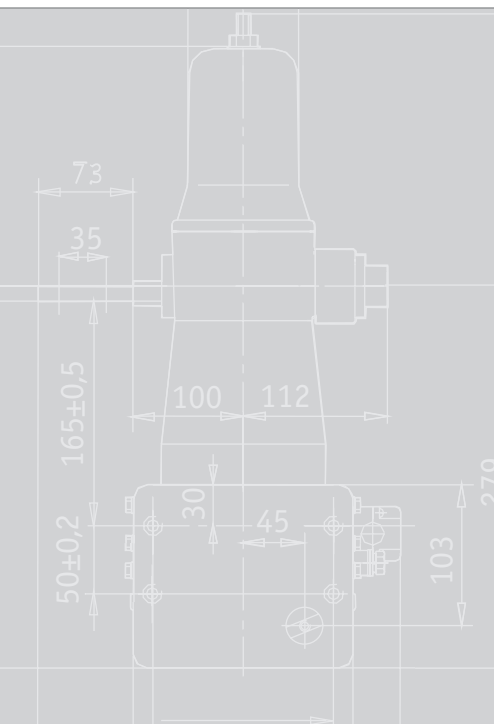




ISM

Vacuum Circuit Breaker
12kV, ...31.5kA, ...1600A
24kV, ...16kA, ...800A



Technical Manual

The present Technical Manual contains information necessary for the installation, commissioning and operation. It is absolutely necessary for the proper use of the vacuum circuit breakers to read the Technical Manual 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 (such as DIN/VDE/IEC), accident prevention regulations and the connecting conditions of the electric utilities shall be followed.
- Take note that during operation of the vacuum circuit breakers certain parts are subject to dangerous voltage. Mechanical parts, also remote-controlled, can move quickly. Failure to comply may result in death, severe personal injury or damage to equipment.
- Pay attention to the hazard statements located throughout this 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 AG.



Control modules of all types meet the requirements of the
EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC.

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Introduction

1

Definitions

The following abbreviations are used in this operating manual:

AR:	Automatic reclosing	NC:	Normally closed contact
CM:	Control module	NO:	Normally open contact
CO:	Close open cycle	PCD:	Pole center distance
ISM:	Indoor switching module	SCADA:	Supervisory control and data acquisition
LED:	Light emitting diode	SF6:	Insulating gas sulfur hexafluoride
MCB:	Miniature circuit breaker	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 have 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 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.

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 by 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 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. Depending on the type, up to 150.000 switching 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 minimizing the number of failure-critical components, the Tavrida Electric circuit breaker monitors its status continuously. In the unlikely event that a fault occurs in the remaining components of the circuit breaker it is indicated and can be rectified before an unsuccessful switching attempt is made. This clearly leads to higher availability of the electric power supply system.

Design and method of operation of the ISM

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)

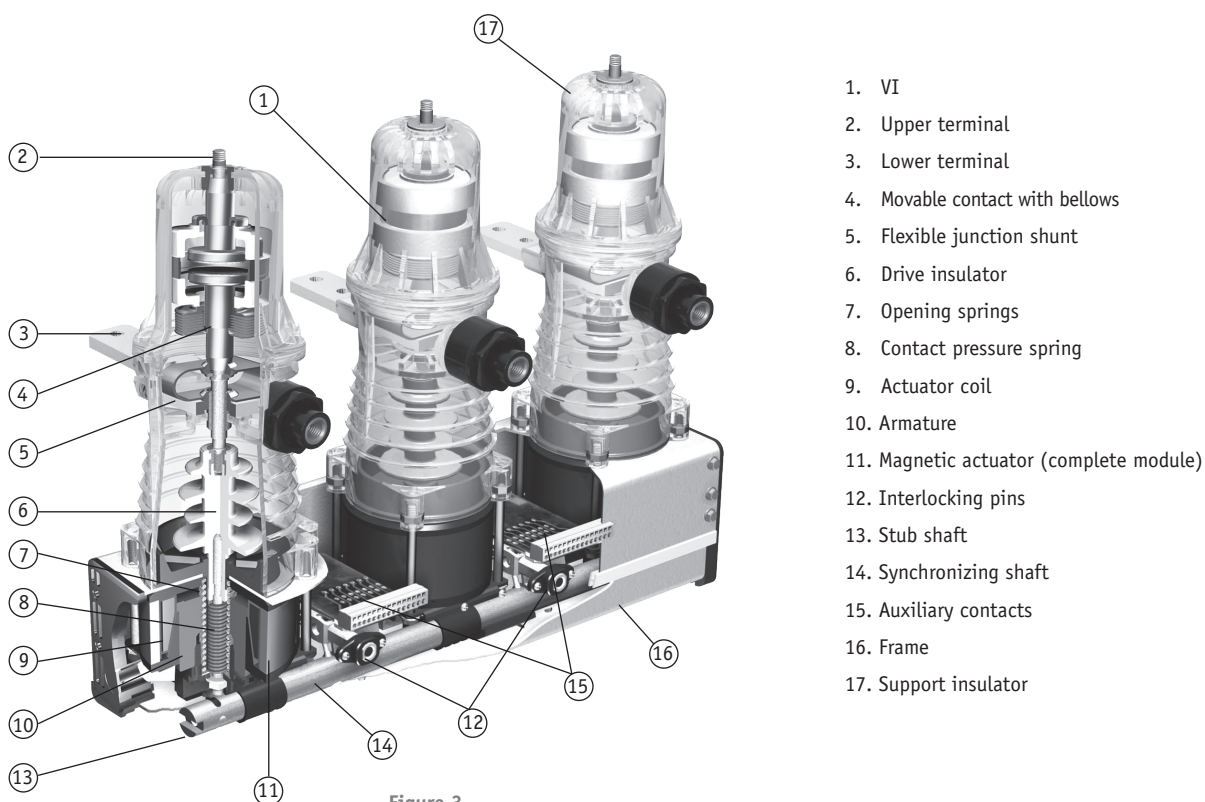


Figure 3
View into the ISM

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 get 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 close 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 4).

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 4).

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.

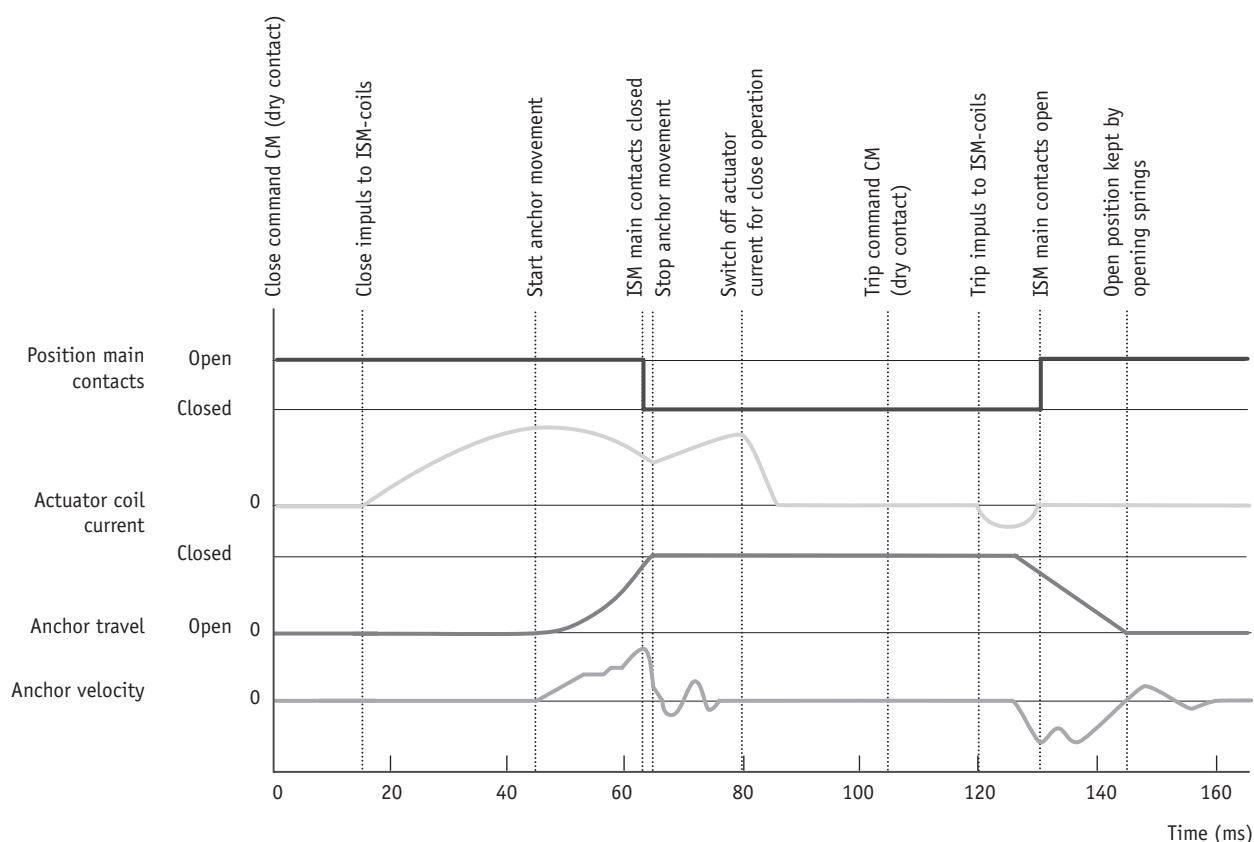


Figure 4

Typical oscillogram of ISM operation

Design and mode of operation of the CM

The CM is encapsulated in an ABS-housing. It has four holes to fix it on flat surfaces. Terminals, LED indicators and operating elements are placed on the front of CM (Figure 5). The control and monitoring functions are performed by microprocessors. The electrical energy for the tripping and closing is stored in separate capacitors. The capacitors are charged as soon as the CM is connected to the auxiliary power supply.

Control Module (CM)

1

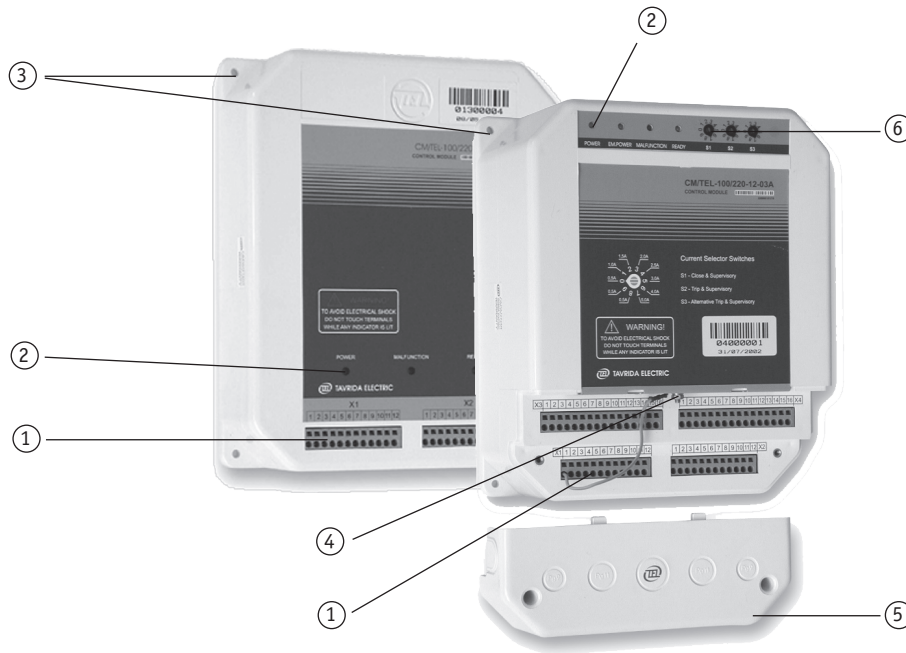


Figure 5

1. Terminals
2. LED indicators
3. Fastening holes
4. Earthing stud
5. Terminals cover
6. Current selector switches



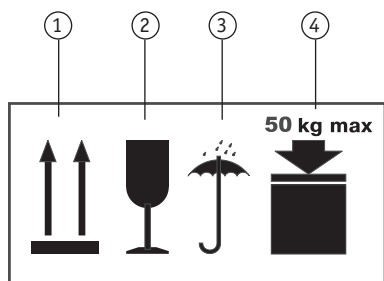
Goods entry

2

Packing

The following information are provided on the ISM packing cartons (Figure 6):

- Handling symbols for transport and storage of the delivery unit (Figure 7)
- Label 1 for manufacturers' and product information (Figure 8)
- 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

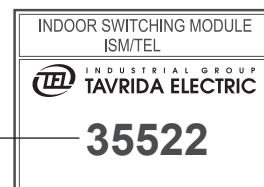


Figure 7
Handling symbols

Figure 8
Label 1 for manufacturers' and product information

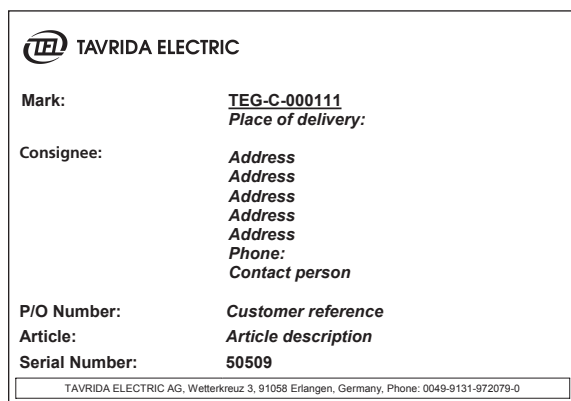


Figure 9
Label 2 Logistics data

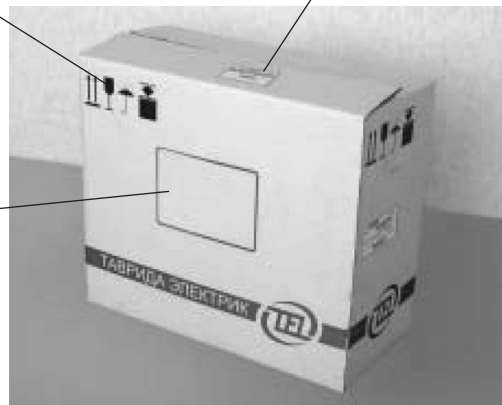
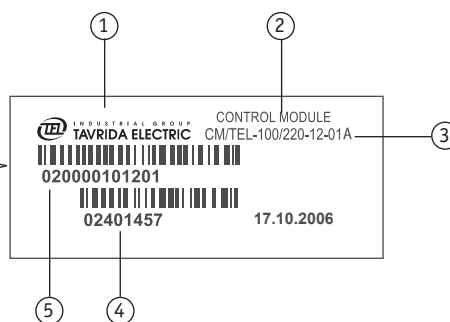
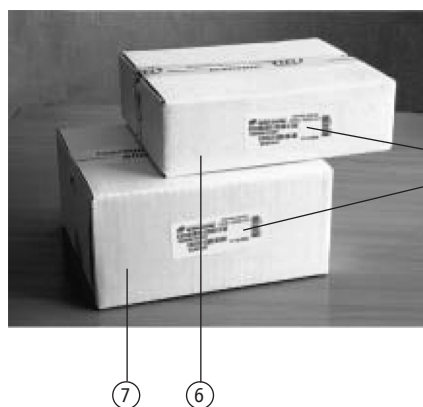


Figure 6
ISM carton package

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)
7. Carton package for CM/TEL...-12-02A, -03A, -14 (265x220x130 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

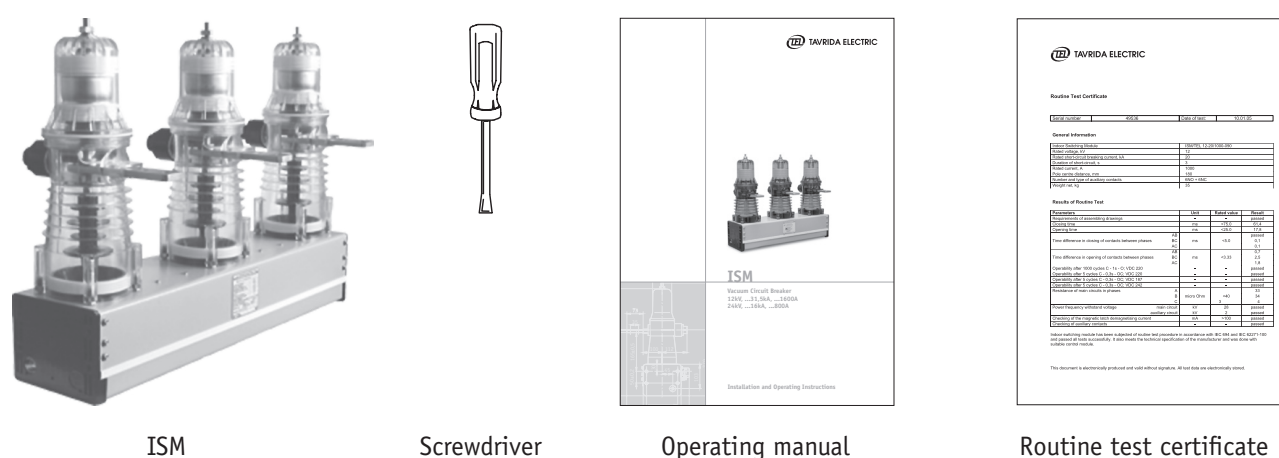
ISM and CM shall be transported in the original packing only. The packed goods shall be handled in accordance with the handling symbols. Loading procedures for ISM packing units shall be carried out only with fork lifts or cranes. If possible the ISM packing unit shall be placed on a pallet. Lifting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

Unpacking, goods received control

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.

