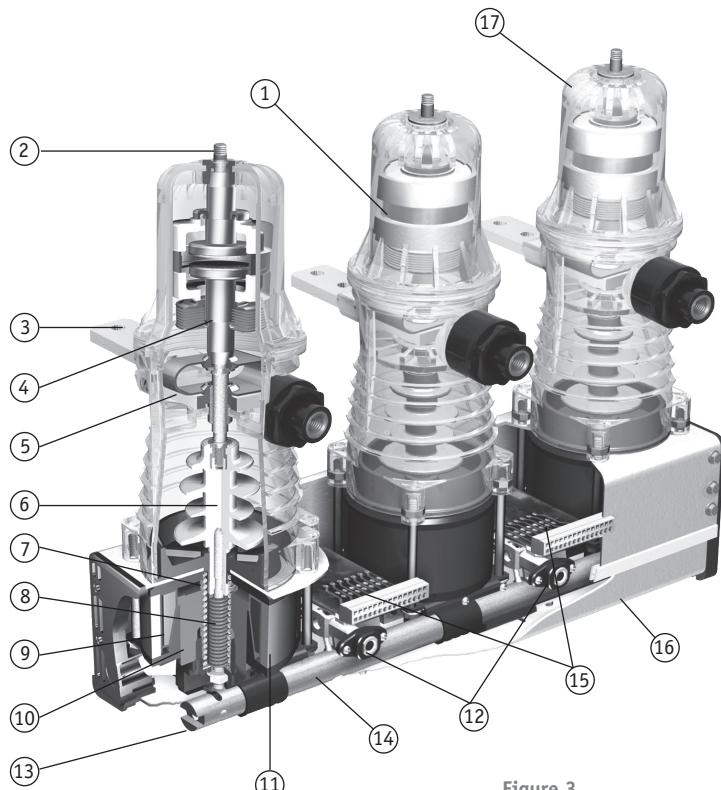


Figure 3
View into the ISM

Control Module (CM)



Figure 4
Control Modules

1. Terminals
2. LED indicators
3. Fastening holes
4. Earthing 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 from the close capacitors of the CM. The opening springs are compressed when the contacts close. In the closed position the contacts are kept closed only by means of the magnetic force. The ISM maintains the closed position without mechanical latching even in the event 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 also be manually opened. When the synchronizing shaft is rotated, a force exceeding the magnetic attraction forces of the ring magnet is applied to the armature, which subsequently starts to move. As the air gap increases, the opening springs and the contact pressure springs overcome the magnetic holding force, and the vacuum interrupter opens.



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.

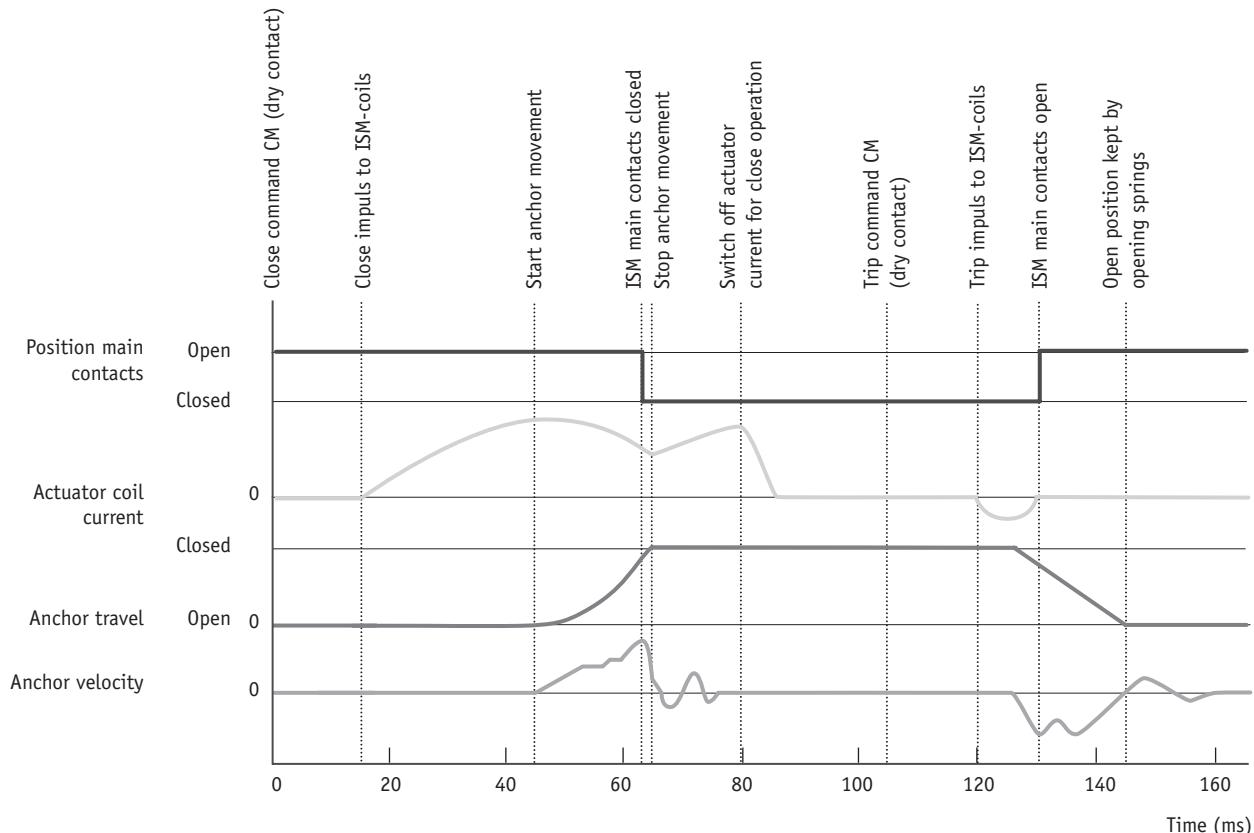


Figure 5

Typical oscilloscope of ISM operation

Receiving, Handling, and Storage

Receiving

The following information is provided on the ISM packing cartons (Figure 9):

- 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 8)

2

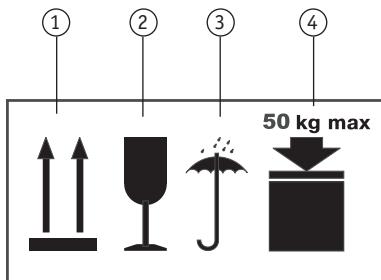


Figure 6

Handling Symbols

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



Figure 7

Product Information Label

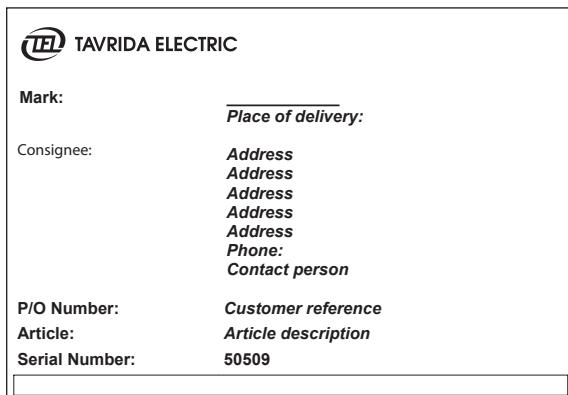


Figure 8

Logistics Data Label

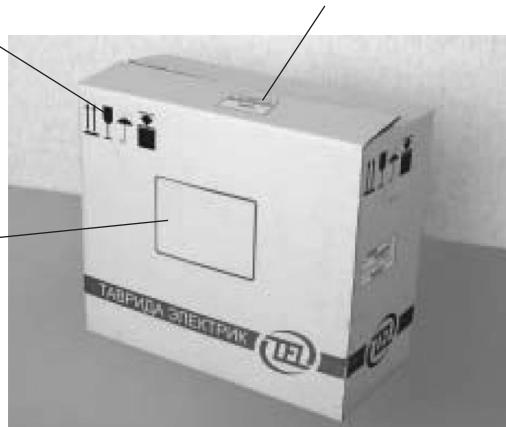


Figure 9

ISM Package

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

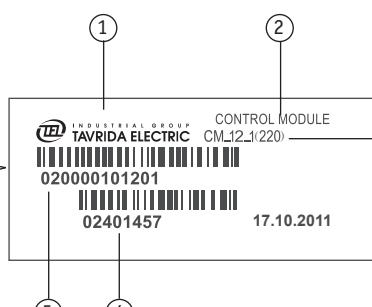


Figure 10 –
CM Package and Label

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 pallet. Lifting gear must not be attached to the support insulators. During transportation the ISM and CM must not be hit or dropped.

Handling and Incoming 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 an incoming inspection.



Circuit breaker modules are heavy. Always use two people to lift out of the original packaging, with due care and attention to safe lifting procedures.

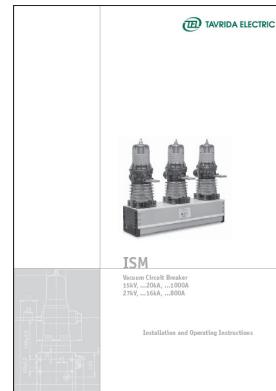
Scope of delivery for the ISM:



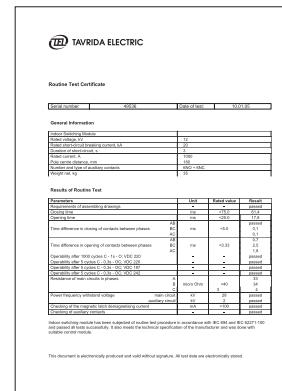
ISM



Screwdriver



Operating manual



Routine test certificate

Figure 11

When requested for 1000A operation, the ISM15_LD_1 and LD_3* require a heat sink set.



*Heat sink
ITEA 741394.006*



*Bolts
ITEA 301611.004-03*

*included

2x



*Heat sink
ITEA 741394.006*

4x



*Bolts
ITEA 301611.004-03*

Figure 12

The ISM25_LD_1 and LD_3* require an insulating cap set.



*Lower cover part
ITEA 711671.004*



*Sealing ring
ITEA 754152.002*

*included

1x



*Lower cover part
ITEA 711671.004*

Figure 13

1x



*Sealing ring
ITEA 754152.002*



*Cap for upper
connecting bolt
ITEA 711121.002*



*Upper cover part
ITEA 714323.001*



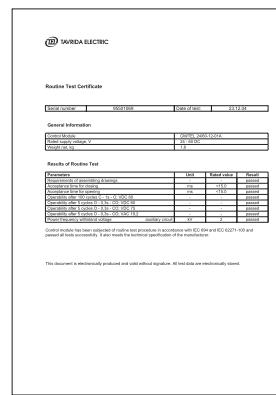
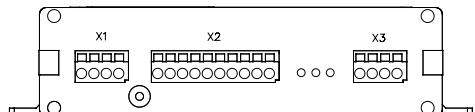
*Cap for upper
connecting bolt
ITEA 711121.002*

1x



*Upper cover part
ITEA 714323.001*

Scope of delivery for the CM:



CM

Screwdriver

Routine test certificate

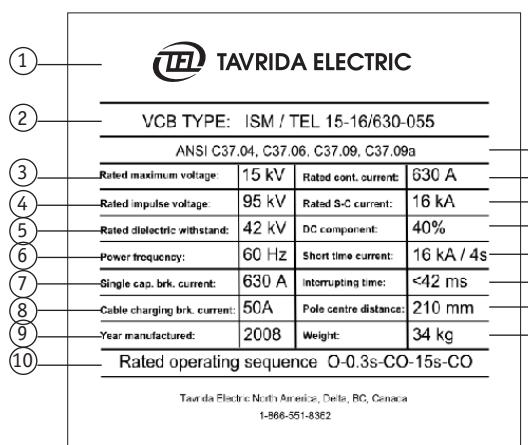
The intactness of the devices should be checked visually for:

- Mechanical damage, scratches, discolouration, corrosion
- Damage to the seals (Figure 19, Figure 20)

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 15):



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. ANSI C37.04, C37.06, C37.09, C37.09a
12. Rated maximum voltage
13. Rated impulse voltage
14. DC component
15. Power frequency
16. Single cap. brk. current
17. Cable charging brk. current
18. Year manufactured
19. Weight
20. Rated continuous current
21. Rated short circuit current
22. DC component percentage
23. Rated short time current
24. Interrupting time
25. Pole centre distance

Figure 15

Rating plate

Figure 14

The rating plates for the CM1501 series contain the following information (Figure 16):

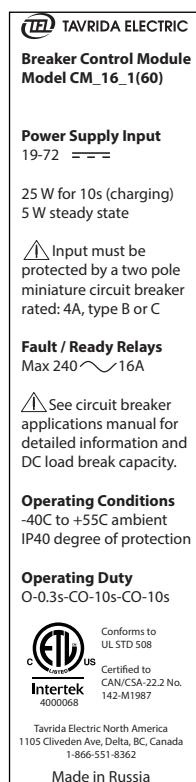


Figure 16

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 17):