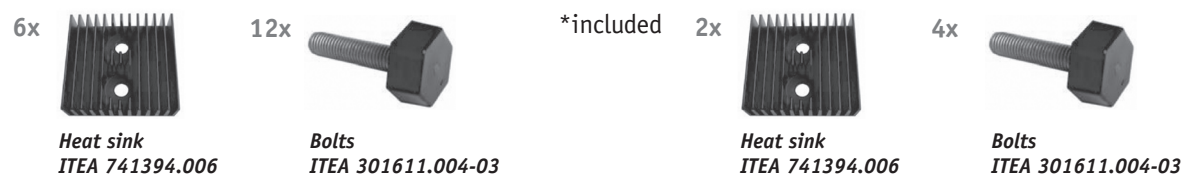
Scope of delivery for the ISM:

Figure 11



In addition ISM/TEL 12-XX/1000-055, -055F, -067, -089* include a heat sink set.

Figure 12



In addition ISM/TEL 24-16/800-053*, -057, -058, -087 include an insulating cap set.

Figure 13



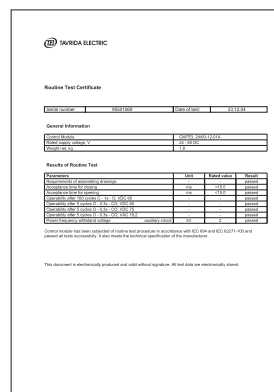
Scope of delivery for the CM:



CM



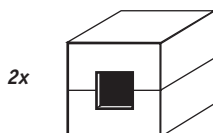
Screwdriver



Routine test certificate

Figure 14

CM/TEL...-14-01 contains additionally:



2x

Cable ferrite filter Ferroxcube Co.
CSA 19/9.4/29-4S2-EN

Figure 15

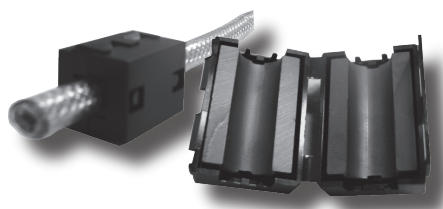


Figure 16

Further, the intactness of the devices should be checked visually for:

- Mechanical damage, scratches, discoloured places, corrosion
- Damage to the seals (Figures 18, 19)

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

Rating plate, seal

Please check that the rating plates of the delivered devices correspond to the data of the order. The rating plate contains the following informations (Figure 17):

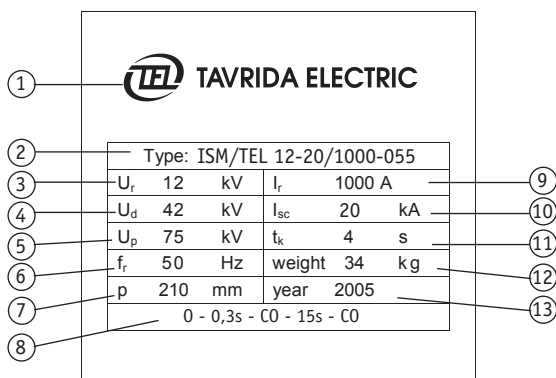


Figure 17

Rating plate

1. Manufacturer
2. Type of device
3. Rated voltage U_r
4. Rated power frequency withstand voltage U_d
5. Rated impulse withstand voltage U_p
6. Rated frequency f_r
7. Pole center distance p
8. Rated operating sequence
9. Rated current I_r
10. Rated short-circuit breaking current I_{sc}
11. Rated duration of short circuit t_k
12. Weight
13. Year of manufacture

Arrangement of the labels (Figures 18, 19):

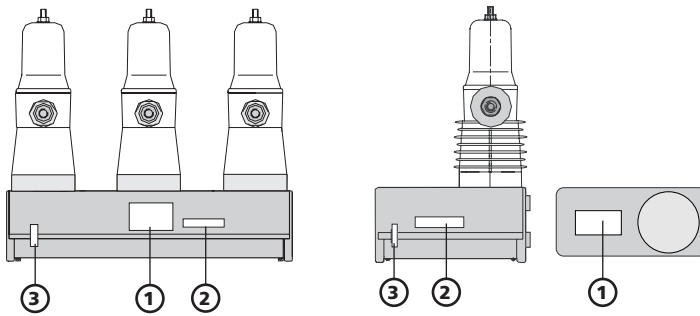


Figure 18

Labelling three-phase ISM

Labelling single-phase ISM

ISM

1. Rating plate
2. Serial number
3. Seal

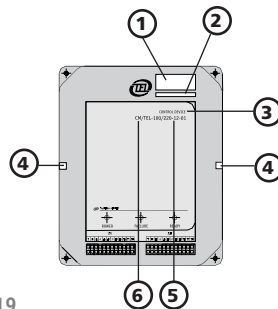


Figure 19

Labelling of the CM...-12-01A

CM

1. Serial number
2. Date of manufacture
3. Type description
4. Seal
5. Product code
6. Product name

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 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 hour.



Installation

3

Primary part

Preparation

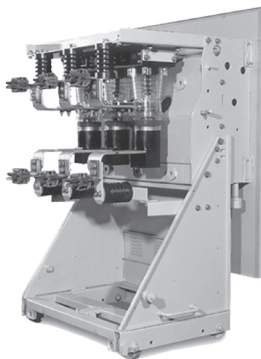
The following regulations must be adhered to during installation, commissioning and operation:

- IEC 60694/DIN VDE 0101, General specification for high-voltage switchgear and control gear standards.
- VDE 0105, Operation of electrical installations.
- DIN VDE 0141, Earth systems for electrical power installations with nominal voltages above 1 kV.
- All rules for accident prevention applicable in the respective countries.

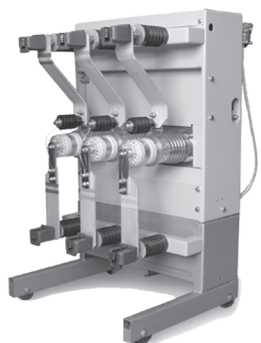
Figure 20



*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.

The 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

The -066, -081 series ISM can be installed vertically.

All other series can be installed in any position (Figure 20). 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 21.

The torque of all fixing points shall not exceed the values stated in figure 22.

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 unacceptable high mechanical loads on the ISM, the bus bar connections shall rest on additional supporting insulators (Figures 21).

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

ISM/TEL-12-20/1000-XX 0,5 m

ISM/TEL-24-16/800-XX 0,5 m

ISM/TEL-12-31,5/1600-XX 1,0 m

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

Fixing points, primary terminals

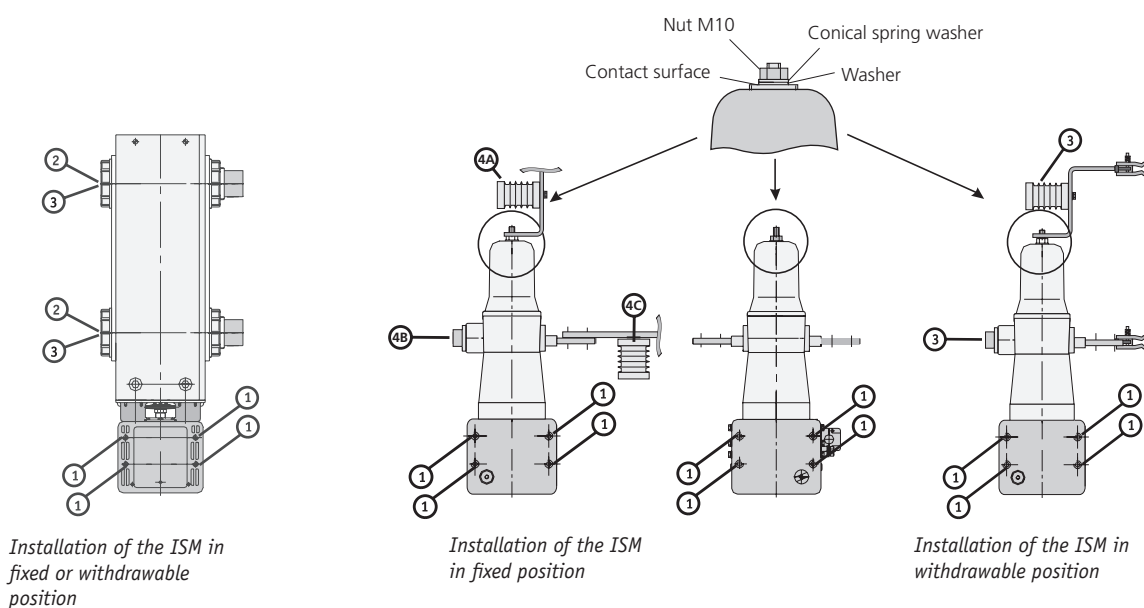


Figure 21

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

Bolt sizes and torques

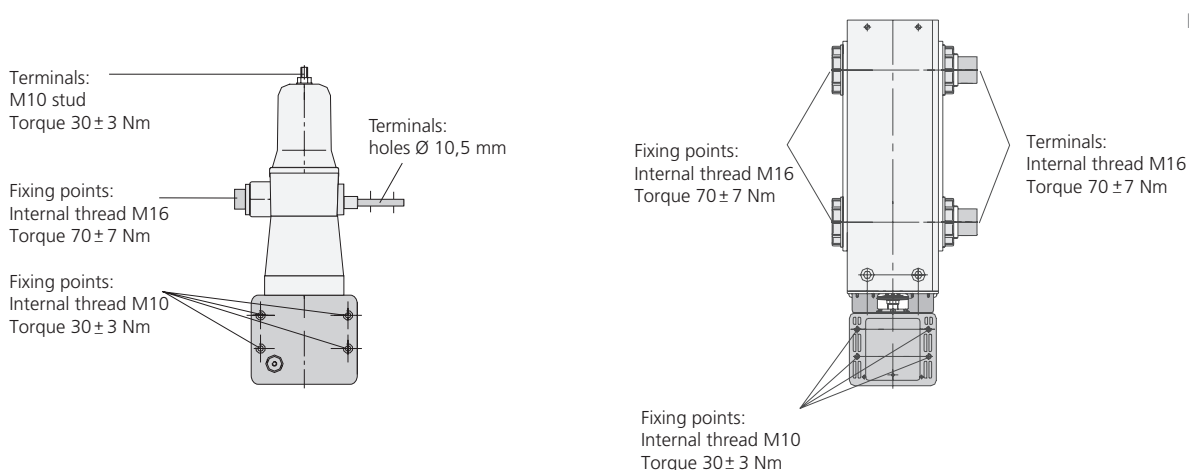


Figure 22

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 23).

U_r	U_p	Minimum clearance (a)
12 kV	75 kV	120 mm
24 kV	125 kV	220 mm

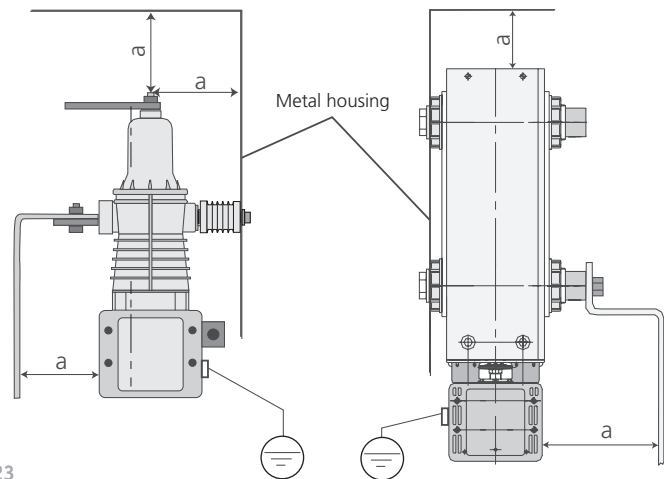


Figure 23

Measures for complying with the rated insulation level

Insulation cap set for 24 kV ISM

To comply with the rated impulse withstand voltage of 125 kV according to IEC 60694 it is recommended to cover the top connections of the 24kV 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 24.

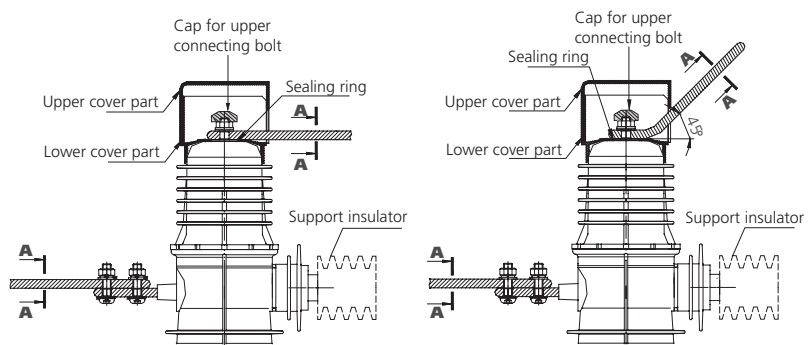


Figure 24

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 24 kV ISM

If the PCD of the 24kV ISM is 210 mm, the connected bus bars shall have the shape as shown in Figure 25.

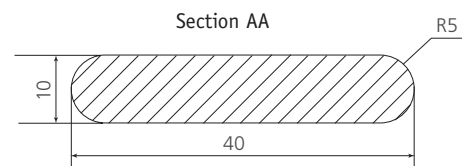


Figure 25

Phase segregation plates for 12 kV and 24 kV ISM

For 12 kV ISM with a PCD of 150 mm or 24 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 26.

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.

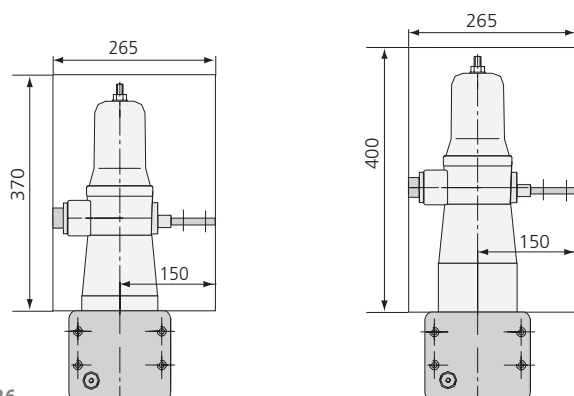


Figure 26

Recommended size and position of the segregation plates for ISM, 12 kV PCD 150 mm

Recommended size and position of the segregation plates for ISM, 24 kV PCD 210 mm

Minimum clearances due to electromagnetic influence

The following clearances must be adhered to (Figure 27):

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

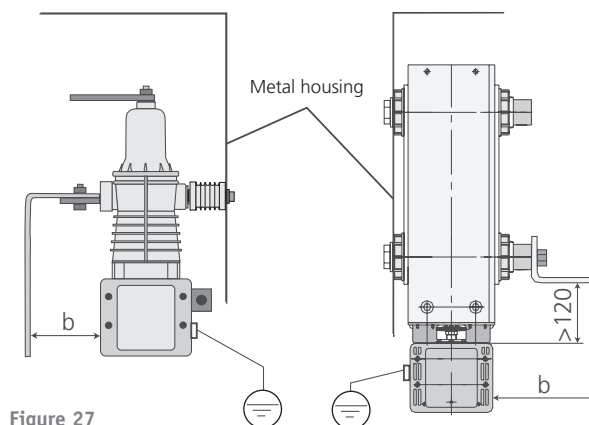


Figure 27

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 28).

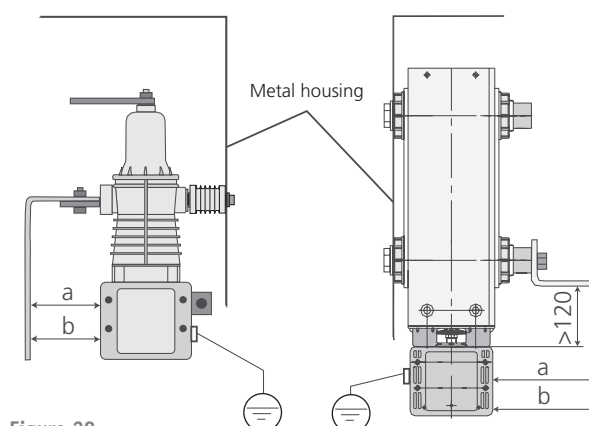


Figure 28

Heating, heat sink

The ISM 12-XX/1000 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 29.

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 ISM/TEL 12-XX/1000: Two mounted ITEA741394.006 heat sinks or equivalent per pole.
Initial state for all other ISM: Without heat sink.

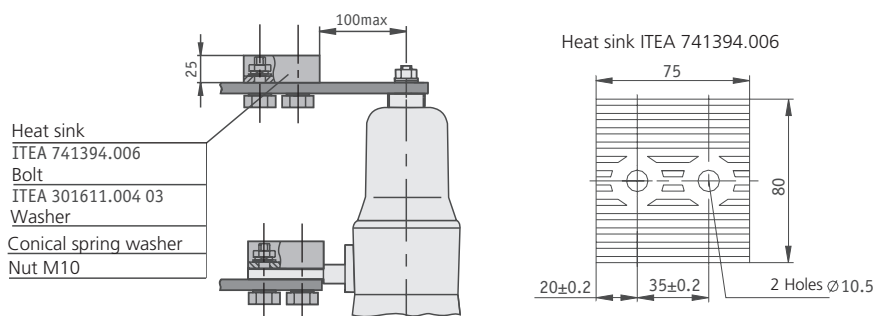


Figure 29

Protective earthing

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 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 30).

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
31,5 kA	300 °C	95-140 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.

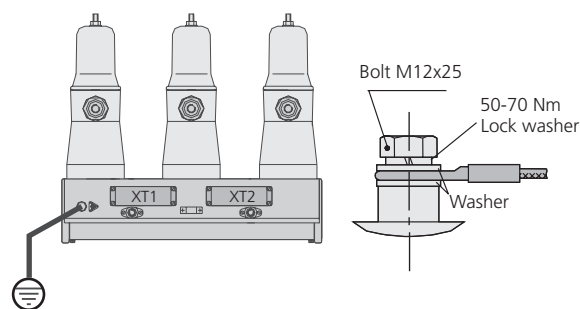


Figure 30

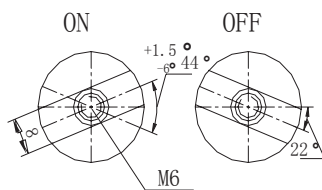
3

Mechanical interlocking

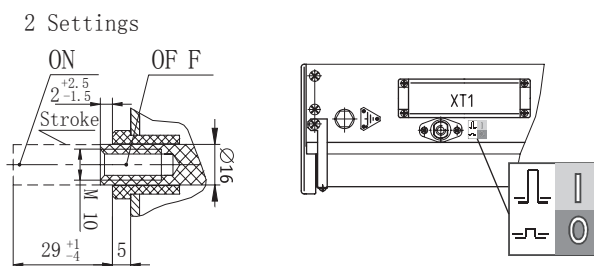
The ISM provides the following interfaces for interlocking (Figure 31):

- Stub shafts at both sides with grooves and tapped holes (Figure 31, details 1 and 3).
- Two interlocking pins with tapped holes (Figure 31, detail 2).

Detail 1



Detail 2



Detail 3

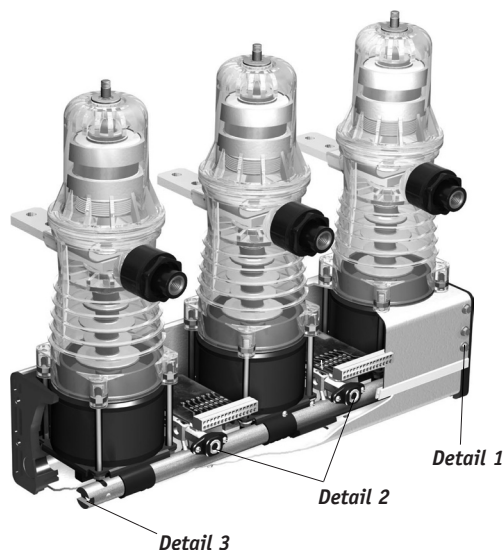
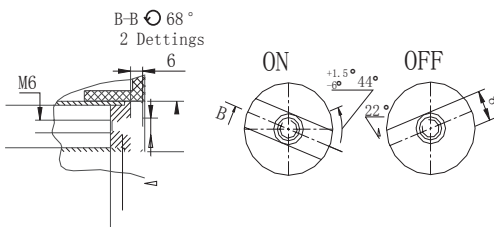


Figure 31

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 ISM/TEL 12-20/1000-055F 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 respectively 0,1 kg (Figure 32).
- If the attached part is joined with a lever mechanism, the weight (including directly moved parts) shall be decreased in proportion of the lever (Figure 33).
- 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 ISM/TEL 12-20/1000-055F series). If both stub shafts of the synchronizing shaft are used, the sum of the attached moments of inertia shall not exceed $4,3 \times 10^{-4} \text{ kgm}^2$ respectively $1,2 \times 10^{-4} \text{ kgm}^2$ (Figure 34).
- For manual-emergency-tripping a force of up to 250 N may affect to the interlocking pins. But no static force shall be applied (Figure 35).
- It is not allowed to perform electrical trip/close commands while blocking the interlocking pins or the synchronizing shaft mechanically.

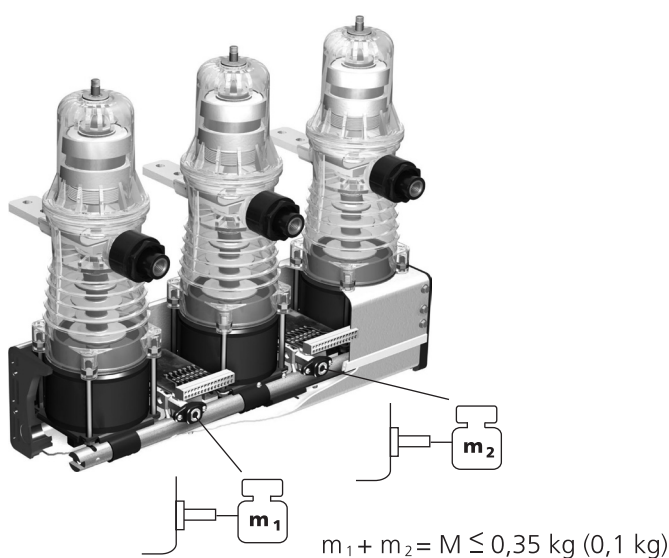


Figure 32

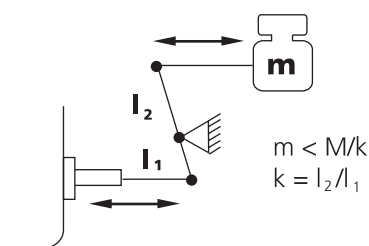


Figure 33

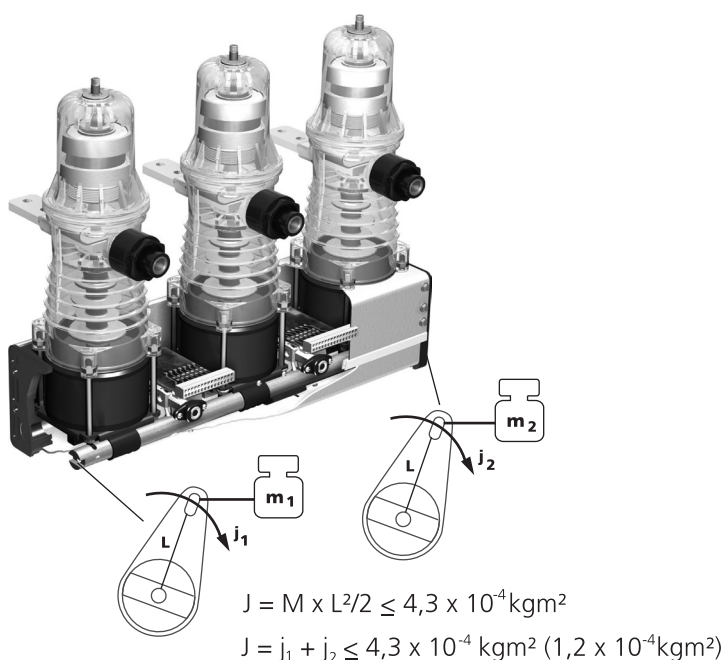


Figure 34

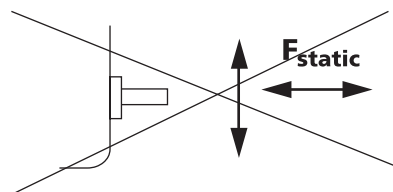


Figure 35

Design of mechanical interlocking at the side stub shafts

Single phase ISM are supplied with installed interlocking lever (Figures 36, 37).

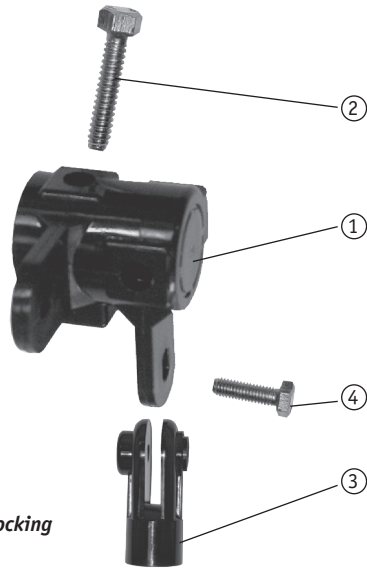
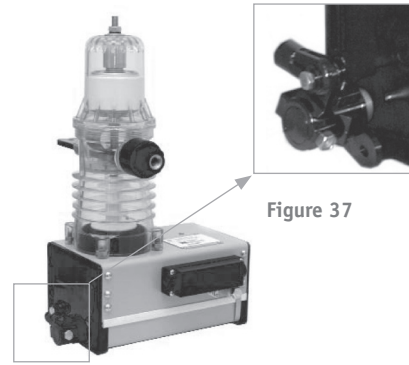


Figure 36

Individual parts of interlocking lever for single phase ISM



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 Tavrida Electric interlocking lever set APTA 44 26 11.004 (Figure 38) at both stub shafts (Figure 39).

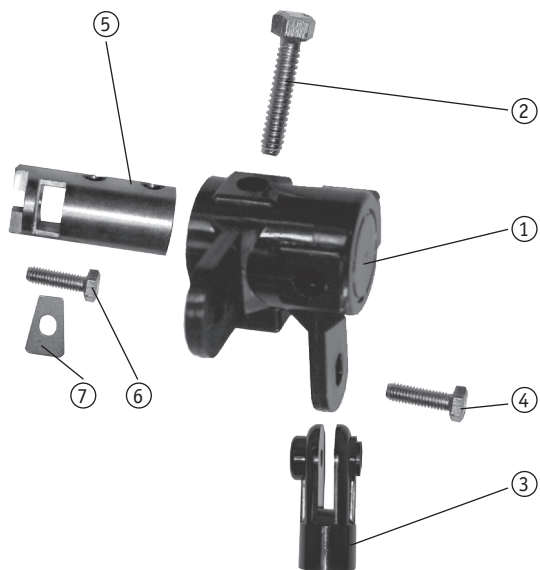
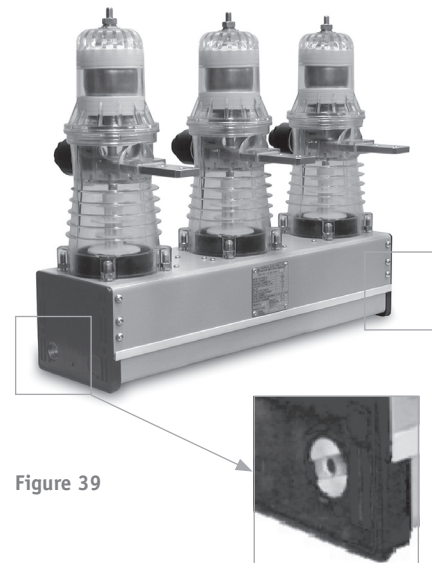


Figure 38

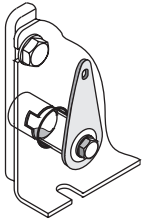
Individual parts of interlocking lever set APTA 44 26 11.004 for three phase ISM



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 respectively $M \leq 0,1$ kg may be attached. If two interlocking levers are used, the total mass at both stub shafts shall not exceed $M = 0,35$ kg respectively $M = 0,1$ kg.

In the following please find an example of a self-construction (not in the scope of supply, Figures 40, 41).



$L = 19,5...50 \text{ mm}$
 $B = 22...50 \text{ mm}$
 The length of L and B depends on the particular project.

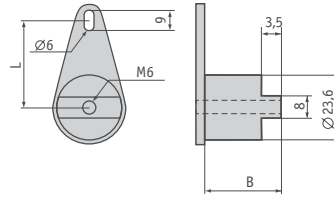


Figure 40

Connection between interlocking lever and synchronizing shaft

Figure 41

Construction and connection variants of interlocking lever at the side stub shafts (Figures 42, 43)

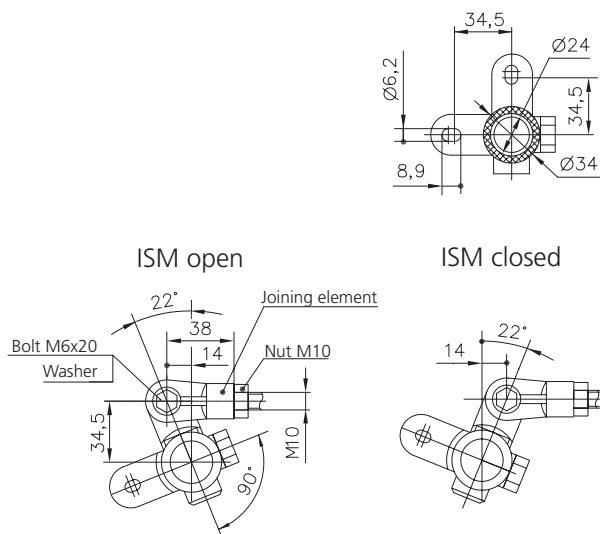


Figure 42

Position of interlocking lever as a function of ISM position

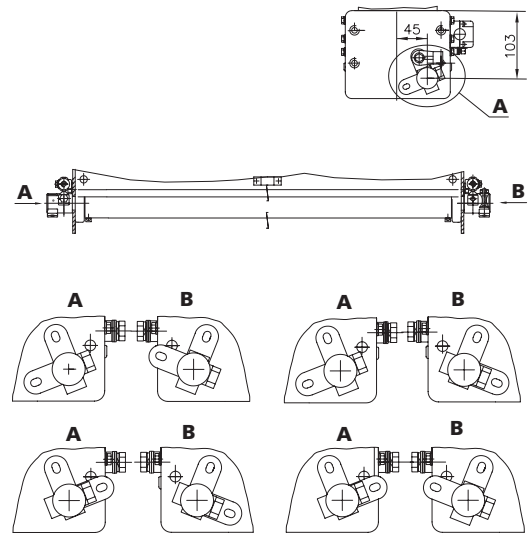


Figure 43

Possible connection variants of the interlocking levers (Figure 43).

Variant A:

One-side connection for single-phase-ISM

Variant A, B:

Two-side connection for three-phase-ISM

Secondary part

Secondary connections of ISM

Secondary connections for three-phase ISM

All three-phase ISM have the same terminals (Figure 44). Connected to the terminal blocks XT1 and XT2 are 13 auxiliary switches (6 “NO”- and 7 “NC”-contacts) and the magnetic actuator coils.

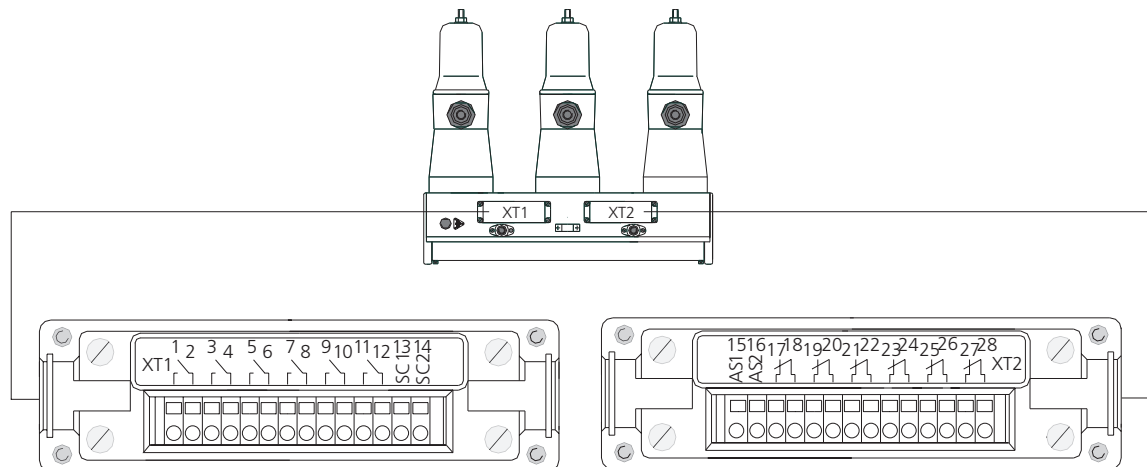


Figure 44

Terminal arrangement of the three-phase ISM

Terminal arrangement ISM (three-phase)

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)

Secondary connections for single-phase ISM

All single-phase ISM have the same terminals (Figure 45). Connected to the terminal block XT1 are 5 auxiliary switches (2 “NO”- and 3 “NC”contacts) and the magnetic actuator coil.

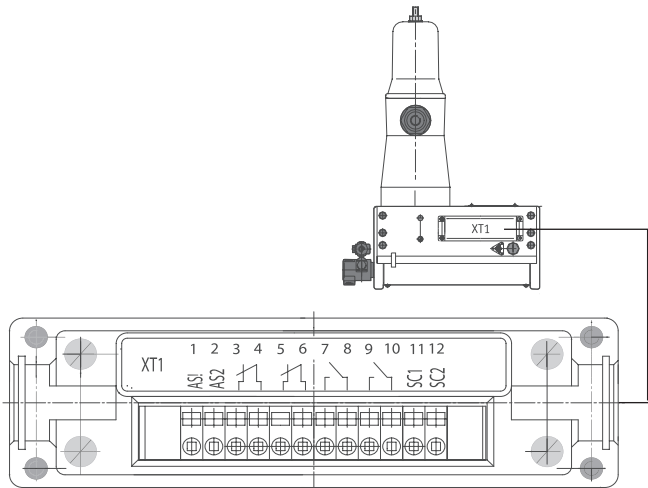


Figure 45
Terminal arrangement of the single-phase ISM

Terminal arrangement ISM (single-phase)

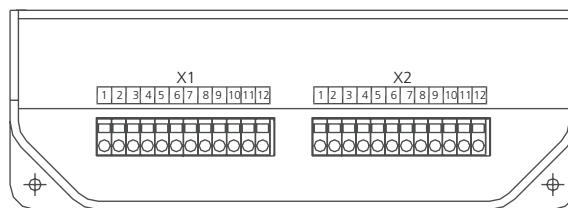
XT1	
Terminal No.	Connection
1	Auxiliary switch SF1 (AS1)
2	Auxiliary switch SF1 (AS2)
3	Auxiliary switch SF2
4	Auxiliary switch SF2
5	Auxiliary switch SF3
6	Auxiliary switch SF3
7	Auxiliary switch SF4
8	Auxiliary switch SF4
9	Auxiliary switch SF5
10	Auxiliary switch SF5
11	Actuator coil (SC1)
12	Actuator coil (SC2)

CM connections

The connections for basic and extended functions of all available CM can be seen from the following terminal arrangements (Figures 46, 47, 48, 49).