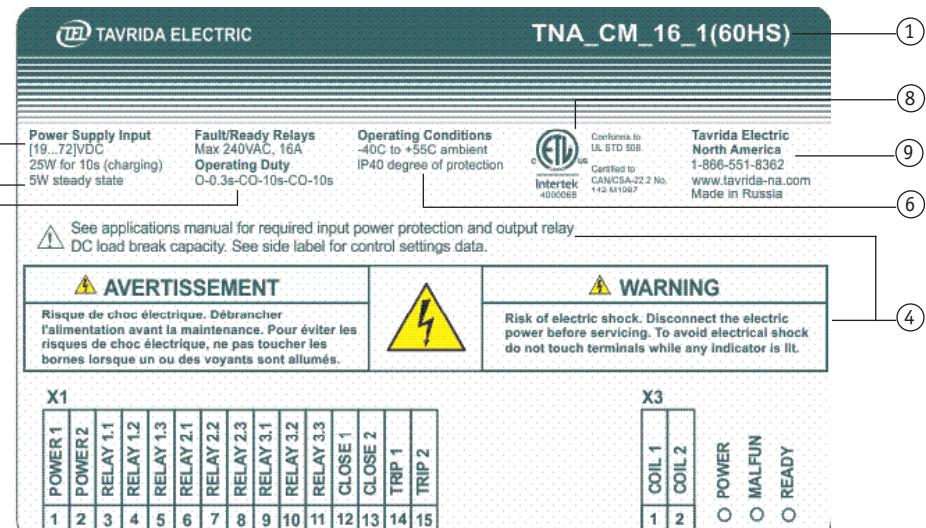


Figure 17

The CM_16 has an additional label for factory programmable settings (Figure 18); see page 31 for detailed information on the settings functions.



Figure 18

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

Arrangement of the labels (Figure 18, Figure 19):

2

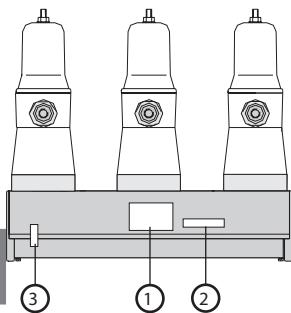
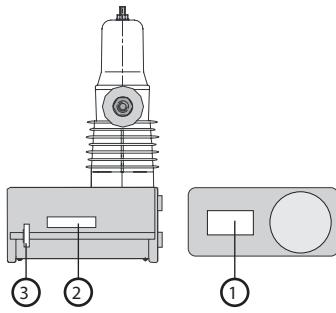


Figure 19

Labelling three-phase ISM



Labelling single-phase ISM

ISM

1. Rating plate
2. Serial number
3. Warranty Seal



Figure 20

Labelling of the CM1501

CM

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

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
- If several ISM are stacked a maximum of two vertical 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.

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

Installation

3

ISM Installation

General, Preparation



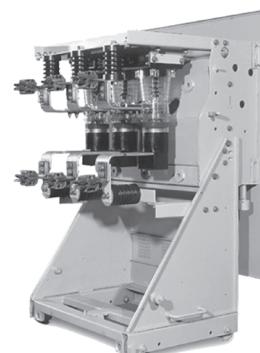
All applicable regulations must be adhered to during installation, commissioning and operation, including ANSI, IEEE, CEC, NEC, and other local, national or international standards / codes as required. Work shall only be performed by qualified personnel.

3

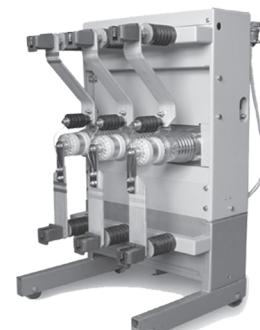
Figure 21



*Vertical installation position
of the ISM (draw out type)*



*Vertical installation position
of the ISM (draw out type)*



*Horizontal 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.

Nuts, washers and conical spring washers shall be used for connecting the upper terminals of the ISM with the busbars. The lower terminals of the ISM shall be connected with the same connecting elements.

If additional fastening material is required, steel bolts according to EN ISO 898 class 8.8 (800 N/mm²), nuts according to EN ISO 890 class 8 (880 N/mm²), washers to DIN 125 and conical spring washers to DIN 6796 shall be used.

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

Installation of the ISM

All LD series can be installed in any position (Figure 21). The ISM shall be installed at the place designated for it (Figure 21) on a sufficiently stable frame.

In order to prevent bending loads at the support insulators the poles must be fixed as shown in Figure 22.

The torque of all fixing points shall not exceed the values stated in Figure 23.

Bus bars and cables shall be connected with the ISM primary terminals mechanically in a stress-free manner. No pressure, tension or torsion forces shall act on the ISM. To avoid unacceptably high mechanical loads on the ISM, the bus bar connections shall rest on additional supporting insulators (Figure 22).

The following limits for maximum unsupported busbar length shall be applied to the design:

ISM15_LD_X 0.5 m

ISM25_LD_X 0.5 m

Other dimensions necessary for correct mounting are indicated in the overall drawings.

Fixing points, primary terminals

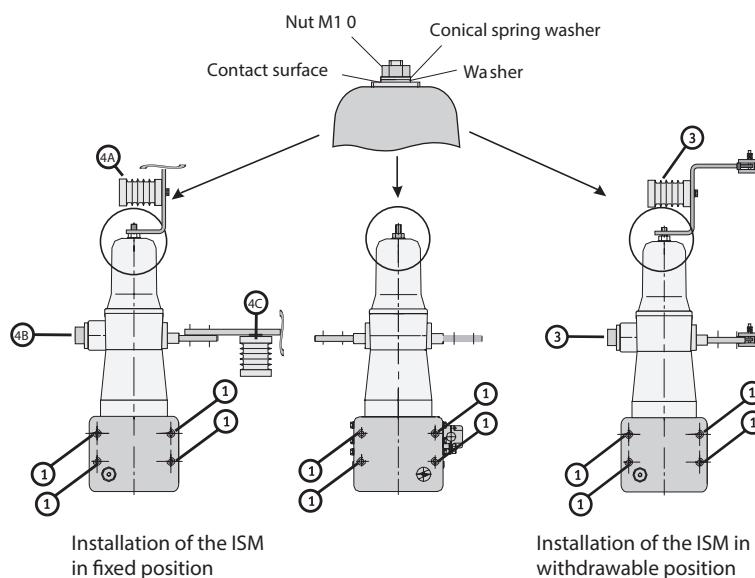
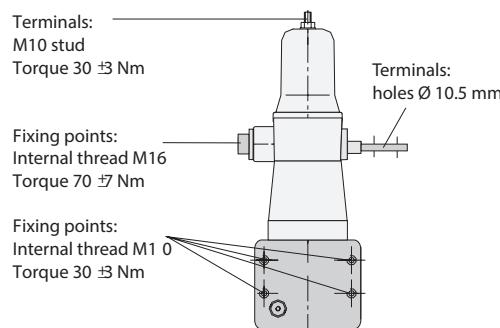


Figure 22

- ① Required fixing points (in each case)
- ② Required fixing points (for withdrawable versions)
- ③ Each two fixing points are required, either 4A+4B or 4A+4C (for fixed installations)

Bolt sizes and torques

Figure 23



Minimum Clearances due to Rated Insulation Voltage

The minimum clearances between the blank phases and to earth shall be according to VDE 0101.

The minimum clearances between phase to phase and phase to earth are equal (Figure 24).

Ur	Up	Minimum clearance (a)
15 kV	95 kV	120 mm
27 kV	125 kV	220 mm

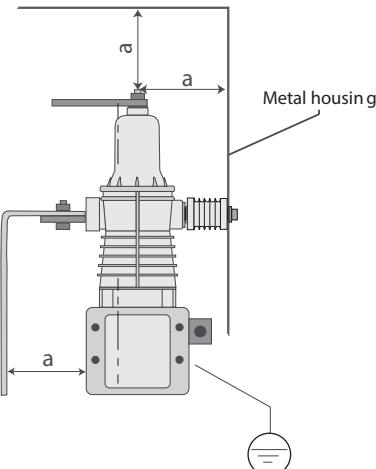


Figure 24

Measures for Complying with the Rated Insulation Level

Insulation cap set for 27 kV ISM

To comply with the rated impulse withstand voltage of 125 kV according to ANSI 37.09 it is recommended to cover the top connections of the 27kV ISM with an insulation cap set.

The insulation cap set is included in the scope of supply of the affected ISM. The arrangement is shown in Figure 25.

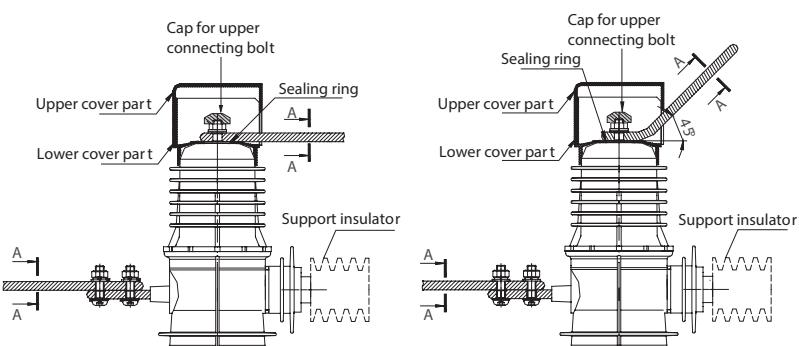


Figure 25

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

Busbar for 27 kV ISM

If the PCD of the 27kV ISM is 210 mm, the connected bus bars shall have the shape as shown in Figure 26.

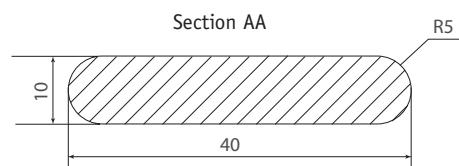


Figure 26

Phase segregation plates for 15 kV and 27 kV ISM

For 15 kV ISM with a PCD of 150 mm or 27 kV ISM with a PCD of 210 mm it is recommended to use segregation plates between the poles. Minimum size and position of the plates are shown in Figure 27.

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

The segregation plates are not included in the scope of supply.

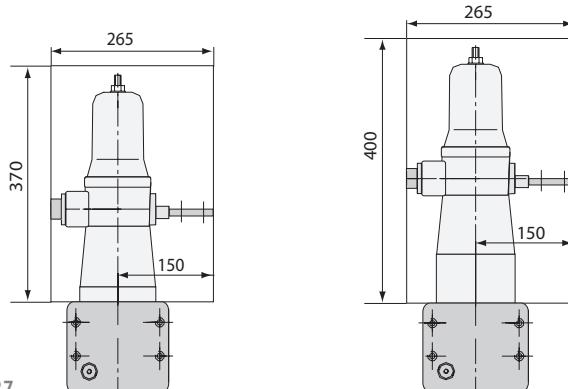


Figure 27

Recommended size and position of the segregation plates for ISM, 15 kV PCD 150 mm

Recommended size and position of the segregation plates for ISM, 27 kV PCD 210 mm

Minimum Clearances due to Electromagnetic Influence

The following clearances must be adhered to (Figure 28):

I_{sc}	Minimum clearance (b)
16 kA, 20 kA	120 mm
25 kA, 31 kA	220 mm

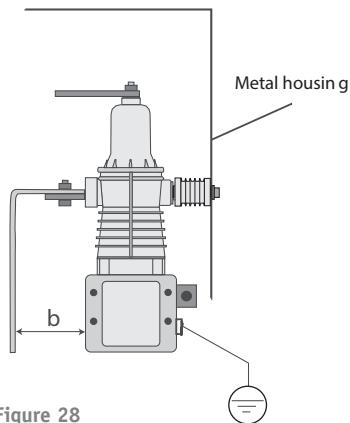


Figure 28

Coordination of Minimum Clearances

In case that due to rated insulation voltage and electromagnetic influence two different minimum clearances (a, b) exist than at least clearance (b) is to be selected. If the clearance is below (a), the compliance with the rated insulation level shall be approved by a voltage test (Figure 29).

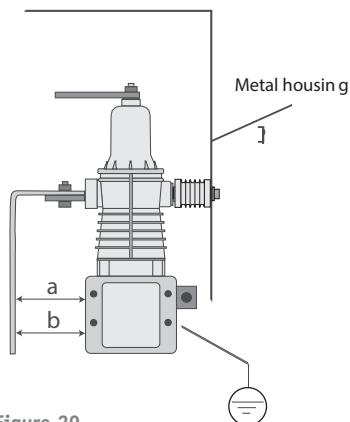


Figure 29

Heat Sinks for Continuous Current >800A

The ISM15_LD modules are designed in such a manner that with installed heat sinks (two ITEA741394.006 per pole) at 1000 A rated current and 55°C ambient temperature, with free surroundings, no impermissible high temperatures will arise at the hottest spots of the ISM. The arrangement is shown in Figure 30.