Figure 46

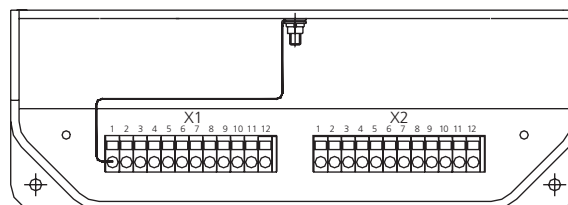
CM/TEL....-12-01A Terminal arrangement



X1		X2	
Terminal No.	Connection	Terminal No.	Connection
1	Earth	1	Ready (com)
2	Free	2	Ready (NO)
3	Auxiliary power supply ~ (+)	3	Ready (NC)
4	Auxiliary power supply ~ (-)	4	Malfunction (com)
5	Free	5	Malfunction (NC)
6	Free	6	Malfunction (NO)
7	Free	7	Auxiliary switch ISM (AS1)
8	Free	8	Auxiliary switch ISM (AS2)
9	Dry contact "Close"	9	Output actuator coil (SC1)
10	Dry contact "Common"	10	Output actuator coil (SC2)
11	Dry contact "Common"	11	Free
12	Dry contact "Trip"	12	Earth

Figure 47

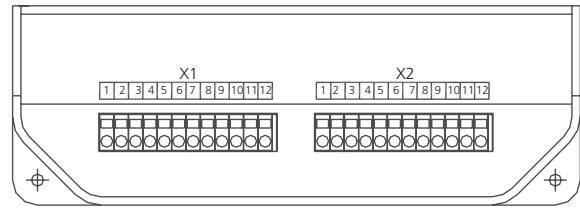
CM/TEL....-14-01 Terminal arrangement



X1		X2	
Terminal No.	Connection	Terminal No.	Connection
1	Earth, internally used	1	Ready (com)
2	Free	2	Ready (NO)
3	Auxiliary power supply ~ (+)	3	Ready (NC)
4	Auxiliary power supply ~ (-)	4	Malfunction (com)
5	Free	5	Malfunction (NC)
6	Free	6	Malfunction (NO)
7	Free	7	Auxiliary switch ISM (AS1)
8	Free	8	Auxiliary switch ISM (AS2)
9	Dry contact "Close"	9	Output actuator coil (SC1)
10	Dry contact "Common"	10	Output actuator coil (SC2)
11	Dry contact "Common"	11	Free
12	Dry contact "Trip"	12	Earth

Figure 48

CM/TEL...-12-02A Terminal arrangement



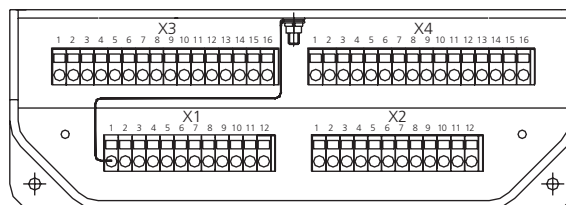
3

X1		X2	
Terminal No.	Connection	Terminal No.	Connection
1	Earth, internally used	1	Ready (com)
2	Free	2	Ready (NO)
3	Auxiliary power supply ~ (+)	3	Ready (NC)
4	Auxiliary power supply ~ (-)	4	Malfunction (com)
5	Free	5	Malfunction (NC)
6	Free	6	Malfunction (NO)
7	Free	7	Auxiliary switch ISM (AS1)
8	Free	8	Auxiliary switch ISM (AS2)
9	Dry contact "Close"	9	Output actuator coil (SC1)
10	Dry contact "Common"	10	Output actuator coil (SC2)
11	Dry contact "Common"	11	Free
12	Dry contact "Trip"	12	Earth

X3		X4	
Terminal No.	Connection	Terminal No.	Connection
1	Close command and supervision ~ (+)	1	Ready (com)
2	Close command and supervision ~ (-)	2	Ready (NO)
3	Simulation close coil	3	Free
4	Simulation close coil	4	Free
5	Free	5	Free
6	Trip command and supervision ~ (+)	6	Free
7	Trip command and supervision ~ (-)	7	Free
8	Simulation trip coil 1	8	Free
9	Simulation trip coil 1	9	Free
10	Trip coil 1 supervision	10	Free
11	Free	11	Free
12	Wipe contact trip operation (NO)	12	Free
13	Wipe contact trip operation (NO)	13	Free
14	Free	14	Free
15	Free	15	Free
16	Free	16	Free

Figure 49

CM/TEL...-12-03A Terminal arrangement



X1		X2	
Terminal No.	Connection	Terminal No.	Connection
1	Earth, internally used	1	Ready (com)
2	Free	2	Ready (NO)
3	Auxiliary power supply ~ (+)	3	Ready (NC)
4	Auxiliary power supply ~ (-)	4	Malfunction (com)
5	Free	5	Malfunction (NC)
6	Emergency power supply ~ (+)	6	Malfunction (NO)
7	Emergency power supply ~ (-)	7	Auxiliary switch ISM (AS1)
8	Free	8	Auxiliary switch ISM (AS2)
9	Dry contact "Close"	9	Output actuator coil (SC1)
10	Dry contact "Common"	10	Output actuator coil (SC2)
11	Dry contact "Common"	11	Free
12	Dry contact "Trip"	12	Earth

X3		X4	
Terminal No.	Connection	Terminal No.	Connection
1	Close command and supervision ~ (+)	1	Emergency signalling NO-contact
2	Close command and supervision ~ (-)	2	Emergency signalling contact (com)
3	Simulation close coil	3	Emergency signalling NC-contact
4	Simulation close coil	4	Free
5	Free	5	CT-Power supply mode
6	Trip command and supervision ~ (+)	6	CT-Power supply mode
7	Trip command and supervision ~ (-)	7	Free
8	Simulation trip coil 1	8	Trip command and supervision for trip coil 2 from alternative auxiliary power supply
9	Simulation trip coil 1	9	Trip command and supervision for trip coil 2 from alternative auxiliary power supply
10	Trip coil 1 supervision	10	Simulation trip coil 2
11	Free	11	Simulation trip coil 2
12	Emergency signalling NO-contact	12	Free
13	Emergency signalling NO-contact	13	Current transformer input 1
14	Free	14	Current transformer input 1
15	Reset input for emergency-signalling contacts	15	Current transformer input 2
16	Reset input for emergency-signalling contacts	16	Current transformer input 2

Terminal arrangement for the basic functions

The control modules CM/TEL... -12-01A, -02A, -03A, CM/TEL...-14-01 have the same basic functions and the same terminal arrangements.

- Auxiliary power supply (terminals X1:3,4)
- Earth connection (terminal X2:12)
- Dry contact inputs (terminals X1:9,10,11,12)
- Output actuator coil (terminals X2:9,10)
- Dry contact input for ISM position (terminals X2:7,8)
- Dry contact output "Ready" (terminals X2:1,2,3)
- Dry contact output "Malfunction" (terminals X2:4,5,6)

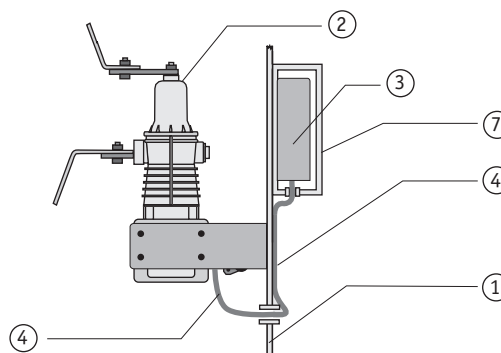


Figure 50

Fixed type installation

3

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 a earthed mild steel box with a thickness of not less than 1 mm. If interference suppressing filters F/TEL03 and F/TEL04 are applied, then it shall be installed also in the CM-steel box (Figures 50, 51).

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 77) 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

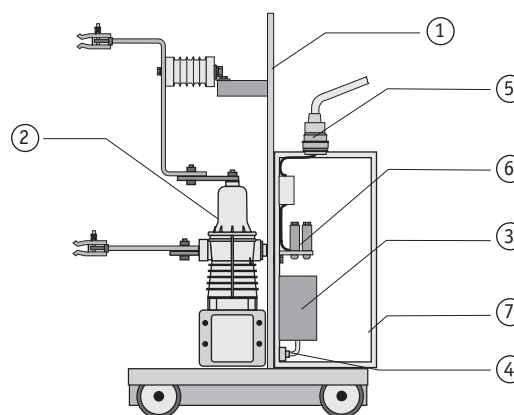
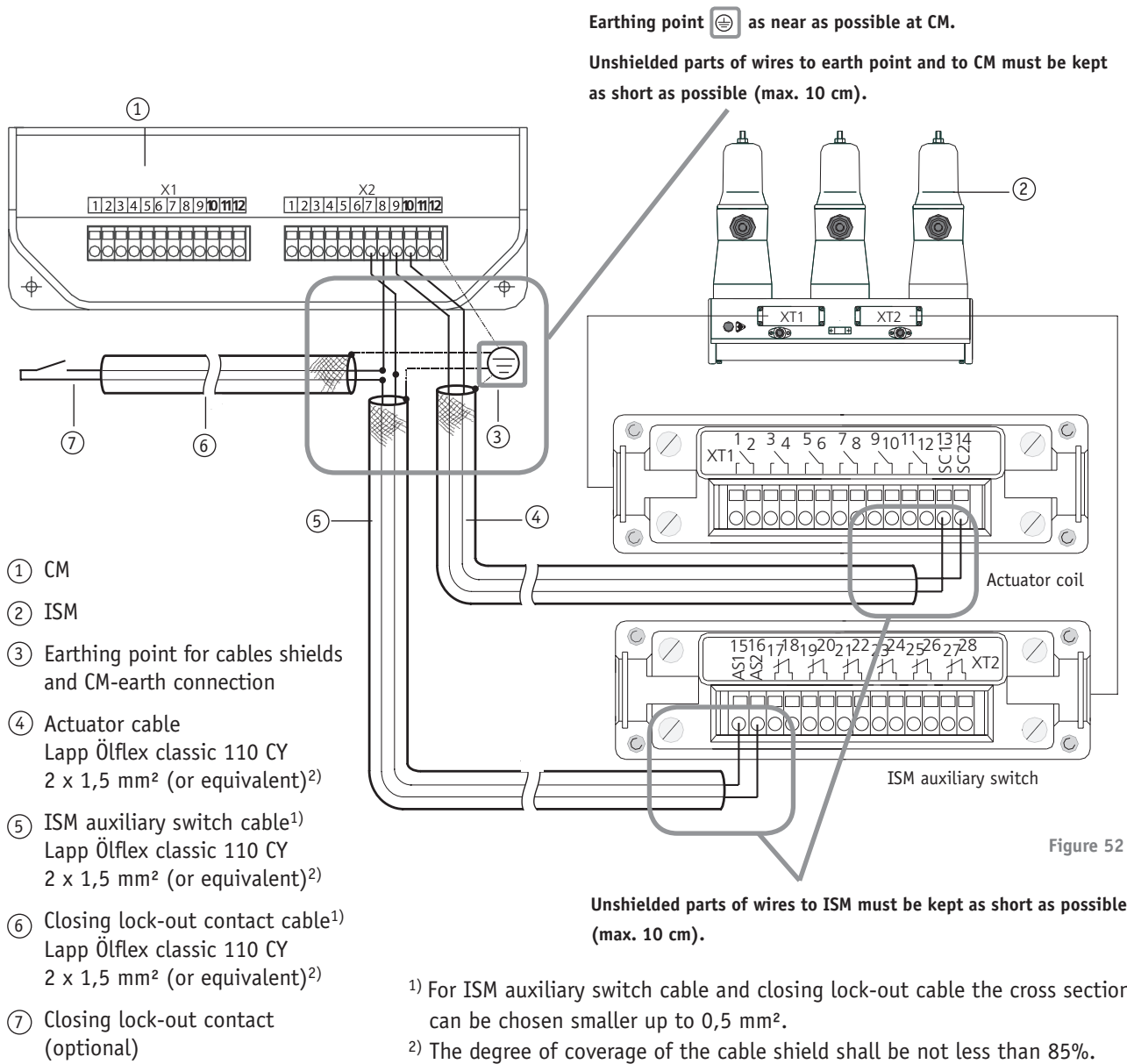


Figure 51

Draw out type installation

Installation of secondary cables between ISM and CM

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



The cables are fixed with a special screwdriver supplied with every ISM and CM (Figure 53). 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.

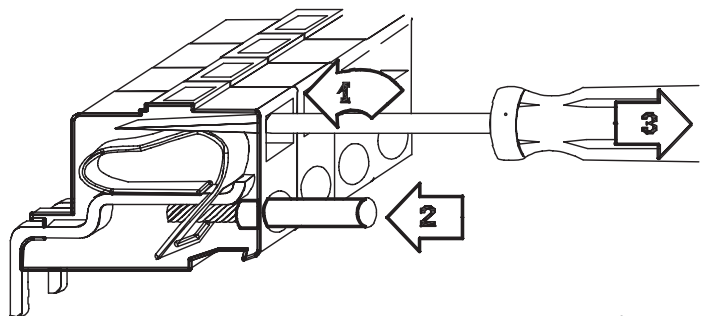


Figure 53

CM auxiliary power supply

To ensure the functionality of the CM, it is recommended to connect the CM to the same auxiliary power supply like the protection relays and control devices. The CM/TEL ...-12-03A can optionally be operated by a 12-30 V DC emergency power supply or by current transformer power supply.

Auxiliary power supply and selection of MCB for CM/TEL...-12-01A, -02A, -03A, CM/TEL...-14-01 (Figure 54)

Technical data of the MCB:

24 V DC :	4A, 1-pole, characteristic B or C
60 V DC :	2A, 2-pole, characteristic B or C
100/220 V AC :	1A, 2-pole, characteristic B or C
100/220 V DC :	1A, 2-pole, characteristic B or C



If the CM is connected with DC voltage please pay attention to the correct polarity.

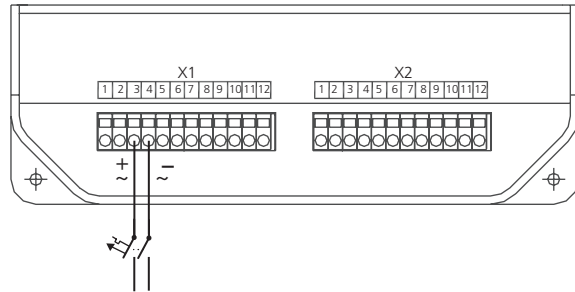


Figure 54

Auxiliary power supply for CM/TEL...-12-01A

Emergency power supply and protection of the CM/TEL...-12--03A (Figure 55)

Technical data of the MCB:

30 V DC: 4A, 1-pole characteristic B or C

The CM/TEL...-12-03A can be operated simultaneously with the operating and the emergency voltage. The functions of the CM are limited if it is operated with emergency power supply only.

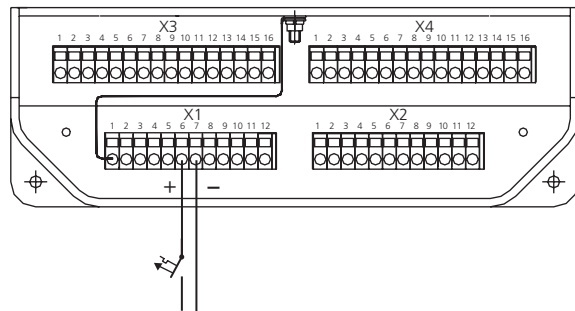


Figure 55

Emergency power supply

Current transformer power supply for CM/TEL...-12-03A (Figure 56)

Current transformer power supply is recommended when the protection relays are also supplied with current transformer power supply. The CM functions are limited when operating with current transformer power supply.

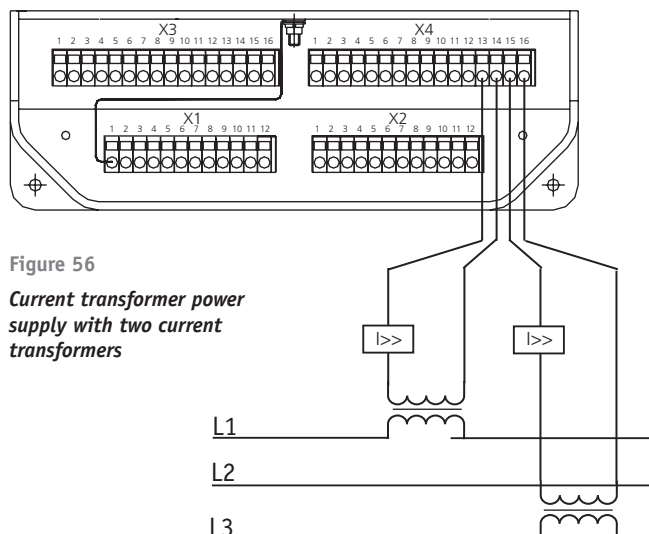


Figure 56

Current transformer power supply with two current transformers

Auxiliary cables for CM and ISM

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

Interference suppressing filters (optional)

Interference suppressing filters F/TEL-03 and F/TEL-04 shall be installed when CM works under severe electromagnetic conditions and the surge level is higher than the one specified in chapter „Technical data“ page 74.

Recommendation for application of F/TEL-03 and F/TEL-04 in following cases:

Type of load	Rated voltage		
	6 kV	12 kV	up to 24 kV
Motor starting from 500 kVA	-	-	F/TEL-03, F/TEL-04
Generator starting from 500 kVA	-	-	F/TEL-03, F/TEL-04
Transformers loaded with motors starting from 500 kVA	F/TEL-03, F/TEL-04	F/TEL-03, F/TEL-04	F/TEL-03, F/TEL-04
Electric arc furnace up to 2000 kVA	-	-	F/TEL-03, F/TEL-04
Electric arc furnace starting from 2000 kVA	-	F/TEL-03, F/TEL-04	F/TEL-03, F/TEL-04
Inverter-fed drives starting from 500 kVA	F/TEL-03, F/TEL-04	F/TEL-03, F/TEL-04	F/TEL-03, F/TEL-04

The filter shall be bolted as near to the CM as possible on flat, earthed and good-conducting metal surfaces. Care must be taken that there is an electrical conducting connection between the filter housing and the metal plate. Any existing paint must be removed.

Interference suppressing filters F/TEL-03 and F/TEL-04 for CM/TEL....-12-01A, -02A, -03A

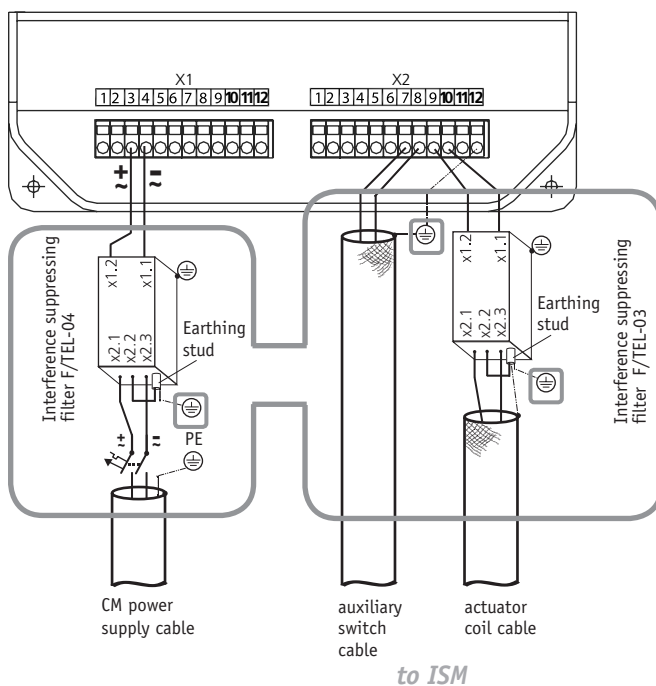
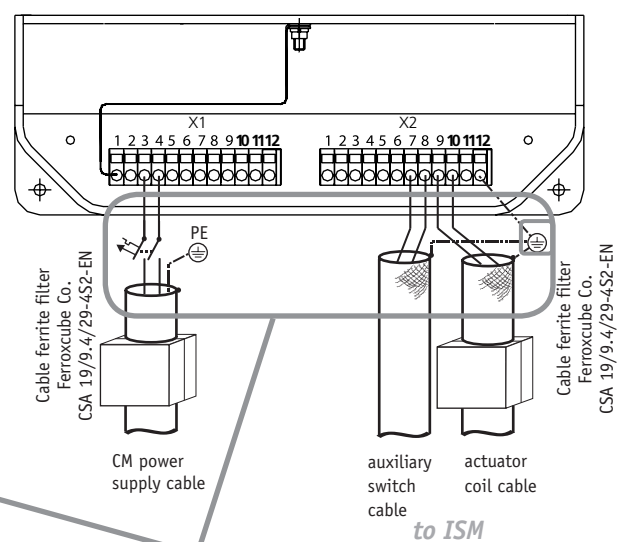


Figure 57

Cable ferrite filters for CM/TEL....-14-01 (in scope of supply)



Earthing points  as near as possible at CM respectively at filters.

Unshielded parts of wires to earthing point, to filters and to CM must be kept as short as possible (max. 10 cm).

Figure 58

Switching and control functions

4

Basic functions for all CM

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 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 flashes continuously and Ready-relay contact X2:1,2 is closed. With blinking or extinguished Ready-LED, the Ready-relay contact X2:1,2 is open. The Ready-relay output, for instance, can be used as release condition for switch 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 chapter: "Signalling"). At the same time the Malfunction-relay contact X2:4,5 will close. In this way a collective CM-Malfunction can be transmitted to an alarm or SCADA system. In case of malfunction the Ready-LED is extinguished and the Ready-relay contact X2:1,2 is opened. The Malfunction-relay contact X2:4,5 is closed, if CM is powered off.

Switching the ISM on and off via the dry contact inputs of the CM



The ISM can only be switched on electrically via the CM. Dry contact inputs are available at 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)

Close conditions for the ISM, for instance:

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

can be carried out according to the three following variants.

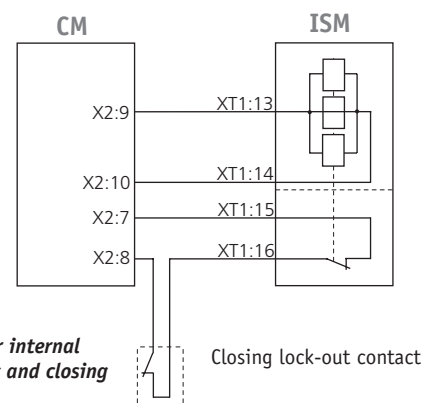


Figure 59

Circuit diagram for internal electrical interlock and closing lock-out

Variant 1 - In the CM close command circuit (e.g. use of the dry contact input X1:9, X1:10)

Variant 2 - In the ISM auxiliary switch circuit (between CM/X2:8 and ISM/XT1:16), Figure 59

Variant 3 - In the close command circuit (e.g. use of the dry contact input X1:9, X1:10) and in the ISM position switch circuit (between CM/X2:8 and ISM/XT1:16)

If despite effective electrical closing lock-out a close attempt is made, the Malfunction LED will blink 2 times (see malfunction indication table, page 49). The reason for the malfunction must be eliminated to abolish the electrical closing lock-out and to activate the close readiness.

ISM forced trip by an undervoltage relay

In case the ISM shall trip because the auxiliary power supply voltage drops below the minimum value an additional undervoltage relay is requested (not part of the scope of supply). The trip contact of the undervoltage relay shall be integrated into the dry contact trip command circuit. If the CM was ready for operation before the voltage dropped below the minimum value, tripping of the ISM is possible within 30 s (5 s with CM/TEL ...14-01) after the voltage dropped below the minimum level (Figure 60).

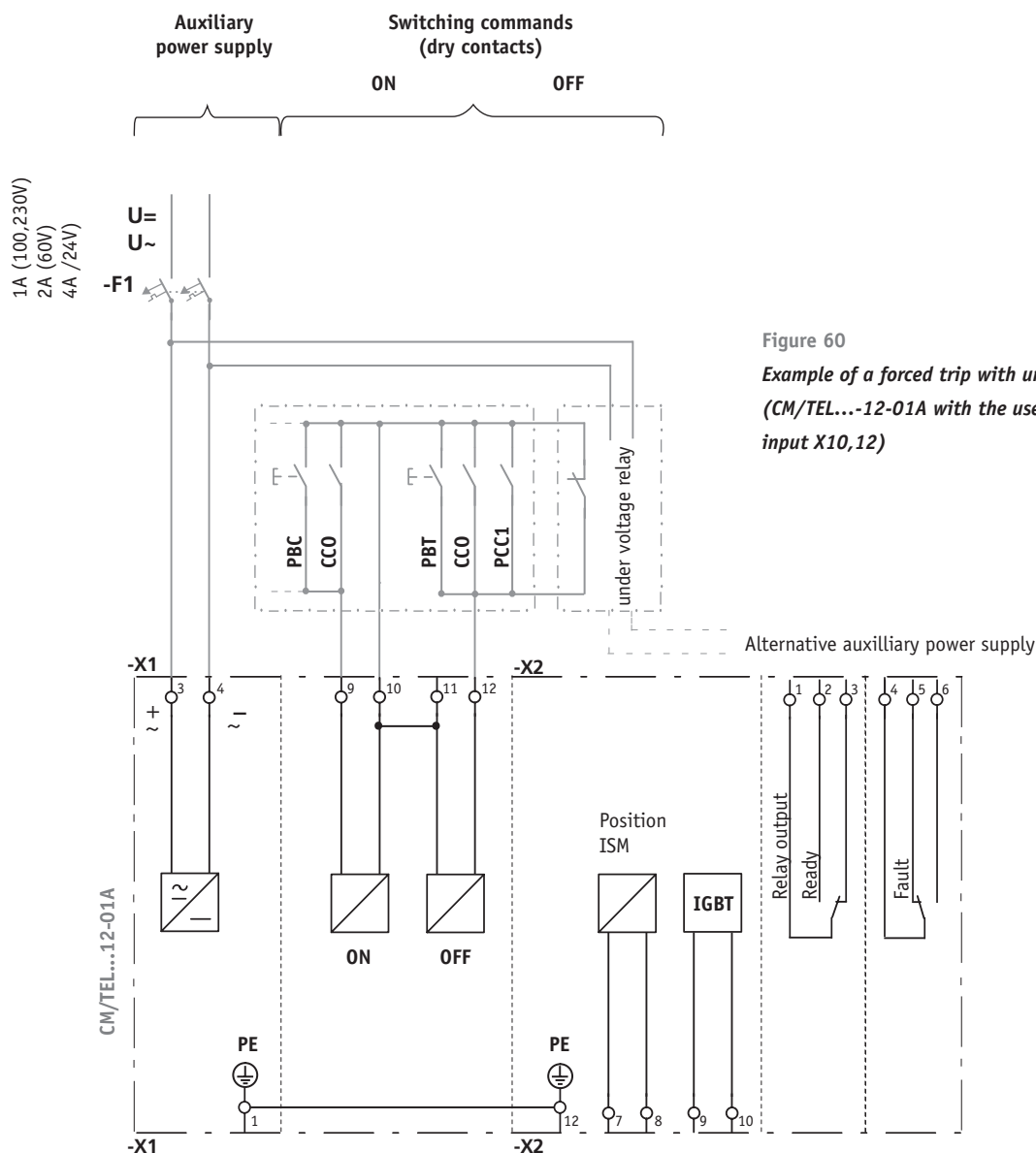


Figure 60

Example of a forced trip with undervoltage relays
(CM/TEL...-12-01A with the use of the dry contact
input X10,12)

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 61).

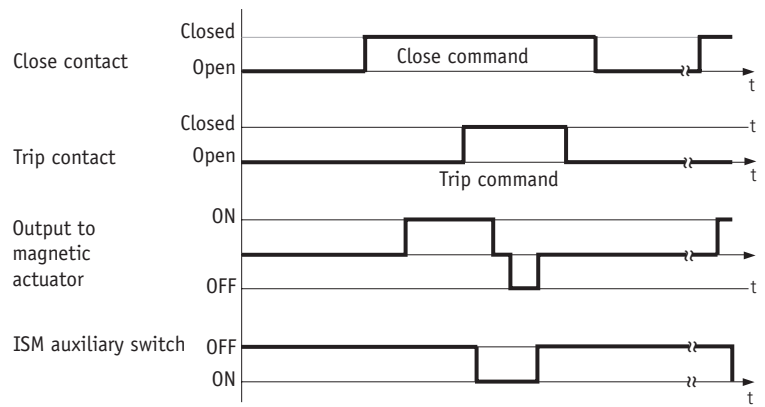


Figure 61

4

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 62).

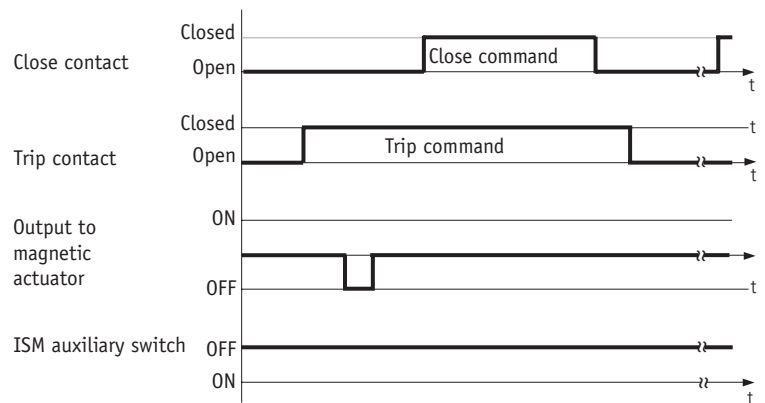


Figure 62

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 63).

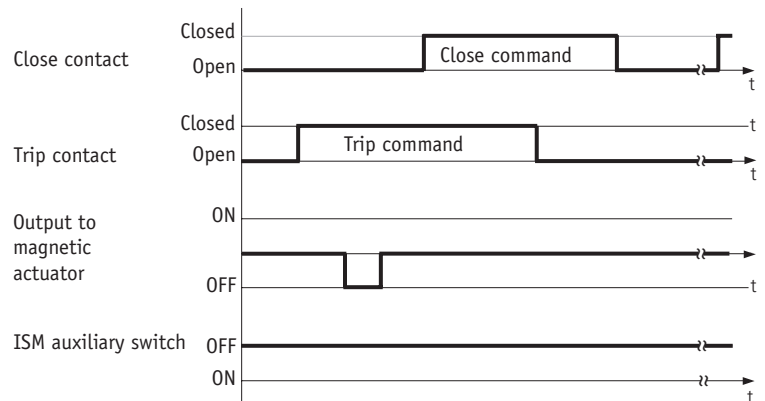


Figure 63

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 49). Internally at the inputs X2:7,8 of the CM 230 V DC is applied for the ISM auxiliary switch S13.

Wipe signal outputs (CM/TEL...-12-02A)

The CM X3 : 12,13 NO relay output closes 25 ± 5 ms after the ISM open operation and opens again after additional 50 ± 5 ms (trip wipe contact). The CM X4 : 1,2 NO relay output closes 25 ± 5 ms after the ISM close operation and opens again after additional 50 ± 5 ms (close wipe contact).

Operation with emergency power supply (CM/TEL...-12-03A)

In case only the emergency power supply voltage is applied to the CM/TEL ...12-03A all basic functions are available (dry contact inputs, actuator coil output, optional electrical closing lock-out, Ready output and Malfunction output).

The rated switching sequence 0 - 0,3 s - CO - 15 s - CO cannot be executed but the following sequence:

CO - max 40 s - CO - max 40 s - CO - max 40 s - CO - max 40 s - CO
11 min pause
CO - max 40 s - CO - max 40 s - CO - max 40 s - CO - max 40 s - CO
11 min pause
etc.



Commissioning, operation, maintenance

5

General

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



**Caution
Danger!**

Insofar as installation, commissioning or retrofit is carried out on energized equipment, the relevant safety regulations must be adhered to (e.g. the 5 safety rules to DIN VDE 0105/078.3 Part 1 Point 9).

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:

- For 12 kV ISM the rated power frequency test voltage is 28 kV (42 kV according to the Chinese Standard GB 1984-2003)
- For 24 kV ISM the rated power frequency test voltage is 50 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, to the earthing stud of filter F/TEL-03.
- Checking whether the CM, ISM and the optional filters 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 15 s (90 s for CM/TEL...-14-01) after switching on.
 - The READY relay contact (X2:1,2) must close within 15 s (90 s for CM/TEL...-14-01).
 - 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 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, Ambient conditions”, page 78) 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 87.



Signalling

6

LED indicators and dry contacts

Functionality	Results	LED indicators				Dry contacts			
		CM/TEL...-12 -01A -02A -03A			CM/TEL...-14 -01	CM/TEL...-12 -01A -02A -03A			CM/TEL...-14 -01
Switch on auxiliary power supply	Power supply On	•	•	•	•				
Switch on emergency power supply	Emergency power supply On			•					
CM is ready to carry-out control commands	Operational readiness	•	•	•	•	•	•	•	•
ISM close operation	Wipe contact close operation						•		
ISM trip operation	Wipe contact trip operation						•		
Unsupervised ISM trip operation	Emergency signalling contacts							•	
Malfunction CM or ISM	Malfunction	•	•	•	•	•	•	•	•

6

LED indicators are situated at the front side of the CM (Figures 64, 65).



Figure 64
Operating and malfunction indications for CM/TEL...-12-01A



Figure 65
Operating and malfunction indications for CM/TEL...-12-03A

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 min for CM/TEL...-12 series, about 10 min for CM/TEL...-14-01)	The power supply has failed for >1.5 s (> 3.5 s for CM/TEL...-14-01) or has been out-side the operating range.	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 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).	- 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.