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.

Initial state for ISM15_LD@ 1000A: Two mounted ITEA741394.006 heat sinks or equivalent per pole.

Initial state for ISM15_LD@ <800A: Without heat sink.

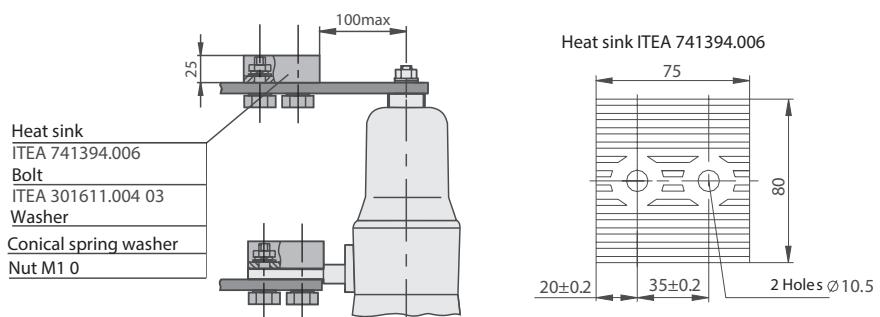


Figure 30

Protective Earthing

For protection of personnel the metal housing of the ISM must be connected according to the applicable regulations, such as NFPA-70, via the marked earth screw of the ISM to the earth arrangement of the particular panel. The earth connection can be carried out with cable or a flat copper bar. The cross section must be dimensioned such that a worst-case fault current (short circuit) does not cause a weakening of the earth connection (Figure 31).

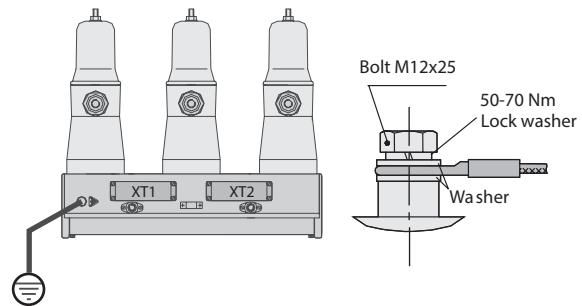


Figure 31

Reference values for cross sections of earth connections (copper):

Fault current(1 s)	Max. temperature	Cross section earth connection
16 kA	300 °C	55-95 mm ²
20 kA	300 °C	70-120 mm ²

The area around the earth screw shall be cleaned before providing the earth connections. After the occurrence of a short circuit, the proper condition of the protective earthing must be checked.

Mechanical Interlocking

The ISM provides the following interfaces for interlocking (Figure 32):

- Stub shafts at both sides with grooves and tapped holes (Figure 32, details 1 and 3).
- Two interlocking pins with tapped holes (Figure 32, detail 2).

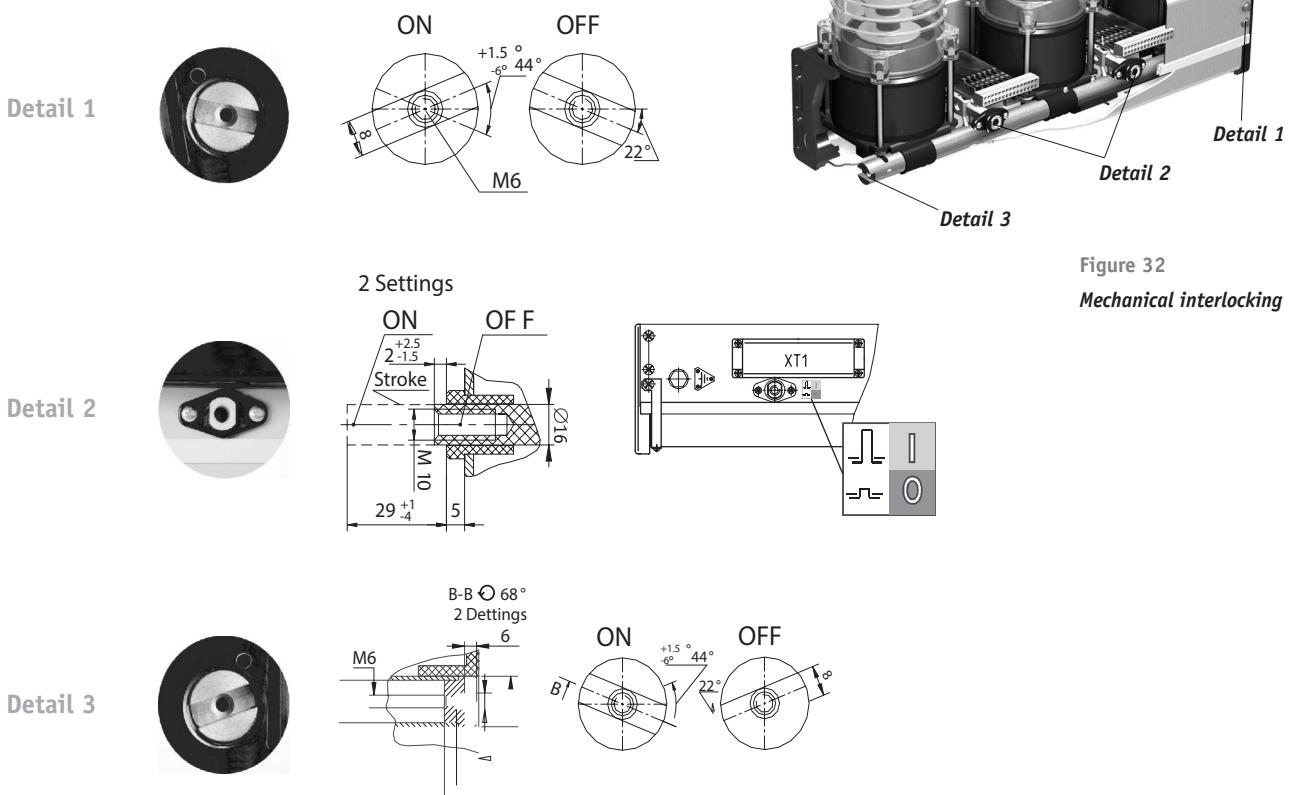


Figure 32
Mechanical interlocking

The following conditions must be fulfilled in carrying out mechanical interlocking:

- If the interlocking mechanism is attached to one of the interlocking pins, the weight of the directly attached movable part to the interlocking pins shall not exceed 0.35 kg. Exception is the single phase LD series, where the attached movable part shall not exceed 0.1 kg. If both interlocking pins are used, the sum of the attached weights shall not exceed 0.35 kg or 0.1 kg for single phase (Figure 33).
- If the attached part is joined with a lever mechanism, the weight (including directly moved parts) shall be decreased in proportion to the lever (Figure 34).
- If the interlocking mechanism is directly attached with the synchronizing shaft the moment of inertia of the attached mechanism shall not exceed $4.3 \times 10^{-4} \text{ kg/m}^2$ ($1.2 \times 10^{-4} \text{ kg/m}^2$ for single phase series). If both stub shafts of the synchronizing shaft are used, the sum of the attached moments of inertia shall not exceed $4.3 \times 10^{-4} \text{ kgm}^2$ or $1.2 \times 10^{-4} \text{ kgm}^2$ for the single phase series (Figure 35).
- For manual tripping a force of up to 250 N may be applied to the interlocking pins. However no static force shall be applied (Figure 36).
- It is not allowed to perform electrical trip/close commands while blocking the interlocking pins or the synchronizing shaft mechanically.

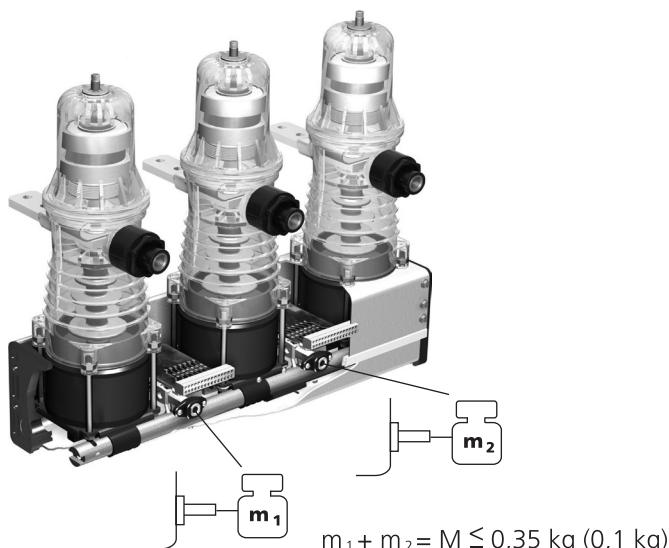


Figure 33

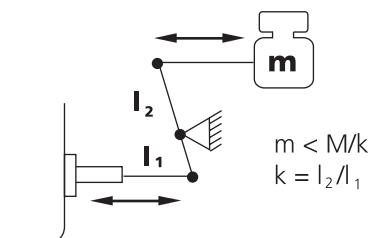


Figure 35

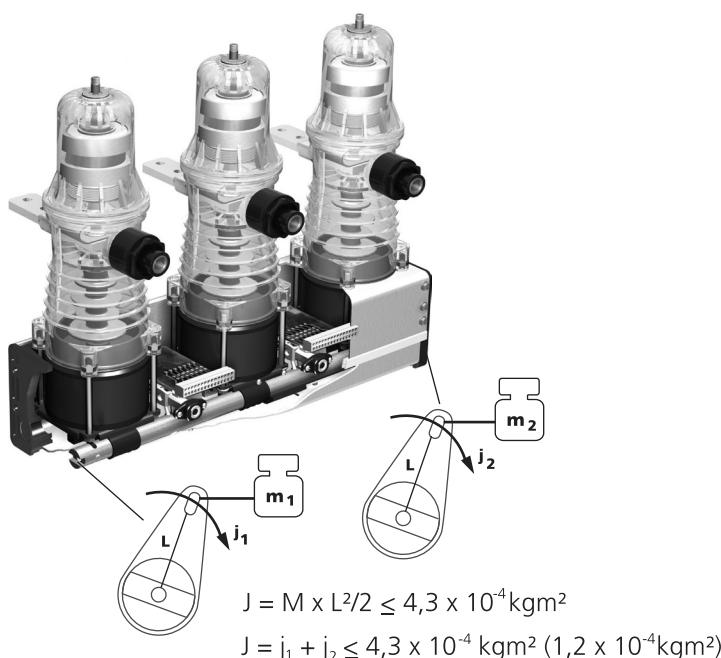


Figure 34

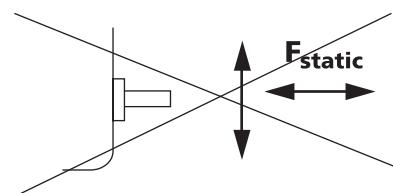


Figure 36

Design of mechanical interlocking at the side stub shafts

Single phase ISM are supplied with an installed interlocking lever (Figure 37, Figure 38).

3

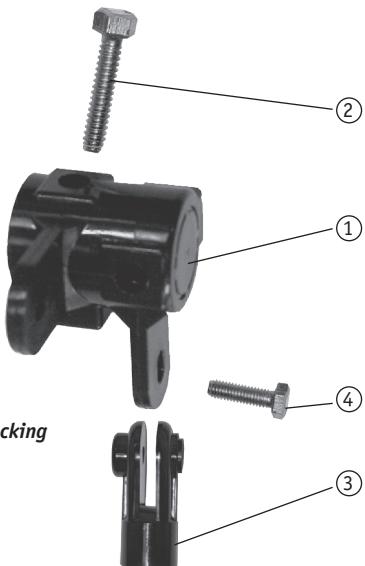


Figure 38

Individual parts of interlocking lever for single phase ISM

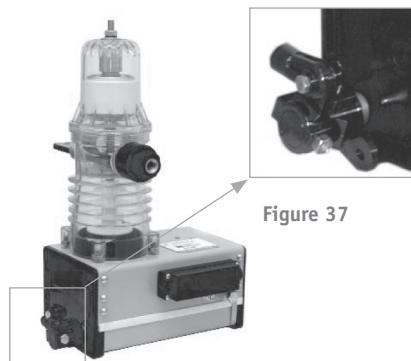


Figure 37

1. Interlocking lever basic element
2. Attachment bolt M8x40 for interlocking lever
3. Joining element
4. Attachment bolt for joining element

To the joining element (3) a mass $M \leq 0.35$ kg respectively attached.

For three phase ISM locking levers can be executed with the Tavrida Electric interlocking lever set APTA 442611.004 (Figure 39) on either stub shaft (Figure 40).



Figure 39

Individual parts of interlocking lever set APTA 442611.004 for three phase ISM

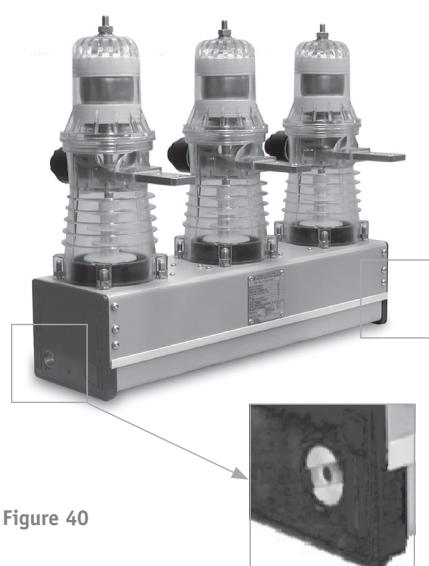
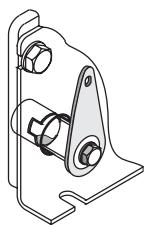


Figure 40

1. Interlocking lever basic element
2. Attachment bolt M8x40 for interlocking lever
3. Joining element
4. Attachment bolt for joining element
5. Extension shaft
6. Attachment bolt for extension shaft
7. Screw retaining device

To the joining element (3) a mass $M \leq 0.35$ kg for three phase ISMs or $M \leq 0.1$ kg for single phase may be attached. If two interlocking levers are used, the total mass at both stub shafts shall not exceed $M = 0.35$ kg or $M = 0.1$ kg respectively.

Figures 41 and 42 show an example of a self-constructed trip unit (not included in the scope of supply).



$L = 19.5 \dots 50 \text{ mm}$
 $B = 22 \dots 50 \text{ mm}$
 The length of L and B depends on the particular project.

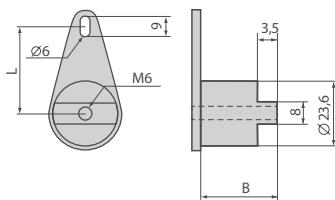


Figure 41

Figure 42

Connection between interlocking lever and synchronizing shaft

Construction and connection variants of interlocking lever at the side stub shafts (Figure 43, Figure 44)

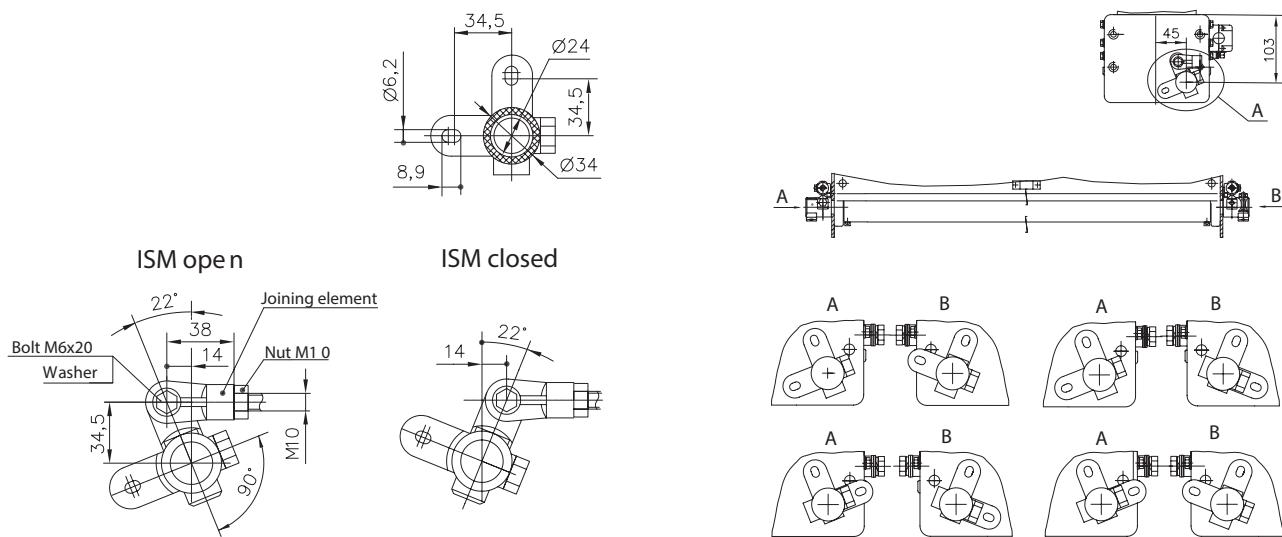


Figure 43

Position of interlocking lever as a function of ISM position

Figure 44

Possible connection variants of the interlocking levers (Figure 44).

Variant A:

One-side connection for single-phase-ISM

Variant A, B:

Two-side connection for three-phase-ISM

CM Installation

Secondary Connections of the ISM

Secondary connections for three-phase ISM_LD types

All three-phase ISM_LD have the same terminals (Figure 45). Connected to the terminal blocks XT1 and XT2 are 13 auxiliary switches (6 "NO"- and 7 "NC"-contacts) and the magnetic actuator coils.

3

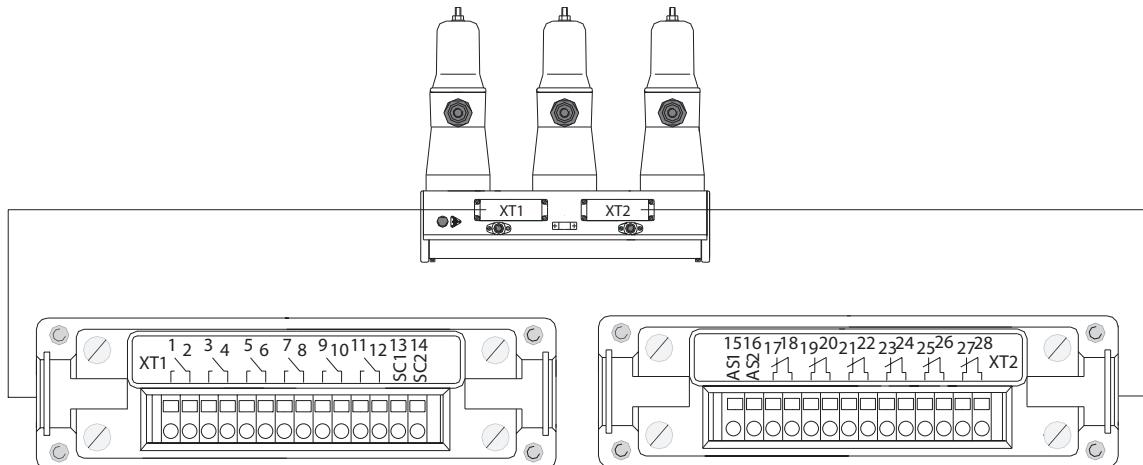


Figure 45

Terminal arrangement of the three-phase ISM

Terminal arrangement ISM (three-phase)

XT1		XT2	
Terminal No.	Connection	Terminal No.	Connection
1	Auxiliary switch S1 (1)	15	Auxiliary switch S13 (AS1)
2	Auxiliary switch S1 (4)	16	Auxiliary switch S13 (AS2)
3	Auxiliary switch S2 (1)	17	Auxiliary switch S7 (1)
4	Auxiliary switch S2 (4)	18	Auxiliary switch S7 (2)
5	Auxiliary switch S3 (1)	19	Auxiliary switch S8 (1)
6	Auxiliary switch S3 (4)	20	Auxiliary switch S8 (2)
7	Auxiliary switch S4 (1)	21	Auxiliary switch S9 (1)
8	Auxiliary switch S4 (4)	22	Auxiliary switch S9 (2)
9	Auxiliary switch S5 (1)	23	Auxiliary switch S10 (1)
10	Auxiliary switch S5 (4)	24	Auxiliary switch S10 (2)
11	Auxiliary switch S6 (1)	25	Auxiliary switch S11 (1)
12	Auxiliary switch S6 (4)	26	Auxiliary switch S11 (2)
13	Actuator coil (SC1)	27	Auxiliary switch S12 (1)
14	Actuator coil (SC2)	28	Auxiliary switch S12 (2)

Secondary connections for single-phase ISM_LD types

All single-phase ISM have the same terminals (Figure 46). Connected to the terminal block XT1 are 5 auxiliary switches (2 "NO"- and 3 "NC" contacts) and the magnetic actuator coil.

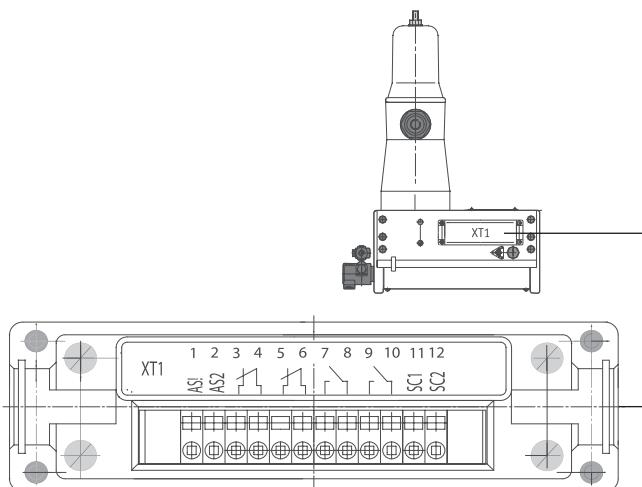


Figure 46
Terminal arrangement of the single-phase ISM

Terminal arrangement ISM (single-phase)

XT1	
Terminal No.	Connection
1	Auxiliary switch S1 (AS1)
2	Auxiliary switch S1 (AS2)
3	Auxiliary switch S2
4	Auxiliary switch S2
5	Auxiliary switch S3
6	Auxiliary switch S3
7	Auxiliary switch S4
8	Auxiliary switch S4
9	Auxiliary switch S5
10	Auxiliary switch S5
11	Actuator coil (SC1)
12	Actuator coil (SC2)

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).

3

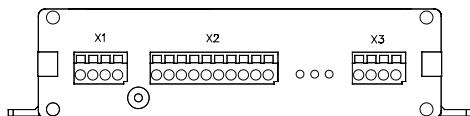


Figure 47
CM_1501_01 Terminal arrangement

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)		



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.

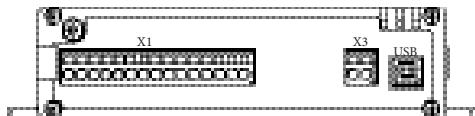


Figure 48
CM_16_1(60), CM_16_1(220) Terminal arrangement

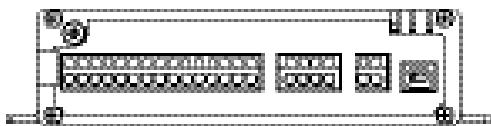


Figure 49
CM_16_2(220) Terminal arrangement

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 xx 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_LD 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_LD_1	1
	ISM25_LD_1	2
	ISM15_LD_3	4
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

3

Example

For a control module programmed with breaker type ISM15_LD_1, UV on, UV delay of zero seconds, 1 trip to lockout with 60 second reclosing delay, D01 = Close / Open Position, D02 = Driver Ready, D03 = Malfunction, trip delay of 12ms, close delay of 12ms, trip input = By opening the contact, close input = By opening the contact:

Settings code = 1-10-160-245-1212-21

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: All Models

The installation of the CM is carried out according to the switchgear cubicle design either on the ISM or in the low voltage compartment of the switchboard. It must in all cases be separated from the high voltage compartment. The CM shall be installed in an earthed mild steel box with a thickness of not less than 1 mm if it is attached to the ISM. See Chapter 8 for bolt hole patterns of all CM models.

3

It is recommended to shield the feeder cables for the CM controls, the CM-signalling and the ISM auxiliary switch cables (if applicable). If these cables need to be in the high voltage compartment they shall be protected by an enclosed metal duct.

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. The ambient conditions as described in the chapter "Regulations and ambient conditions"(page 64) shall apply.