Product line

7

Indoor switching modules (ISM)

Type	Rated voltage	Rated short-circuit breaking current	Rated current	Standard ISM		High frequency ISM	Continuous busbar ISM	Single phase ISM	ISM for British Retrofit
Indoor switching module	kV	kA	A	p=150 mm	p=210 mm	p=210 mm	p=210 mm		p=133 mm
ISM/TEL	12	16	630	...-067	...-055	...-055F	...-086	...-089	...-026
			800	...-067	...-055	...-055F	...-086	...-089	
			1000	...-067	...-055			...-089	
		20	630	...-067	...-055	...055F	...-086	...-089	...-026
			800	...-067	...-055	...-055F	...-086	...-089	
			1000	...-067	...-055			...-089	
		25	630	...-066	...-081				
			800	...-066	...-081				
			1250	...-066	...-081				
			1600	...-066	...-081				
		31,5	630	...-066	...-081				
			800	...-066	...-081				
			1250	...-066	...-081				
			1600	...-066	...-081				

Type	Rated voltage	Rated short-circuit breaking current	Rated current	Standard ISM		For SF6 application	Continuous busbar ISM	Single phase ISM
Indoor switching module	kV	kA	A	p=210 mm	p=275 mm	p=150 mm	p=275 mm	
ISM/TEL	24	16	630	...-057	...-058	...-085	...-087	...-053
			800	...-057	...-058	...-085	...-087	...-053

Example for complete type description of an ISM:

Indoor switching
module version

Type description

Vacuum circuit breaker

ISM/TEL

Rated voltage 12 kV

12-

Rated short-circuit breaking current 20 kA

20/

Rated current 630 A

630-

ISM with 210 mm PCD

055

Complete type description

ISM/TEL 12-20/630-055

Control modules (CM)

Type	Rated power supply	Type series	Design 1	Design 2	Design 3
Control Module			Basic equipment	Basic equipment, additional supervised close / trip circuits, wipe signals	Basic equipment, additional supervised close / trip circuits, emergency power supply, current transformer power supply
CM/TEL	24/60 V DC	12	...-01A	...-02A	...-03A
	100/220 V AC/DC	12	...-01A	...-02A	...-03A
	24/60 V DC	14	...-01		
	100/220 V AC/DC	14	...-01		

Example of the complete type description of a CM:

Control module version	Type description
Control unit	CM/TEL
Rated power supply	100/220-
Type series	12-
Model	02A
Complete type description	CM/TEL 100/220-12-02A

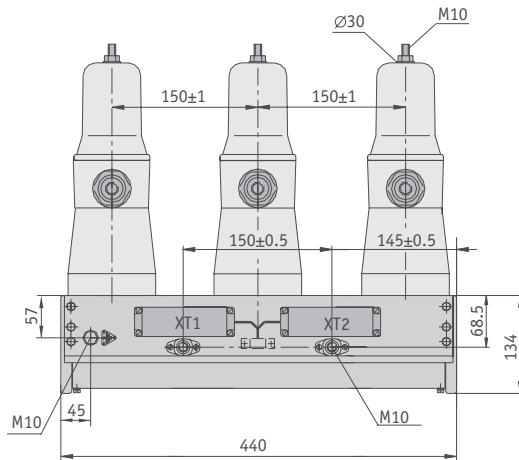


Dimensions and weights

8

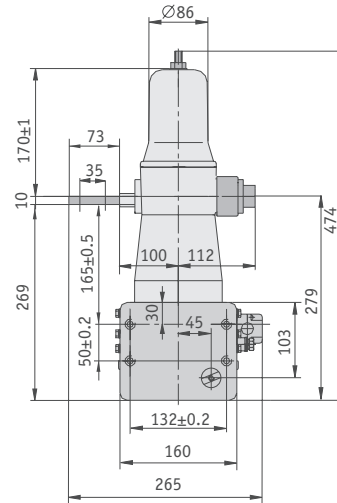
Dimensions and weights of ISM

Dimensions and weights of the three-phase ISM

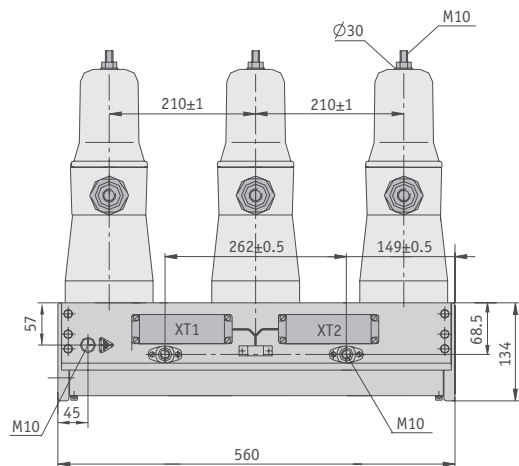


12 kV VCB,
PCD 150 mm
Weight: 34 kg

ISM/TEL 12-20/1000-067
ISM/TEL 12-20/800-067
ISM/TEL 12-20/630-067
ISM/TEL 12-16/1000-067
ISM/TEL 12-16/800-067
ISM/TEL 12-16/630-067

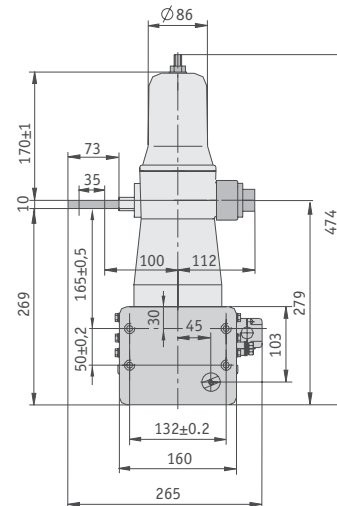


24 kV SF6 - VCB,
PCD 150 mm
ISM/TEL 24-16/800-085
ISM/TEL 24-16/630-085

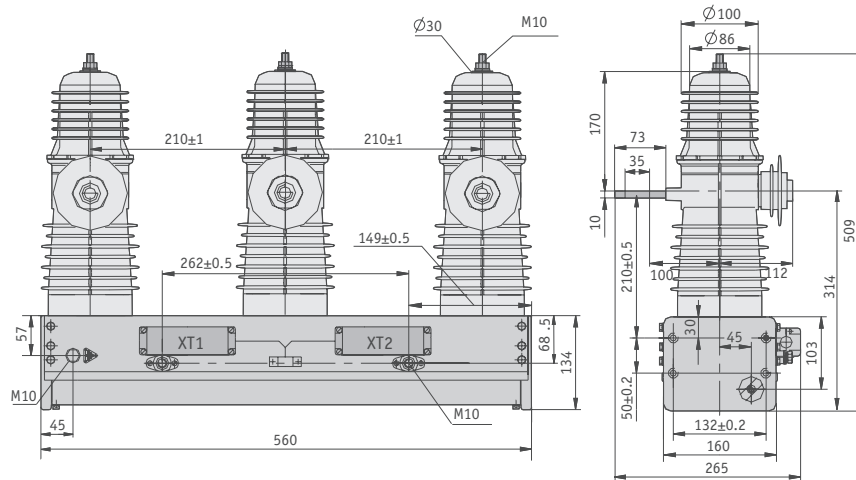


12 kV VCB,
PCD 210 mm
Weight: 36 kg

ISM/TEL 12-20/1000-055
ISM/TEL 12-20/800-055
ISM/TEL 12-20/630-055
ISM/TEL 12-16/1000-055
ISM/TEL 12-16/800-055
ISM/TEL 12-16/630-055



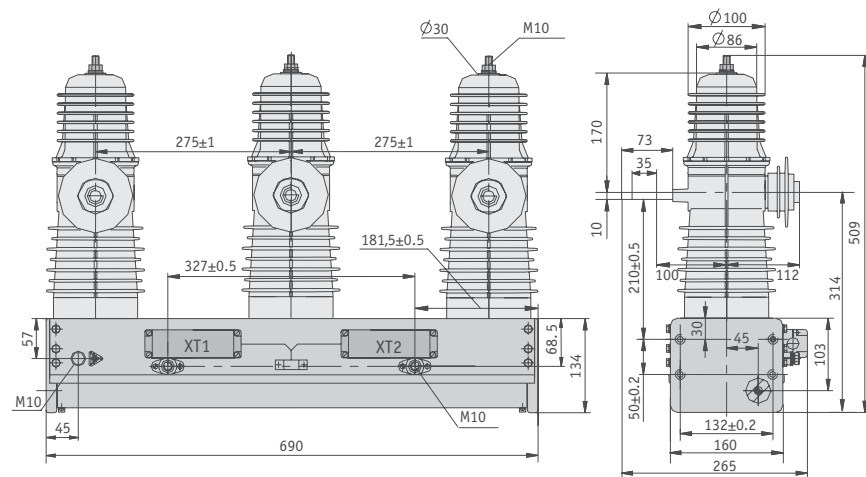
12 kV high frequency-VCB,
PCD 210 mm
Weight: 36 kg
ISM/TEL 12-20/1000-055F
ISM/TEL 12-20/800-055F
ISM/TEL 12-20/630-055F
ISM/TEL 12-16/1000-055F
ISM/TEL 12-16/800-055F
ISM/TEL 12-16/630-055F



24 kV VCB, PCD 210 mm
Weight: 36 kg

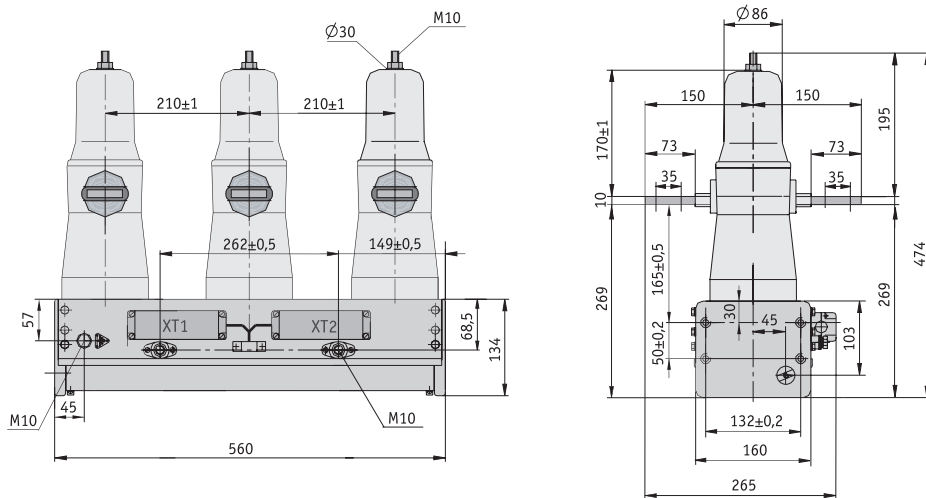
ISM/TEL 24-16/800-057
ISM/TEL 24-16/630-057

8



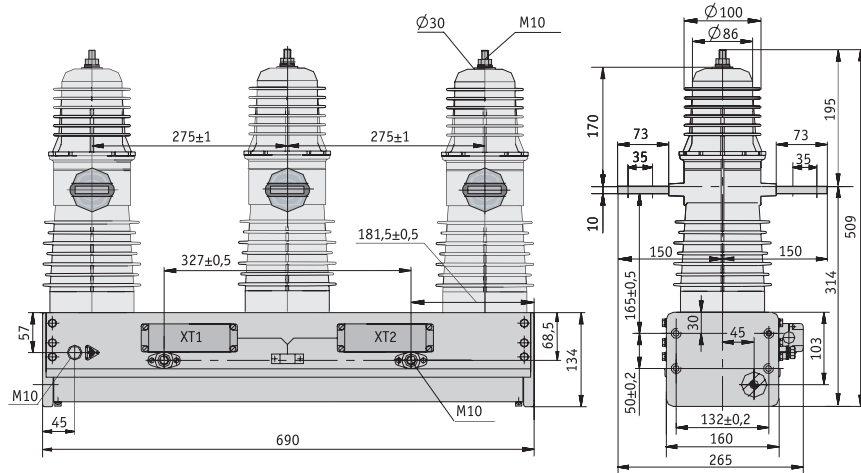
24 kV VCB, PCD 275 mm
Weight: 38 kg

ISM/TEL 24-16/800-058
ISM/TEL 24-16/630-058



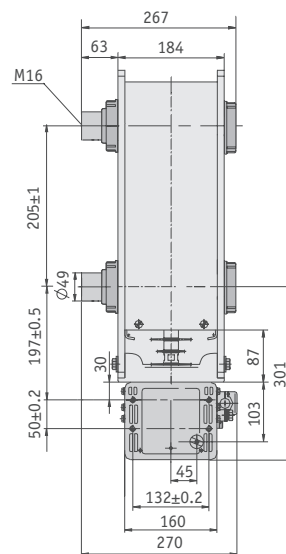
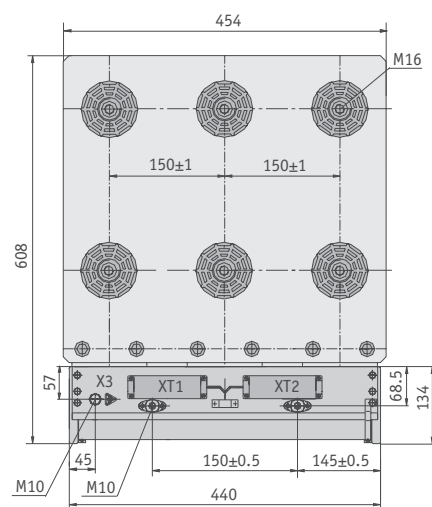
**12 kV VCB, continuous busbar,
PCD 210 mm**

Weight: 37 kg ISM/TEL 12-20/800-086
ISM/TEL 12-20/630-086
ISM/TEL 12-16/800-086
ISM/TEL 12-16/630-086



**12 kV VCB, continuous busbar,
PCD 275 mm**

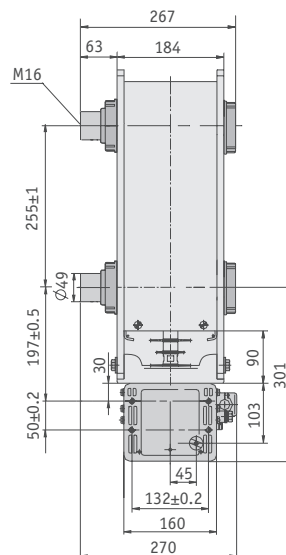
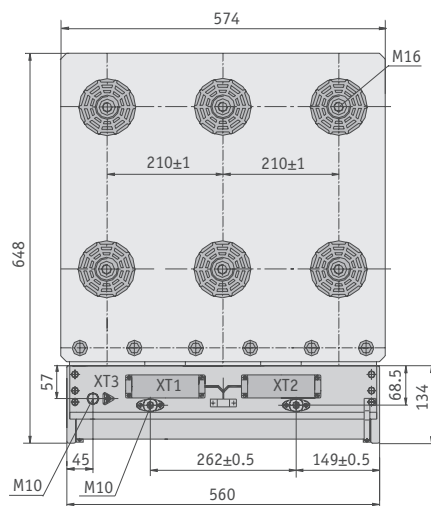
Weight: 39 kg ISM/TEL 24-16/800-087
ISM/TEL 24-16/630-087



12 kV VCB, PCD 150 mm
Weight: 60 kg

ISM/TEL 12-31,5/1600-066
ISM/TEL 12-31,5/1250-066
ISM/TEL 12-31,5/ 800-066
ISM/TEL 12-31,5/ 630-066

ISM/TEL 12-25/1600-066
ISM/TEL 12-25/1250-066
ISM/TEL 12-25/ 800-066
ISM/TEL 12-25/ 630-066

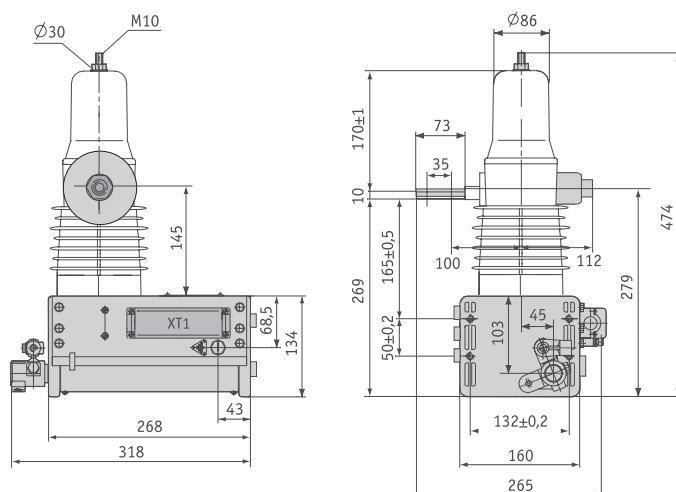


12 kV VCB, PCD 210 mm
Weight: 66 kg

ISM/TEL 12-31,5/1600-081
ISM/TEL 12-31,5/1250-081
ISM/TEL 12-31,5/ 800-081
ISM/TEL 12-31,5/ 630-081

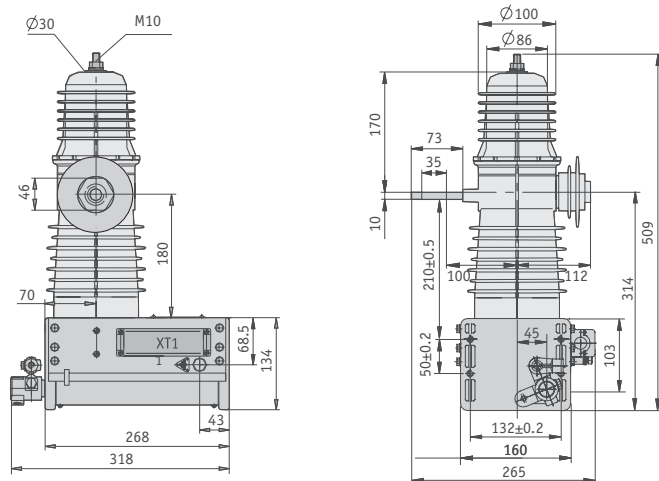
ISM/TEL 12-25/1600-081
ISM/TEL 12-25/1250-081
ISM/TEL 12-25/ 800-081
ISM/TEL 12-25/ 630-081