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

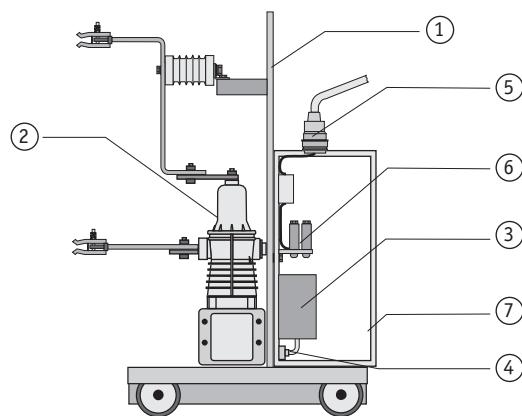


Figure 50
Draw out type installation

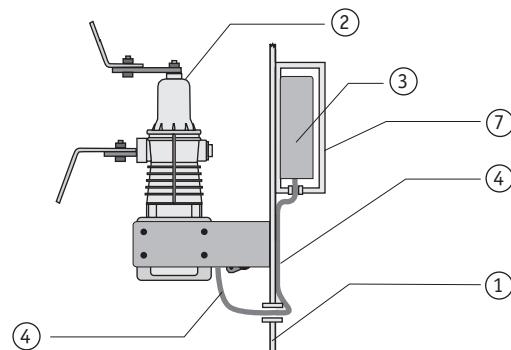
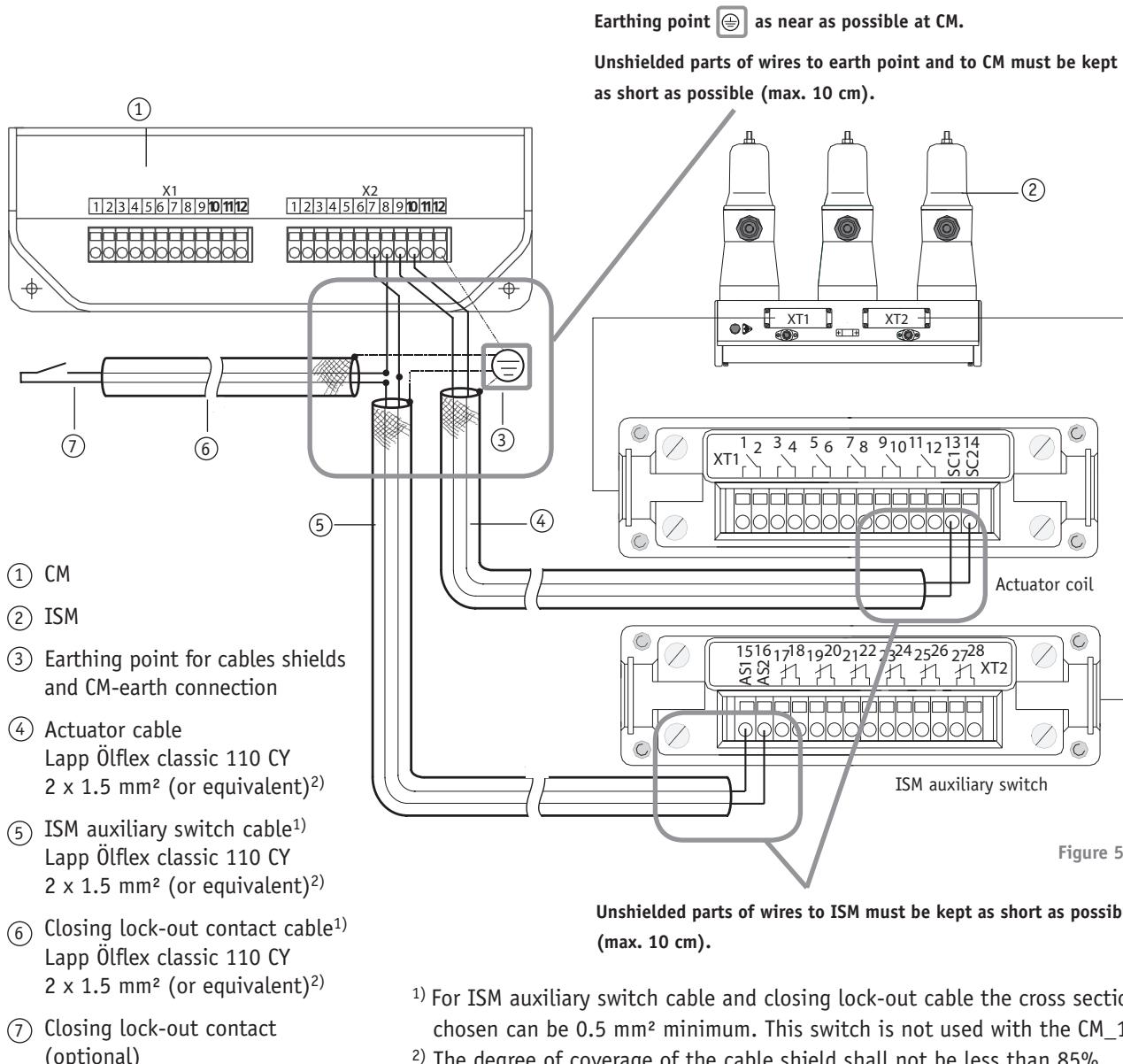


Figure 51
Fixed type installation

Installation of Secondary Cables Between ISM and CM: All Models

In the high voltage compartment it is recommended to install secondary shielded cables between the ISM and CM in an earthed metal hose or an enclosed metal duct.



Note CM_12 series control shown. CM_1501 and CM_16 series pinouts can be seen on pages 28 and 29 of Chapter 3. CM_16 series does not utilize the auxiliary switch on the ISM.

The cables are fixed with a special screwdriver supplied with every ISM and CM (Figure 54). 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.

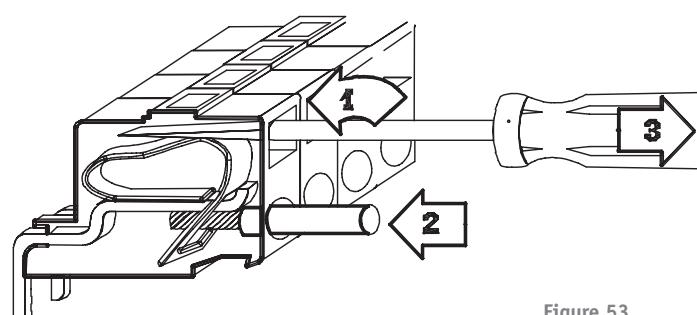


Figure 53

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.

4

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 (Optional - CM1501 series)

Close conditions for the ISM with the examples below can be carried out by the three following lock-out variants.

- Earthing switch OFF
- Disconnector of the panel is in the "on-position"
- Draw out type circuit breaker is in the "service-position"
- Release key switch is in the "operation-position"
- etc.

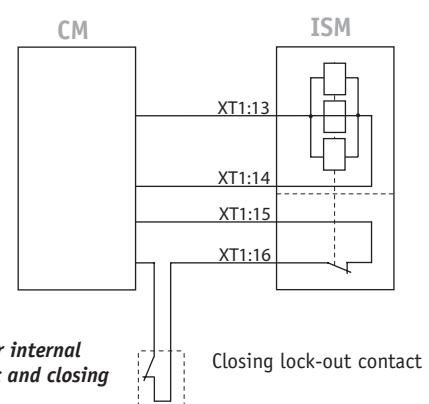


Figure 54
Circuit diagram for internal electrical interlock and closing lock-out

- Variant 1** - In the CM close command circuit
Variant 2 - In the ISM auxiliary switch circuit
Variant 3 - In the close command circuit and in the ISM position switch circuit

If despite effective electrical closing lock-out a close attempt is made, the Malfunction LED will blink 2 times (see malfunction indication table, page 43). The reason for the malfunction must be eliminated to abolish the electrical closing lock-out and to activate the close readiness.

4

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

In case the ISM shall trip due to the auxiliary power supply voltage dropping 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 impedance 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 digital 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 55).

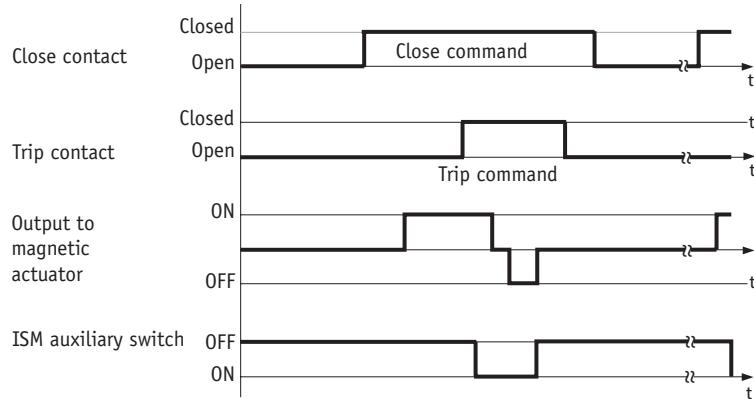


Figure 55

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 56).

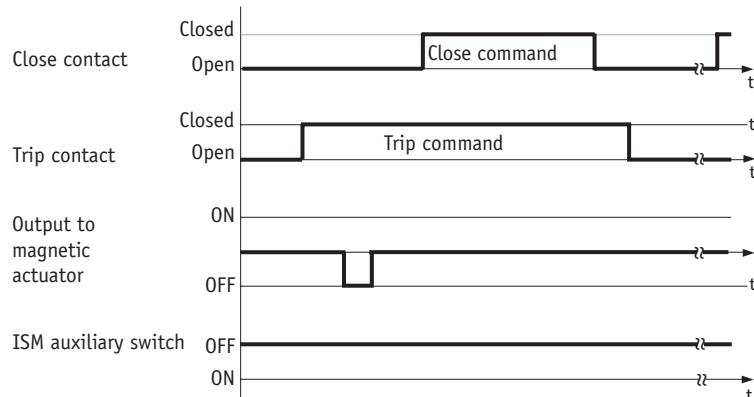


Figure 56

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 57).

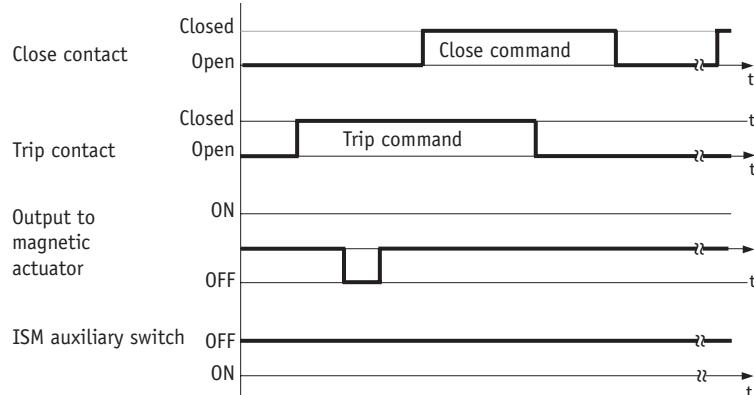


Figure 57

Commissioning, Operation, Maintenance

Safety

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 must be adhered to.

Caution

Danger! 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 include at least:

- Check for damage
- Remove dirt
- Check bolted connections for fixing points, primary terminals and earthing (also torques)
- Test special functions such as moving function, mechanical interlocks and plug connections insofar as ISM is mounted on a draw-out unit
- Check that free air circulation at ISM is possible

Testing the rated insulation level to IEC 6094 and VDE 06701 Part 1000, ANSI C37.09:

- For 15 kV ISM the rated power frequency test voltage is 36 kV (42 kV according to the Chinese Standard GB 1984-2003)
- For 27 kV ISM the rated power frequency test voltage is 60 kV

Commissioning Secondary Part

Preparation before testing the functionality include at least:

- Testing the availability of the CM auxiliary power supply. It is recommended to use the same auxiliary power supply as for protection and control devices.
- Checking whether the correct type of voltage, the correct voltage level and for direct current the correct polarity have been selected.
- Checking that the correct MCB has been installed.
- Checking that all secondary connections have been pulled up tight.
- Checking whether the optional interference suppressing filters have been installed and earthed (see chapter "Installation, Secondary part, Interference suppressing filters (optional)").
- Checking that the shielding of the secondary cables and the earth connection of the CM have been properly connected to the earthing point nearby the CM or if applicable for actuator coil cable
- Checking whether the CM, ISM and the optional elements are connected according to the circuit diagrams.

Operating test

While testing the functionality, at first the ISM must be separated from high voltage.

- 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 10 s
 - The READY relay contact must close within 10 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".



- During operation both CM close / trip outputs and internal auxiliary voltage for ISM auxiliary switch S13 can equal or exceed 230 V DC.

**Caution
Danger!**

- After switching off the CM, there is still a voltage at the terminals of the capacitors. Only after the MALFUNCTION-LED is extinguished has the voltage 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 disappeared permanently (unless the polarity is changed again).

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

Maintenance

Under normal operating conditions (see chapter "Regulations and Ambient conditions", page 64) 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 69.

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	CM_1501_01	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

6

See wiring diagram on page x 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. 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.	Delete malfunction with Trip command. The ISM can only be closed when the mechanical lock has been removed.	

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. ISM is closed, a trip is simulated.	Malfunction variant 1: Mechanical emergency trip. Malfunction variant 2: The ISM was properly closed by the CM and the close position feedback exists. Then a malfunction occurs 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).	Delete the malfunction indication with the CM Trip command. - Check for short circuit in the cable - Check for short circuited terminals - Check ISM position switch S13	All CM
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.

Product Line

6

Indoor switching modules (ISM)

Type	Former Product Code	Rated Voltage	Rated Short Circuit	Rated Continuous Current	Pole Center Distance
ISM15_LD_1(67)	ISM/TEL-15-20/1000-067	15 kV	20 kA	1000 A	150 mm
ISM15_LD_1(55)	ISM/TEL-15-20/1000-055	15 kV	20 kA	1000 A	210 mm
ISM15_LD_2	ISM/TEL-15-20/1000-055F	15 kV	20 kA	1000 A	210 mm
ISM15_LD_3	ISM/TEL-15-20/1000-089	15 kV	20 kA	1000 A	Single Phase
ISM25_LD_1(210)	ISM/TEL-27-16/800-057	27 kV	16 kA	800 A	210 mm
ISM25_LD_1(275)	ISM/TEL-27-16/800-058	27 kV	16 kA	800 A	275 mm
ISM25_LD_2	N/A	15 kV	16 kA	800 A	150mm
ISM25_LD_3	ISM/TEL-27-16/800-053	27 kV	16 kA	800 A	Single Phase

6

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)			Basic functionality + factory programmable options
CM_16_1(60HS) ²⁾	N/A	24 - 60 VDC	
CM_16_1(220)			Basic functionality + factory programmable options
CM_16_1(220HS) ²⁾	N/A	100 - 270 VAC / VDC	
CM_16_2(220)			Basic functionality, CT power supply + factory programmable options
CM_16_2(220HS) ²⁾	N/A	100 - 270 VAC / VDC	

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).

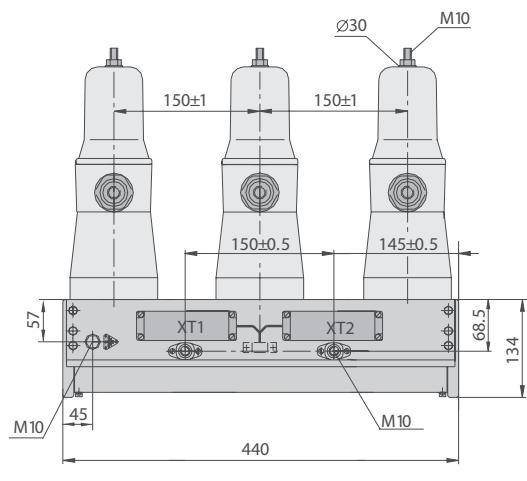
Dimensions and Weights

7

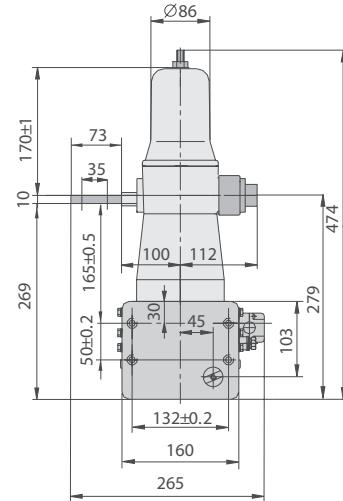
Dimensions and Weights of ISM

Dimensions and weights of the three-phase ISM

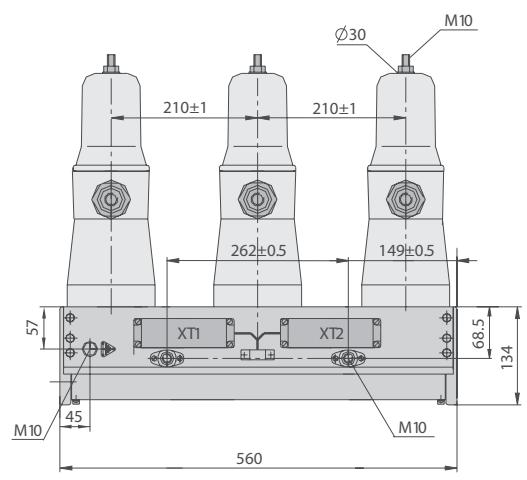
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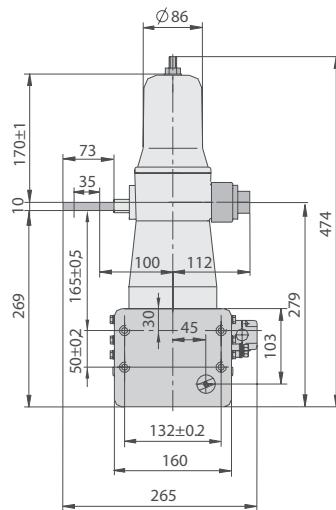
15 kV VCB,
PCD 150 mm
Weight: 34 kg ISM15_LD_1(67)



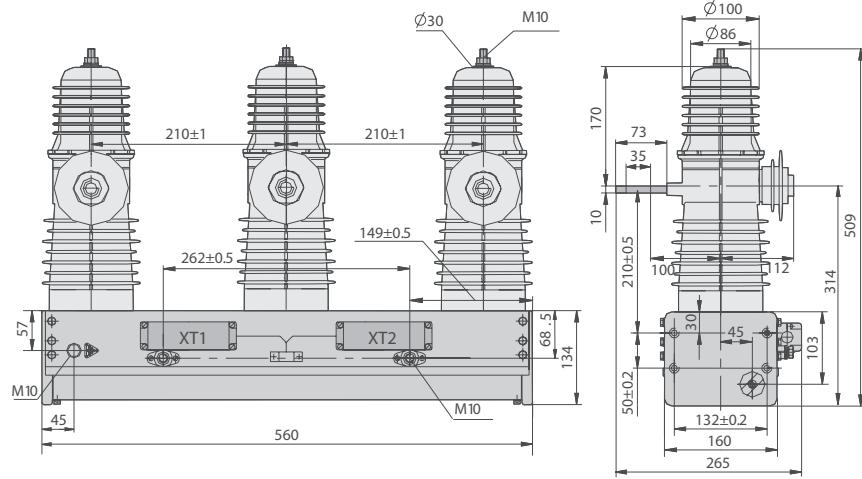
15 kV VCB,
PCD 150 mm
Weight: 36 kg ISM25_LD_2



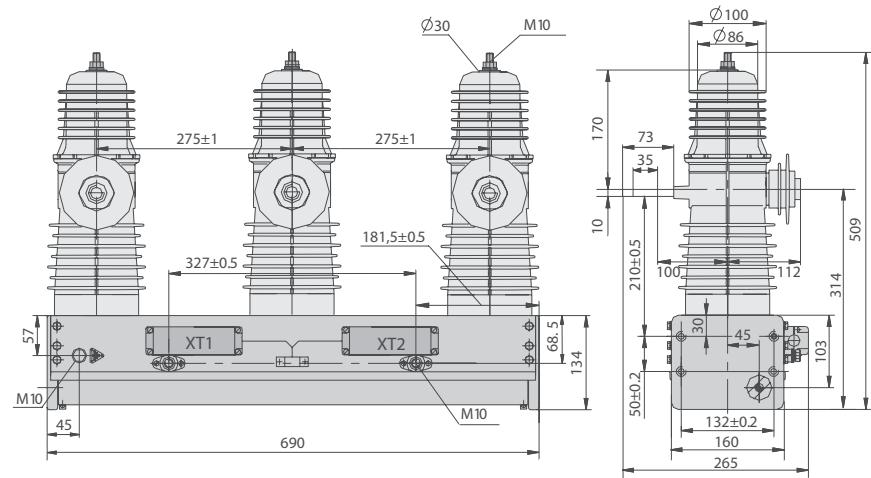
15 kV VCB,
PCD 210 mm
Weight: 36 kg ISM15_LD_1(55)



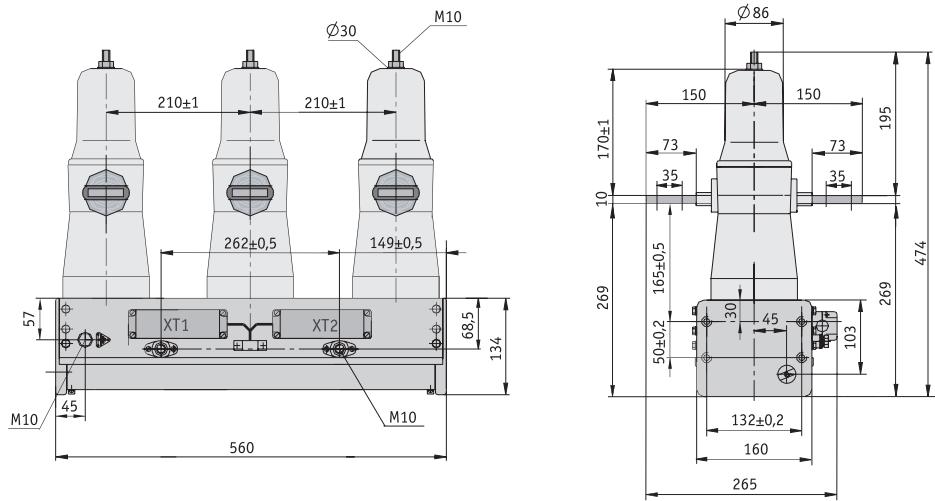
15 kV high frequency-VCB,
PCD 210 mm
Weight: 36 kg ISM15_LD_2



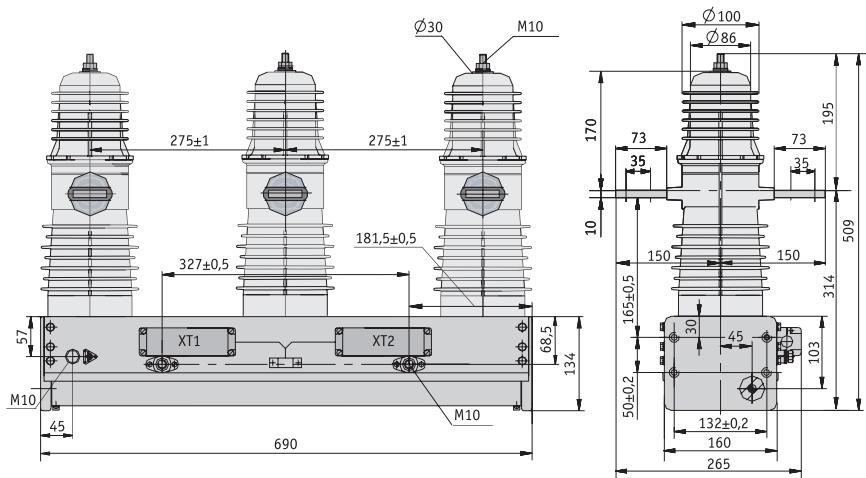
27 kV VCB, PCD 210 mm
Weight: 36 kg ISM25_LD_1(210)



27 kV VCB, PCD 275 mm
Weight: 38 kg ISM25_LD_1(275)

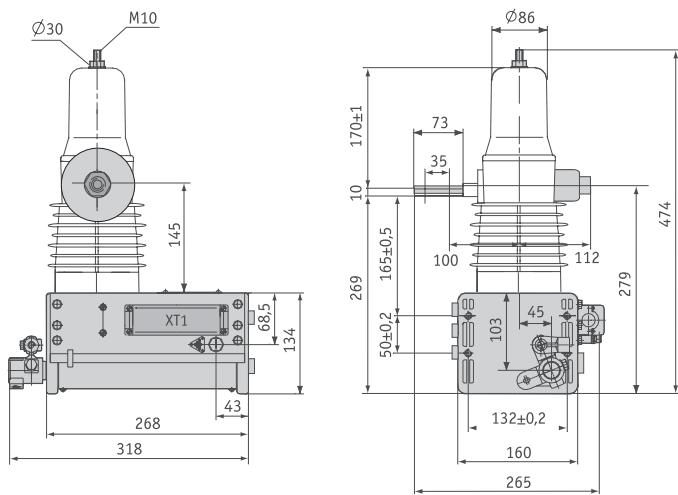


**15 kV VCB, continuous busbar,
PCD 210 mm
Weight: 37 kg By Special Order Only**

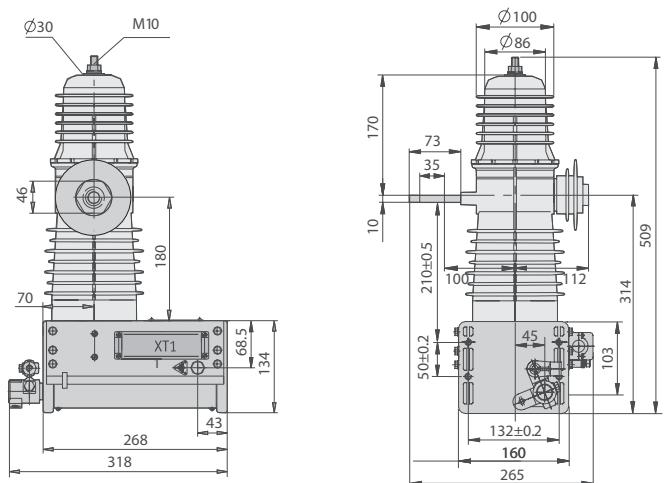


**27 kV VCB, continuous busbar,
PCD 275 mm
Weight: 39 kg By Special Order Only**

Dimensions and weights of the single-phase ISM



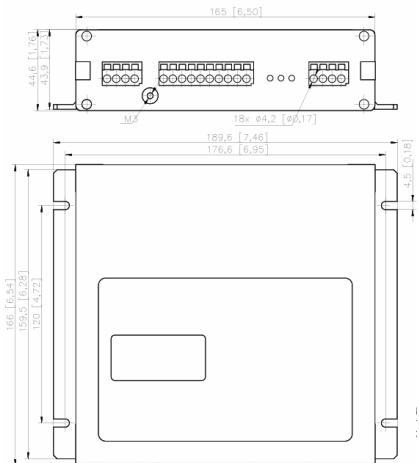
15 kV single-phase VCB, ISM15_LD_3
Weight: 13 kg