Dimensions and weights of the single-phase ISM



12 kV single-phase VCB,
Weight: 13 kg

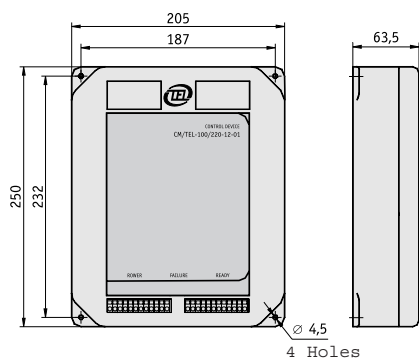
ISM/TEL 12-20/1000-089
ISM/TEL 12-20/800-089
ISM/TEL 12-20/630-089
ISM/TEL 12-16/1000-089
ISM/TEL 12-16/800-089
ISM/TEL 12-16/630-089



24 kV single-phase VCB,
Weight: 14 kg

ISM/TEL 24-16/800-053
ISM/TEL 24-16/630-053

Dimensions and weights of the CM

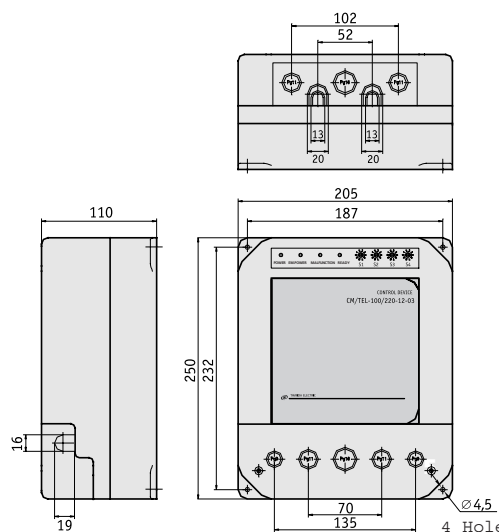


CM/TEL...-12-01A

Weight: 1.8 kg

CM/TEL 24/60-12-01A

CM/TEL 100/220-12-01A



CM/TEL...-12-02A

Weight: 2.8 kg

CM/TEL 24/60-12-02A

CM/TEL 100/220-12-02A

CM/TEL...-12-03A

Weight: 3.2 kg

CM/TEL 24/60-12-03A

CM/TEL 100/220-12-03A

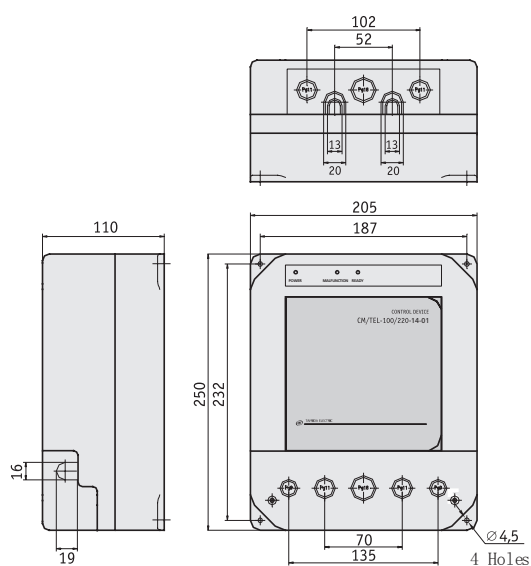
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CM/TEL...-14-01

Weight: 3 kg

CM/TEL 24/60-14-01

CM/TEL 100/220-14-01



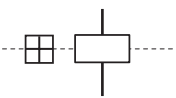


Circuit diagrams

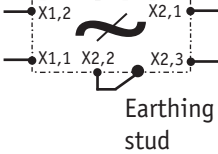
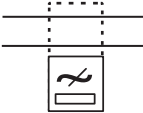
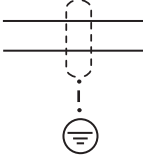
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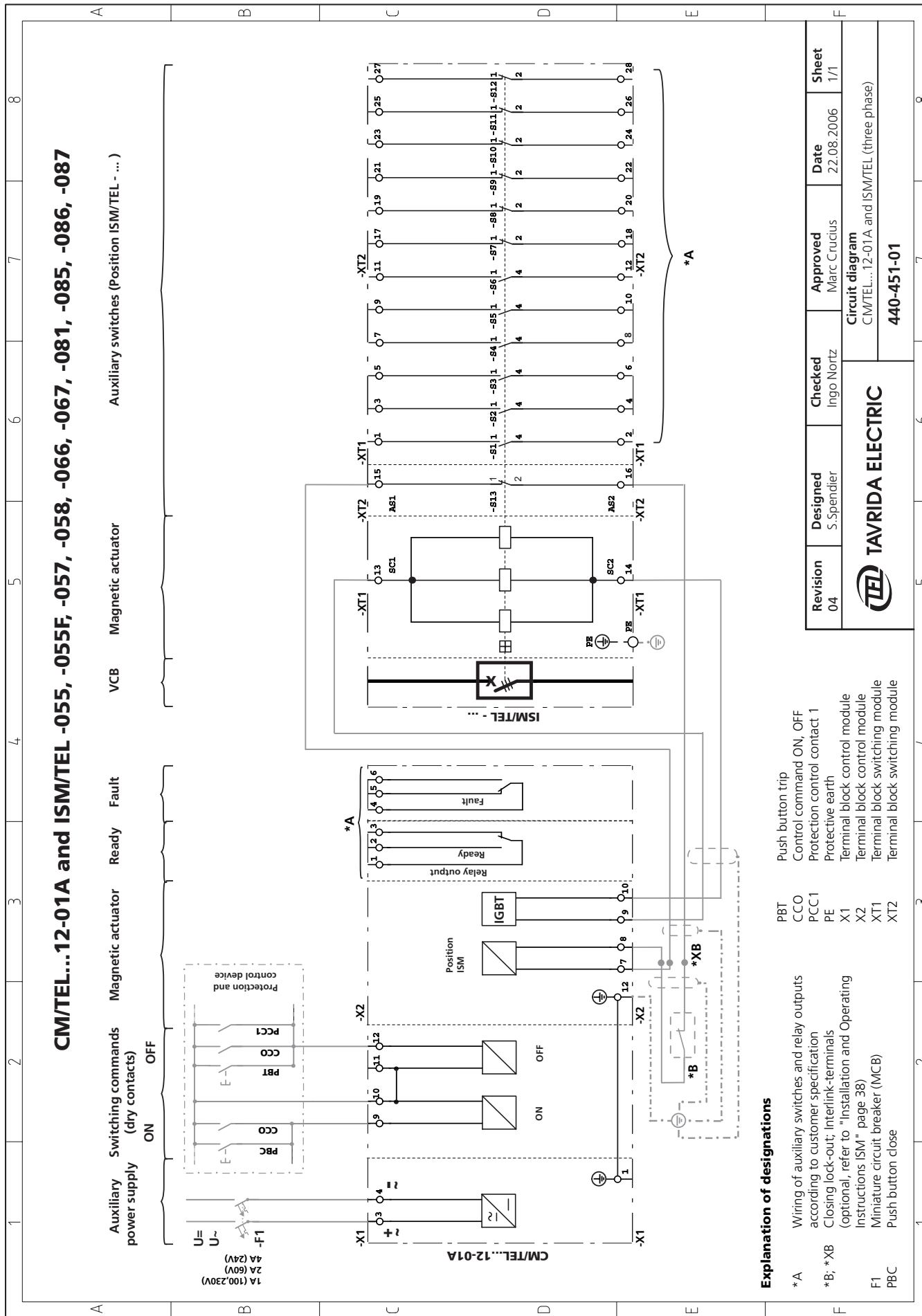
Explanation of the switching symbols used

ISM, CM

	VCB, three phase
	VCB, single phase
	Magnetic actuator coil with mechanical coupling to the VCB
	Auxiliary power supply unit / inverter
	IGBT transistor bridge
	Signal converter
	Normally open contact (NO)
	Normally closed contact (NC)
	Change-over contact

External devices

	MCB
	Push button with closing contact
	Interference suppressing filter F/TEL-03, F/TEL-04
	Ferrite filter
	Shielded cable
	Earthing point



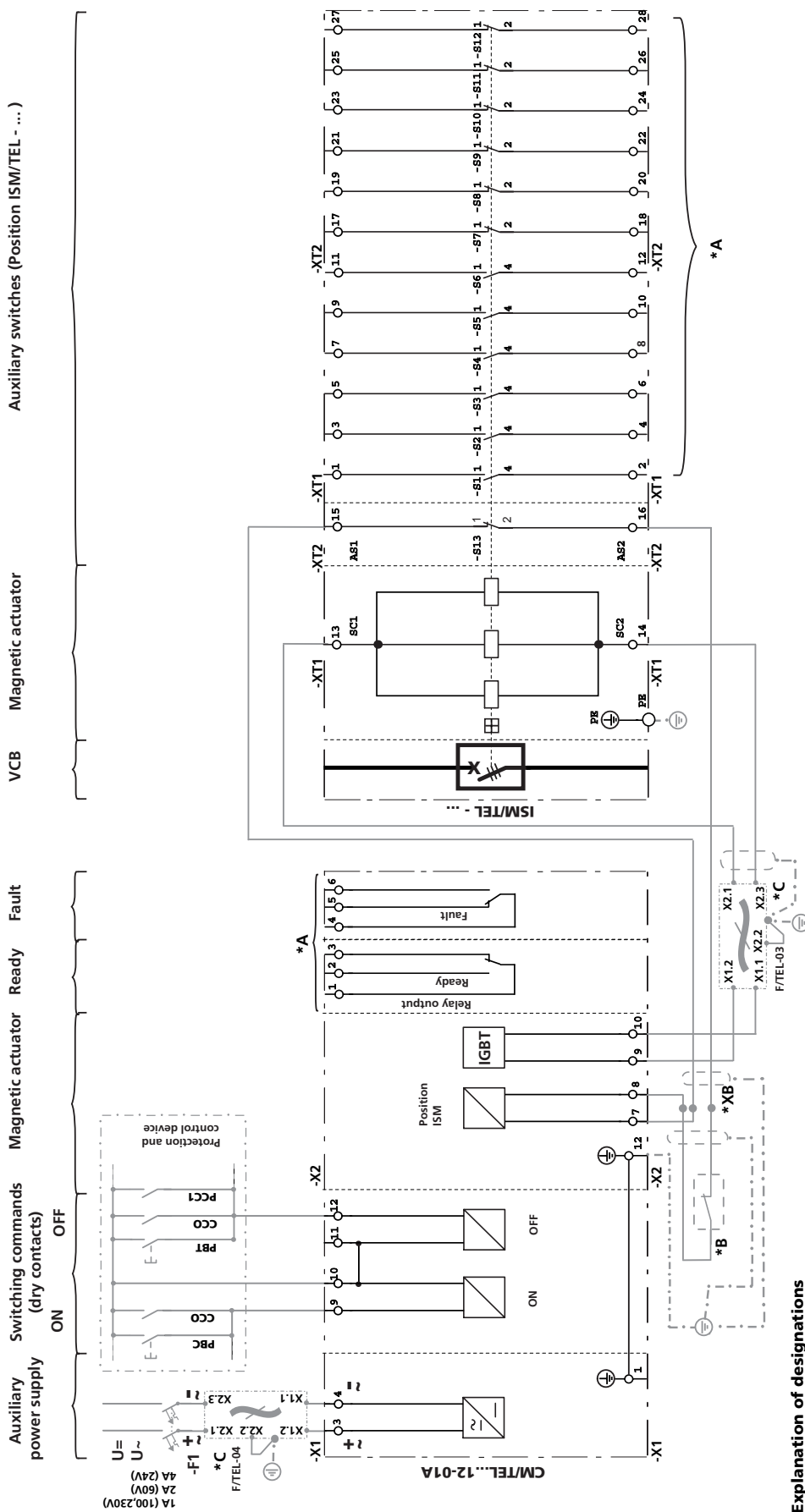
Explanation of designations

- *A Wiring of auxiliary switches and relay outputs according to customer specification
- *B; *XB Closing lock-out; Interlink-terminals (optional, refer to "Installation and Operating Instructions ISM" page 38)
- F1 Miniature circuit breaker (MCB)
- PBC Push button close
- PBT Push button trip
- CCO Control command ON, OFF
- PCC1 Protection control contact 1
- PE Protective earth
- X1 Terminal block control module
- X2 Terminal block control module
- XT1 Terminal block switching module
- XT2 Terminal block switching module

Revision	Designed	Checked	Approved	Date	Sheet
04	S.Spindler	Ingo Nortz	Marc Crusius	22.08.2006	1/1

TAVRIDA ELECTRIC			Circuit diagram		
			CM/TEL...12-01A and ISM/TEL (three phase)		
			440-451-01		

CM/TEL...12-01A with filter and ISM/TEL -055, -057, -058, -066, -067, -081, -085, -086, -087



Explanation of designations

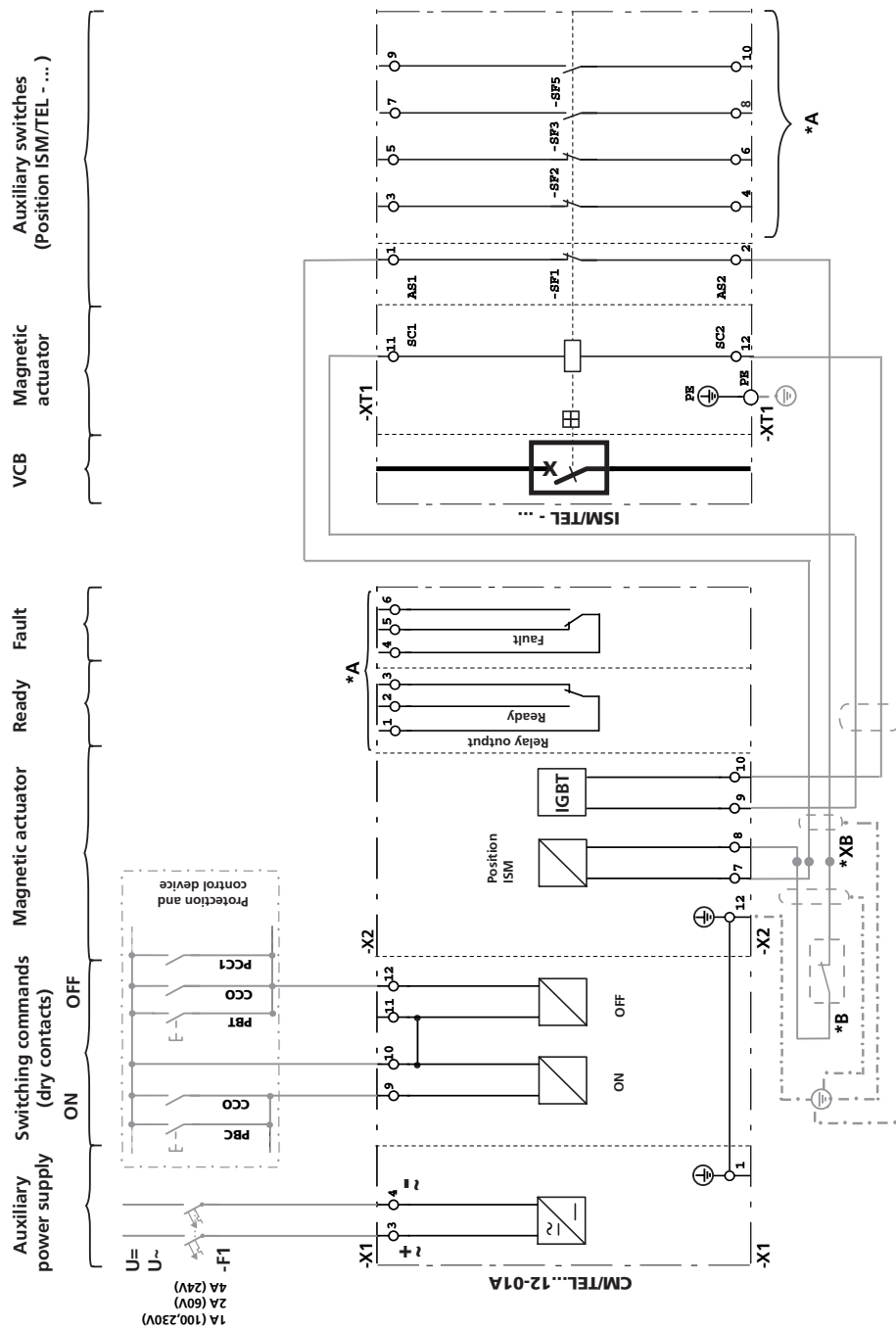
- *A Wiring of auxiliary switches and relay outputs according to customer specification
- *B, *XB Closing lock-out; Interlink-terminals (optional, refer to "Installation and Operating Instructions ISM" page 38)
- *C Filter (optional, refer to "Installation and Operating Instructions ISM" page 36)
- F1 Miniature circuit breaker (MCB)
- PBT, PBC Push button trip; Push button close
- CCO Control command ON, OFF
- PCC1 Protection control contact 1
- PE Protective earth
- X1 Terminal block control module
- X2 Terminal block control module
- XT1 Terminal block switching module
- XT2 Terminal block switching module