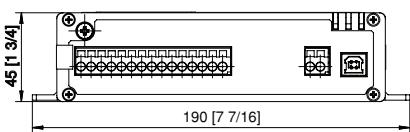
27 kV single-phase VCB, ISM25_LD_3
Weight: 13.5 kg

Dimensions and Weights of the CM

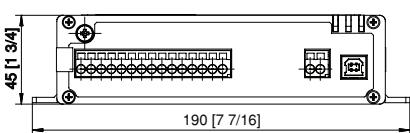
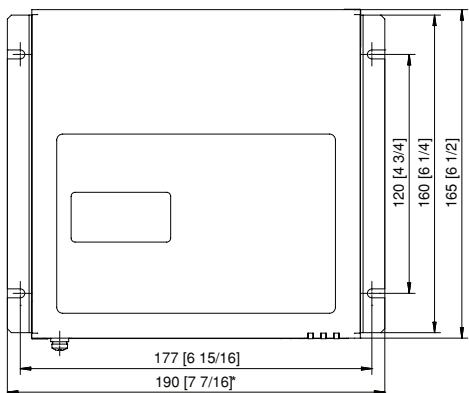
7



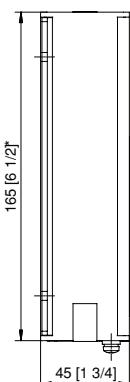
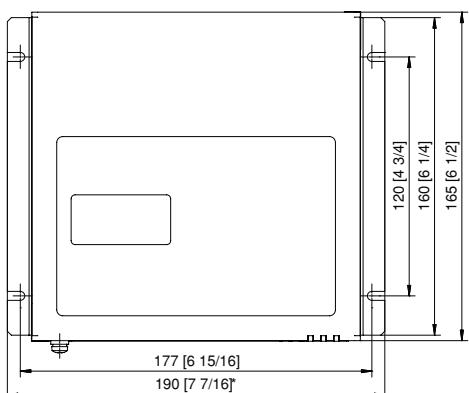
CM_1501_01
Weight: 1.5 kg
CM_1501_01(12)
CM_1501_01(4)



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)

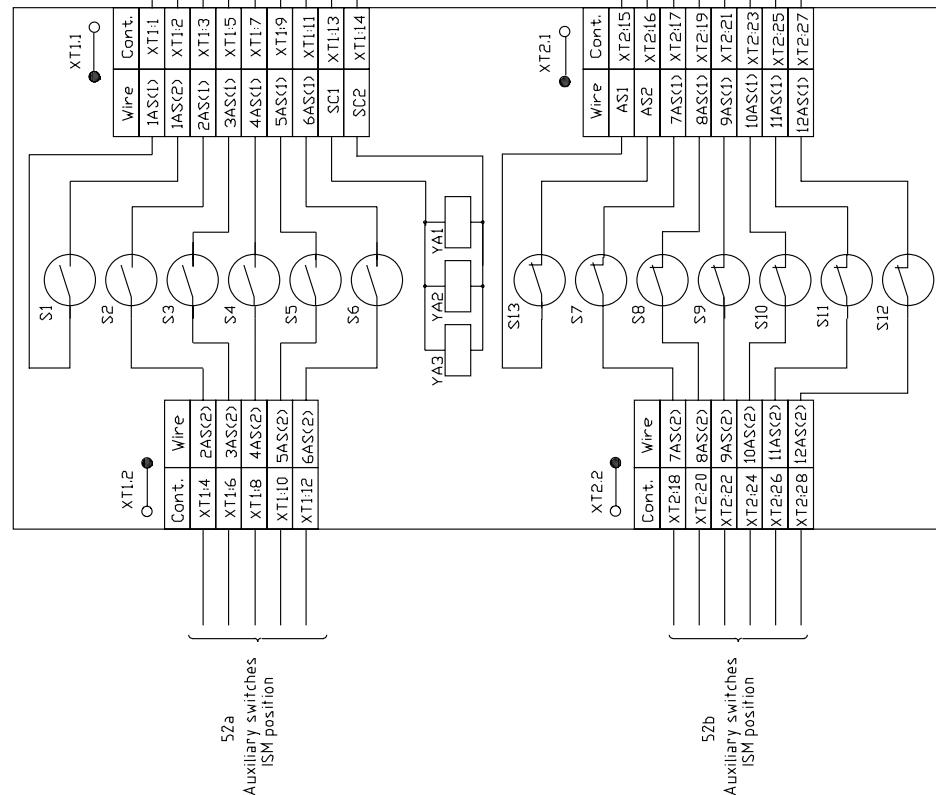


Circuit Diagrams

8

ISM_LD with CM_16_1 Control Module

INDOOR SWITCHING MODULE
ISM15_LD_155_E



Notes:

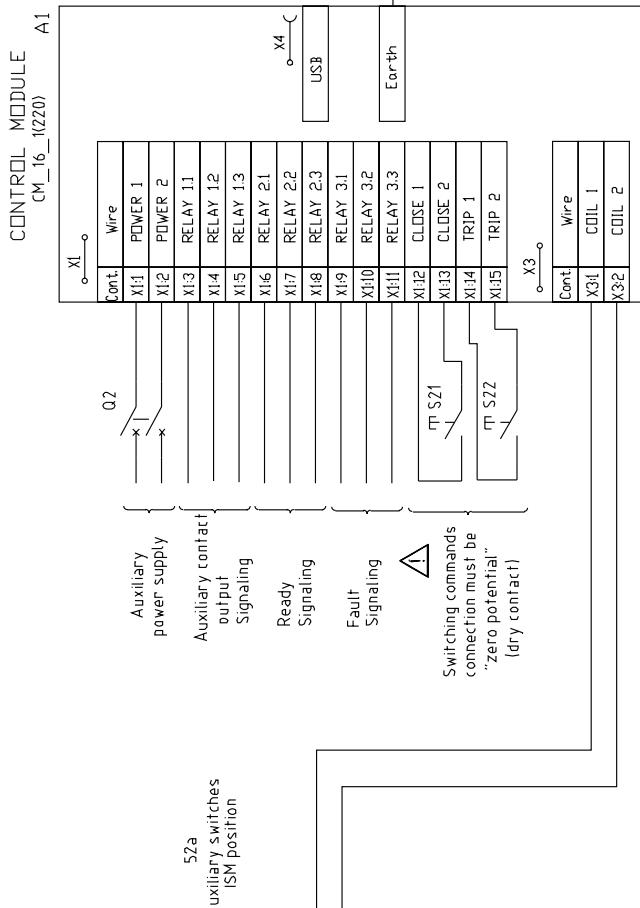
1. The diagram is for mandatory control connection only, and is strictly for reference.
2. The diagram is suitable for indoor switching modules of the following types:
ISM15_LD_153_E, ISM15_LD_155_E, ISM15_LD_2155_E, ISM15_LD_1167_E,
ISM25_LD_11210_E_S and ISM25_LD_11275_E_S.
3. The diagram is suitable for control modules of the following types: CM_16_1(220) and CM_16_1(60).
4. Auxiliary power supply range: (88...265)VAC - for CM_16_1(220)
or (19...72)VDC - for CM_16_1(60).
5. Default settings for CM_16_1(220) and CM_16_1(60):
Relay 1 X - "Auxiliary contact output"
Relay 2 X - "Ready"
Relay 3 X - "Malfunction"

Where X:
1 - NO contact
2 - Com contact
3 - NC contact

6. For further technical details see appropriate Manuals.

Explanation of designations:
YA1, YA2, YA3 - magnetic actuator coils.
S13 - S2b reserved for control module feedback

S2 - miniature circuit breaker Recommended rating: 2A, class C or D for CM_16_1(220);
10A, class D for CM_16_1(60). Supplied by customer.
S21 - push button close. Supplied by customer.
S22 - push button trip. Supplied by customer.



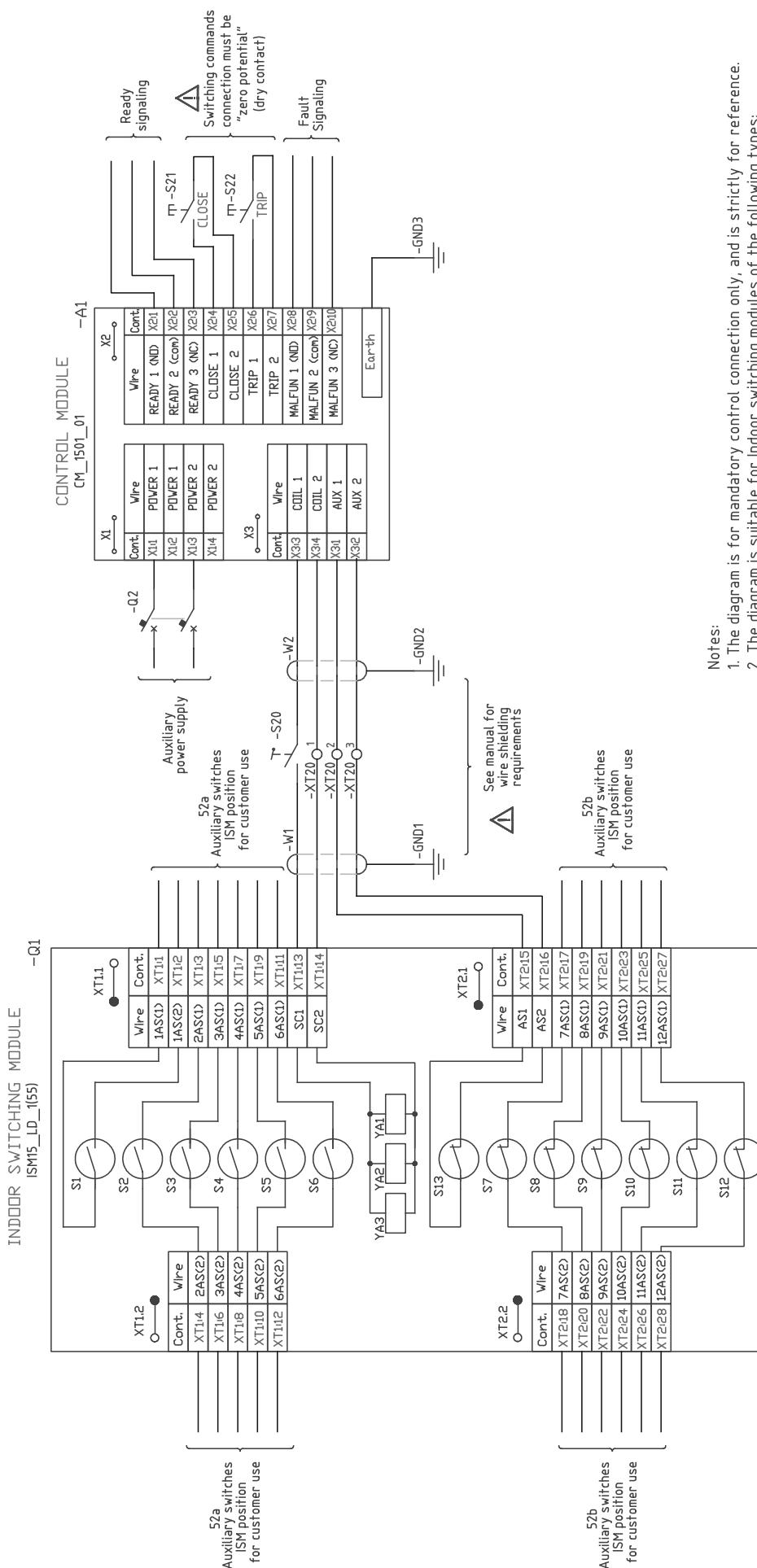
Notes:

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_LD_153_E, ISM15_LD_155_E, ISM15_LD_2155_E, ISM15_LD_1167_E.
3. The diagram is suitable for control modules of the following types: CM_16_1(220) and CM_16_1(60).
4. Auxiliary power supply range: (88...265)VAC - for CM_16_1(220)

5. Default settings for CM_16_1(220):
Relay 1 X - "Auxiliary contact output"
Relay 2 X - "Ready"
Relay 3 X - "Malfunction"

Where X:
1 - NO contact
2 - Com contact
3 - NC contact

ISM_LD with CM_1501_01 Control Module



Technical Data

Indoor Switching Modules (ISM) - ANSI C37.09

	Type	ISM15_LD_1 ISM15_LD_2 ISM15_LD_3	ISM25_LD_1 ISM25_LD_3
Rated Data	Rated voltage (Ur)	15 kV	27 kV
	Rated current (Ir)	to 1000 A	to 800 A
	Rated power frequency withstand voltage (Ud)	36 kV	60kV
	Rated lightning impulse withstand voltage (peak) (Up)	95 kV	125 kV
	Rated short-circuit breaking current (Isc)	to 20 kA ⁶⁾	to 16 kA ⁶⁾
	Rated peak withstand current (Ip)	to 52 kA	to 42 kA
	Rated short-time withstand current (Ik)	to 20 kA	to 16 kA
	Rated duration of short circuit (tk)	4 s	
Switching Performance	Rated frequency (fr)	50 / 60 Hz	
	Mechanical life ⁵⁾ (CO-cycles)	50000/150000 ²⁾	30000
	Operating cycles ⁵⁾ , rated current (CO-cycles)	50000/150000 ²⁾	30000
	Maximum number of CO-cycles per hour	refer to CM	
	Operating cycles ⁵⁾ , rated-short circuit breaking current	100	
	Closing time ³⁾ , with CM_1501_01 - not more than	30 ms	35 ms
	Opening time ³⁾ , with CM_1501_01 - not more than	15 ms	
	Break time ³⁾ , with CM_1501_01 - not more than	23 ms	
Standards	Rated operating sequence (CM_1501_01)	0-0.3s-CO-10s-CO	
	Design class with regard to severity of service conditions in accordance with IEC 932	Class 1	Class 0
	Standards	IEC 62271-100, GB 1984-2003 ANSI C37.04, C37.06, C37.09, C37.09a	
	Mechanical vibration withstand capability according to IEC 721-3-4	Class 4M4	
	Other data		
Design, Switching Capacity of Auxiliary Contacts	Resistance of main circuit	< 40 μ Ohm	
	Weight (depending on PCD) for three-phase ISM	34, 36, 37 kg	33, 36, 38, 39 kg
	Weight for single phase ISM	13 kg	14 kg
	Type of driving mechanism	Monostable magnetic actuator	
	Number of available auxiliary contacts for three-phase ISM	6 NO + 6 NC	
	Number of available auxiliary contacts for single-phase ISM	2 NO + 2 NC	
	Minimum current for 12 V AC / DC, ohmic load	100 mA	
	Minimum current for 12 V AC / DC, inductive load ($t=20$ ms, $\cos\phi =0,3$)	100 mA	

Indoor Switching Modules (ISM) - Additional Standards

	Type	C37.60	C37.74 (With Exceptions)
Applies to Breaker Types ISM25_LD_1, ISM25_LD_3			
Rated Data	Rated voltage (U_r)	27 kV	
	Rated current (I_r)	to 800 A	to 630 A
	Rated power frequency withstand voltage (U_d)		60kV
	Rated lightning impulse withstand voltage (peak) (U_p)		125 kV
	Rated short-circuit breaking current (I_{sc})		to 12.5 kA ⁶⁾
	Rated peak withstand current (I_p)		to 32.5 kA
	Rated short-time withstand current (I_k)		to 12.5 kA
	Rated fault-making	N/A	to 12.5kA [Max x2 sequential without load interruption]
	Rated duration of short circuit (t_k)		4 s
	Rated frequency (f_r)		50 / 60 Hz
Switching Performance	Mechanical life ⁵⁾ (CO-cycles)	30000	
	Operating cycles ⁵⁾ , rated current (CO-cycles)	30000	
	Maximum number of CO-cycles per hour		refer to CM
	Operating cycles ⁵⁾ , rated-short circuit breaking current		100
	Closing time ³⁾ , with CM_1501_01 - not more than		35 ms
	Opening time ³⁾ , with CM_1501_01 - not more than		15 ms
	Break time ³⁾ , with CM_1501_01 - not more than		23 ms
	Rated operating sequence (CM_1501_01)	0-0.3s-CO-10s-CO-10s-CO-10s	0-0.3s-CO-10s-CO

Explanatory notes - C37.60

The ISM25_LD series have been tested to ANSI C37.60 in a minimal enclosure through full testing of the OSM25_AL_1 and OSM25_AL_2 recloser series. Test reports and further information can be obtained from Tavrida applications engineers.

Explanatory notes - C37.74

 The ISM25_LD series have been tested to and passed elements of C37.74. **It should be carefully noted however** that the type of vacuum interrupter used in this series is designed for breaking current, whereby the interrupter contacts rejuvenate during the load breaking process. Make events followed by mechanical "cold" opening, such as the x3 fault-making tests prescribed under ANSI C37.74, will potentially cause welding of the contacts and inability to open the breaker. Consult Tavrida applications engineers if the system design may subject the breaker to make events of this type.

Note

- ²⁾ ISM15_LD_2(55) available with 150.000 CO cycles
- ³⁾ Excluding CM processor acceptance time. See CM technical specifications or contact Tavrida NA for detailed operation timing.

⁴⁾ 10 A current is permissible for 5 minutes

⁵⁾ See Figure 58 / page 61

⁶⁾ At 40% d. c. component

Control Modules

Type	CM_1501_01	CM_16_1(60)	CM_16_1(220) CM_16_2(220)
Type of operation			
Rated operating sequence	0-0.1s-CO-10s-CO-10s-CO	0-0.3s-CO-10s-CO-10s-CO	0-0.3s-CO-10s-CO-10s-CO
Maximum CO operating cycles per hour	100	100	100
Auxiliary power supply 24/60			
Auxiliary power supply 100/220 - DC	85VDC to 370VDC	N/A	85VDC to 265VDC
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
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 MΩ	> 5 MΩ	> 5 MΩ

Electromagnetic compatibility

Interference immunity to voltage dips short interruptions and voltage swings in accordance 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 transients/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 earth 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 earth 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

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 capacitor¹⁾), 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

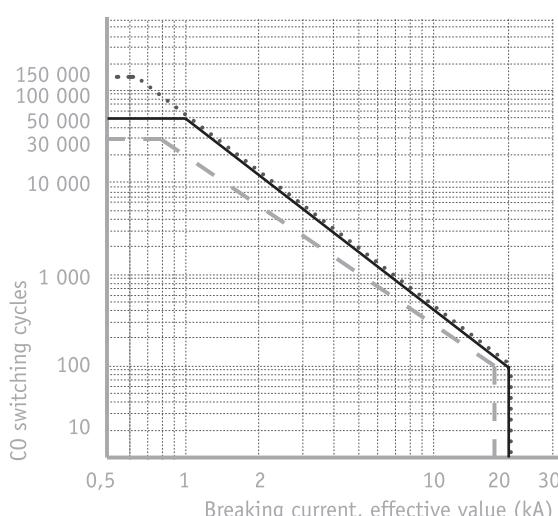
Remarks¹⁾ Charging times apply for charging the capacitors over both CT power supply inputs**Life cycle of ISM**

Figure 58

- Standard ISM 15 kV
- High frequency ISM 15 kV
- - - - Standard ISM 27 kV, ISM25_LD_2

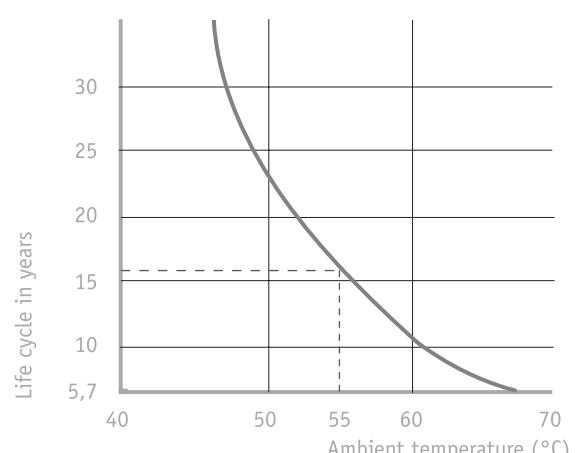
Life cycle of CM close and trip capacitors

Figure 59

Regulations and Ambient Conditions

Regulations

The ISM fulfils the requirements of the following standards:

- | | |
|---------------------------|--------------------------|
| · DIN VDE 0670, Teil 1000 | Germany |
| · IEC 60056 | International standard |
| · IEC 62 271-100 | International standard |
| · IEC 60 694 | International standard |
| · GB 1984-2003 | China |
| · GOST 687-78 | Russian Federation |
| · ANSI C37.09 | North American Standards |
| · ANSI C37.09a | North American Standards |



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 K_a according to IEC 60 684 compared to the insulation measurement at sea level (Figure 69).

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: $28 \text{ kV} \times 1.2 = 33.6 \text{ kV}$
Corrected rated impulse withstand voltage: $75 \text{ kV} \times 1.2 = 90 \text{ kV}$

Because of the corrected voltage values, it is necessary to select a 24 kV ISM.

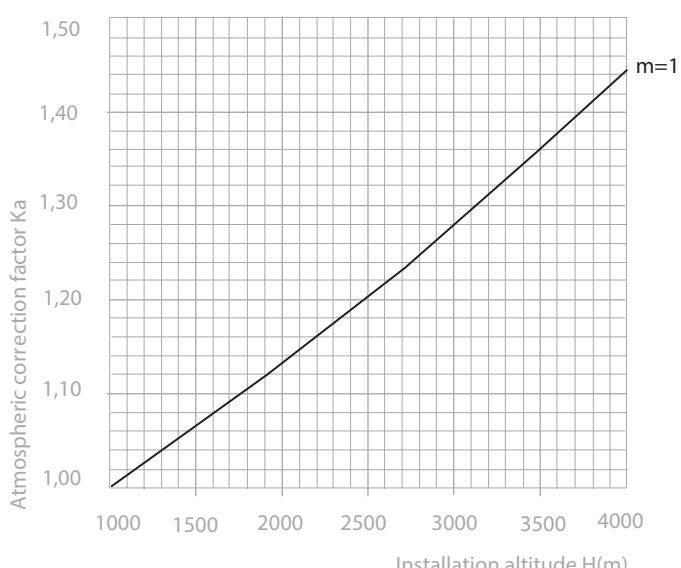


Figure 60

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

Legal Information

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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.

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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-0 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



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. Transport damage must be reported in writing to the supplier as soon as it is discovered. 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 benign and recyclable material. No special disposal is 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 handled if the accompanying report is properly filled including 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 Ave
Delta, BC, Canada
V3M 6G9

Phone: (604)-540-6600
Fax: (604)-540-6604

E-Mail: info@tavrida-na.com
Web: www.tavrida-na.com

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Liability

Damages and demands for reimbursement of expenses incurred by the customer (in the following: compensation) for what-ever 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, user-side incorrect interpretation and/or for consequences arising therefrom.

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NON-CONFORMITY REPORT

To:	TAVRIDA ELECTRIC NA Service Department	From:	
Phone:	(604)-540-6600	Address:	
Fax:	(604)-540-6604		
E-Mail:	info@tavrida-na.com	Name:	
Web:	www.tavrida-na.com		
		Phone:	
		Fax:	
		E-Mail:	

Type designation:	Serial No.:
ISM	
CM	

Date of commissioning:	Date when non-conformity was noticed:
When did the non-conformity occur: <input type="radio"/> Incoming inspection <input type="radio"/> Installation/Commissioning <input type="radio"/> Service	Place of installation of CM: <input type="radio"/> Low voltage compartment of panel <input type="radio"/> High voltage compartment of panel <input type="radio"/> Separate control cubicle <input type="radio"/> Draw-out unit

Description of non-conformity:

How many blinks occurred on Malfunction-LED of CM?

- 1x 2x 3x 4x 5x ≥17x

Non-conformity report issued by:

Date:	Name:	Signature:
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Please note:

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

Date: _____

Tavrida Electric North America

Tavrida Electric North America Ltd.

1105 Cliveden Avenue,

Delta, BC, Canada

V3M6G9

Phone: (604)-540-6600

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Tavrida Electric does not accept any responsibility for loss or damage incurred as a result of acting or refraining from action based on information in this Installation and Operating Instructions.