Revision	Designed	Checked	Approved	Date	Sheet
04	S.Spender	Ingo Nortz	Marc Crusius	22.08.2006	1/1
Circuit diagram					
CM/TEL...12-01A with filter and ISM/TEL (three phase)					
440-451-01a					



TAVRIDA ELECTRIC

CM/TEL...12-01A and ISM/TEL -053, -089



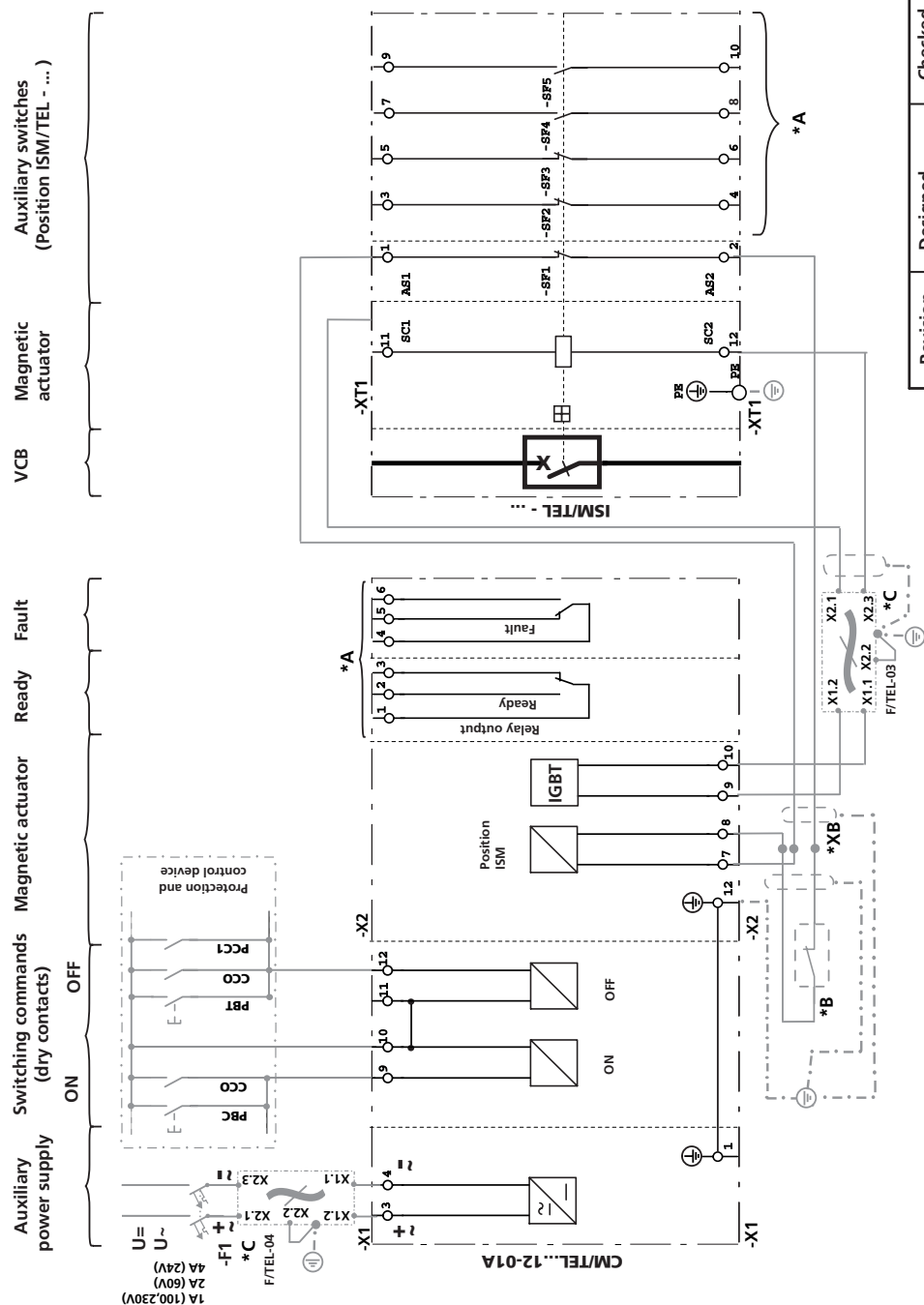
Revision	Designed	Checked	Approved	Date	Sheet
04	S.Spendier	Ingo Nortz	Marc Cruci	22.08.2006	1/1

TEL TAVRIDA ELECTRIC

Circuit diagram
CM/TEL...12-01A and ISM/TEL (single phase)

440-451-04

CM/TEL...12-01A with filter and ISM/TEL -053, -089



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04	S.Spindler	Ingo Nortz	Marc Crucius	22.08.2006	1/1

Circuit diagram
CM/TEL...12-01A with filter and ISM/TEL (single phase)
440-451-04a



CM/TEL...14-01 with filter and ISM/TEL -055, -057, -058, -066, -067, -081, -085, -086, -087

Auxiliary switches (Position ISM/TEL - ...)

VCB Magnetic actuator

Ready Fault

Magnetic actuator

Auxiliary Switching commands (dry contacts)

ON OFF

CSA 19/9/4/29-452-EN
FERROXCUBE

1A (100,230V)

4A (24V)

2A (60V)

U_~ U_~

-F1

-X1

12

11

10

9

8

7

6

5

4

3

2

1

0

-X2

12

11

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-X1

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7

6

5

4

3

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0

-X2

12

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-X1

12

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-X2

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-X1

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-X2

12

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9

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5

4

3

2

1

0

-X1

12

11

10

9

8

7

6

5

4

3

2

1

0

-X2

12

11

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-X1

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-X1

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-X1

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Technical data

10

Indoor switching modules (ISM)

Type	...-055, ...-055F, ...-067, ...-086, ...-089	...-066, ...-081	...-053, ...-057, ...-058, ...-085, ...-087
Rated data			
Rated voltage (Ur)	12 kV	12 kV	24 kV
Rated current (Ir)	to 1000 A	to 1600 A	to 800 A
Rated power frequency withstand voltage (Ud)	28 (42) ¹⁾ kV	28 (42) ¹⁾ kV	50kV
Rated lightning impulse withstand voltage (peak) (Up)	75 kV	75 kV	125 kV
Rated short-circuit breaking current (ISC)	to 20 kA ⁶⁾	to 31,5 kA ⁶⁾	to 16 kA ⁶⁾
Rated peak withstand current (Ip)	to 50 kA	to 80 kA	to 40 kA
Rated short-time withstand current (Ik)	to 20 kA	to 31,5 kA	to 16 kA
Rated duration of short circuit (tk)	3 (4) ¹⁾ s	3 (4) ¹⁾ s	3 s
Rated frequency (fr)	50/60 Hz		
Switching performance			
Mechanical life ⁵⁾ (CO-cycles)	50 000 ²⁾	30 000	
Operating cycles ⁵⁾ , rated current (CO-cycles)	50 000 ²⁾	30 000	
Maximum number of CO-cycles per hour	refer to CM		
Operating cycles ⁵⁾ , rated-short circuit breaking current	100	30	100
Closing time ³⁾ , not more than	77 ms		
Opening time ³⁾ , not more than	32 ms		
Break time ³⁾ , not more than	42 ms	37 ms	42 ms
Rated operating sequence (CM/TEL...-12-01A,-02A,-03A)	0-0.3s-CO-15s-CO		
Rated operating sequence (CM/TEL...-14-01)	0-0.1s-CO-1s-CO-1s-CO		
Standards			
Design class with regard to severity of service conditions in accordance with IEC 932	Class 1	Class 1	Class 0
Standards	IEC 62271-100 GB 1984-2003	IEC 62271-100 GB 1984-2003	IEC 62271-100
Mechanical vibration withstand capability according to IEC 721-3-4	Class 4M4		
Other data			
Resistance of main circuit	< 40 μ0hm	< 30 μ0hm	< 40 μ0hm
Weight (depending on PCD) for three-phase ISM	34, 36, 37 kg	60, 66 kg	33, 36, 38, 39 kg
Weight for single phase ISM	13 kg		14 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		
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, cosφ =0,3)	100 mA		
Maximum current for 30 V DC, ohmic load	5 A ⁴⁾		
Maximum current for 30 V DC, inductive load (t=20 ms)	3 A		
Maximum current for 60 V DC, ohmic load	0.9 A		
Maximum current for 60 V DC, inductive load (t=20 ms)	0.9 A		
Maximum current for 125 V DC, ohmic load	0.5 A		
Maximum current for 125 V DC, inductive load (t=20 ms)	0.03 A		
Maximum current for 250 V DC, ohmic load	0.2 A		
Maximum current for 250 V DC, inductive load (t=20 ms)	0.03 A		
Maximum current for 125 V AC, ohmic load	5 A ⁴⁾		
Maximum current for 125 V AC, inductive load (cosφ =0,3)	5 A		
Maximum current for 250 V AC, ohmic load	5 A ⁴⁾		
Maximum current for 250 V AC, inductive load (cosφ =0,3)	5 A		

Control modules (CM)

Type	CM/TEL...-12-01A, -02A, -03A	CM/TEL...-14-01
Type of operation		
Rated operating sequence	0-0.3s-CO-15s-CO	0-0.1s-CO-1s-CO-1s-CO
Maximum CO operating cycles per hour	100	60
Auxiliary power supply 24/60		
Auxiliary power supply	24 V DC to 60 V DC	
Operating range (80-125%)	19.2 V DC to 75 V DC	
Auxiliary power supply 100/220		
Auxiliary power supply	110 V DC to 220 V DC	
Operating range (80-125%)	88 V DC to 275 V DC for close operations	
Operating range (70-125%)	77 V DC to 275 V DC for trip operations	
Auxiliary power supply	100 V AC to 220 V AC	
Operating range (80-125%)	80 V AC to 275 V AC for close operations	
Operating range (65-125%)	65 V AC to 275 V AC for trip operations	
Power consumption		
Charging the close and trip capacitors	≤50 W/70 VA	
Permanent power consumption (standby)	≤10 W/15 VA	≤5 W
Reaction times		
Preparation time for the operation of the CM after switching on the auxiliary power supply, not more than	15 s	90 s
Preparation time for the close operation of the CM after a previous close operation, at most	9 s	1 s
Preparation time for the trip operation of the CM after switching on the auxiliary power supply , not more than	0.5 s	
Trip capability after failure of the auxiliary power supply, at least	30 s	5 s
Preparation time for the close operation of CM after switching on the emergency power supply, not more than (CM/TEL...12-03A)	50 s	
Electric strength		
Power-frequency withstand voltage, 1 min (to IEC 60 255-5)	2 kV	
Lightning impulse withstand voltage, 1.2 μs/ 50 μs/ 0.5 J (according to IEC 60 255-5)	5 kV	
Insulation resistance at 1000 V DC at most 1 min at 2000 V DC (according to IEC 60 255-5)	> 5 MOhm	

Note

¹⁾ The information in brackets refer to the national Chinese standards GB 1984-2003 and refer to an installation altitude of maximum 1000 m

²⁾ ISM/TEL...-055F available with 150.000 CO cycles

³⁾ In combination with the associated CM

⁴⁾ 10 A current is permissible for 5 minutes

⁵⁾ See Figure 66 / page 76

⁶⁾ At 40% d. c. component

Type	CM/TEL...-12-01A, -02A, -03A	CM/TEL...-14-01
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Electromagnetic compatibility

Interference immunity to voltage dips short inter-ruptions 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 μ s to earth 2 kV 1,2/50 μ s 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	

Other data

Weight, CM/TEL...-12-01A	1.8 kg	
Weight, CM/TEL...-12-02A	2.8 kg	
Weight, CM/TEL...-12-03A	3.2 kg	
Weight, CM/TEL...-14-01		3.0 kg
Degree of protection	IP40	
Life cycle of CM close and trip capacitors	see Figure 67 / page 76	

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	≤ 0.12 A	
Maximum breaking alternative current at 250 V AC and $\cos\phi = 0.3$	≤ 2 A	

Inputs for dry type close and trip commands (X1: 9, 10, 11, 12)

Control command (close or trip) acceptance time	15 ± 2 ms	
CM generated voltage at the dry type inputs	≥ 30 V	
Current at the time of closing the input current circuit	≥ 100 mA	
Time constant of reducing current	≥ 10 ms	
Continuous current value	≥ 5 mA	≥ 5 mA

Type	CM/TEL...12-02A
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Wipe contact outputs (CM/TEL...-12-02A)

Close wipe contact (X4: 1, 2)

Delay time from closing the main ISM contact (opening the ISM auxiliary switch S13) up to closing the close wipe contact	25 ± 5 ms
Closing time of the close wipe contact (close wipe signal length)	50 ± 5 ms

Trip wipe contact (X3: 12, 13)

Delay time from opening the main ISM contact (closing the ISM auxiliary switch S13) up to closing to trip wipe contact	25 ± 5 ms
Closing time of the trip wipe contact (trip wipe signal length)	50 ± 5 ms

Type	CM/TEL...-12-02A, -03A
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Inputs for potential-loaded close and trip commands (X3: 1, 2, 3, 4 and X3 : 6, 7, 8, 9) and alternative potential-loaded trip command inputs (X4: 8, 9, 10, 11) as well as supervision of these switching command circuits

Voltage range (close, trip)	20.4 - 275 V AC or DC
Rated current I _N setting with external resistances and selection switches	0.5/ 1/ 1.5/ 2/ 2.5/ 3/ 4/ 5 A
Minimum trip command current	0.65 × I _N
Minimum close command current	0.8 × I _N
Maximum sustained supervision current	0,3 × I _N but not more than 0.2 A
Control command (close or trip) acceptance time	25 ± 5 ms
Input resistance in the low impedance mode	Equal to the external resistor
Input resistance in the high impedance mode, not less than	500 kOhm

Type	CM/TEL...-12-03A
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Input for supervision the trip coil (X3: 10)

Resistance in the low impedance mode	Equal to the external resistor
Resistance in the high impedance mode, not less than	500 kOhm

Reset input for emergency signalling contacts (X3: 15, 16)

Voltage range	20.4 - 275 V AC/DC
Resistance	36 ± 15% kOhm

Emergency power supply (X1: 6, 7)

Voltage range	12-30 V DC
Power consumption while charging the close capacitors for close operation	35 W
Standby power input	15 W
Preparation time for the close operation of the CM after switching on the emergency power supply, not more than	50 s

Type	CM/TEL...-12-03A
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Input for CT power supply

Operating current range	2-300 A
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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

Remarks ¹⁾ Charging times apply for charging the capacitors over both CT power supply inputs

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Life cycle of ISM

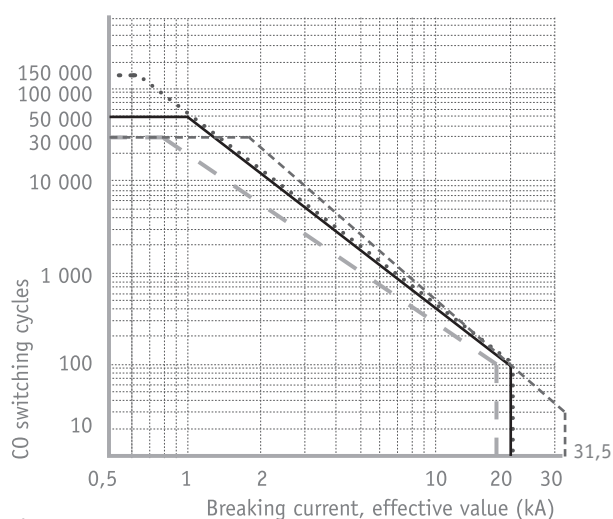


Figure 66

- Standard ISM 12 kV
- High frequency ISM 12 kV
- High duty ISM 12 kV
- - - - - Standard ISM 24 kV

Life cycle of CM close and trip capacitors

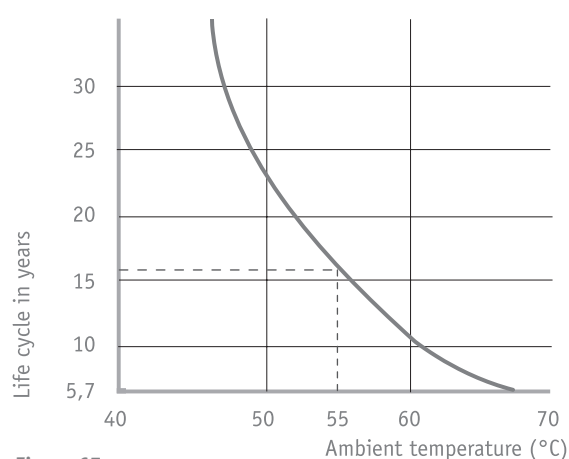


Figure 67

Regulations and ambient conditions

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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



The EMC Directive 89/336/EEC

The Low Voltage Directive 73/23/EEC.

Ambient conditions

The ISM and CM were designed for the following ambient and operating conditions for indoor installations (IEC 60 694).

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 66).

Example:

Installation altitude:	2500 m
Operating voltage:	12 kV
Rated power frequency withstand voltage:	28 kV
Rated impulse withstand voltage	75 kV
K_a 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.

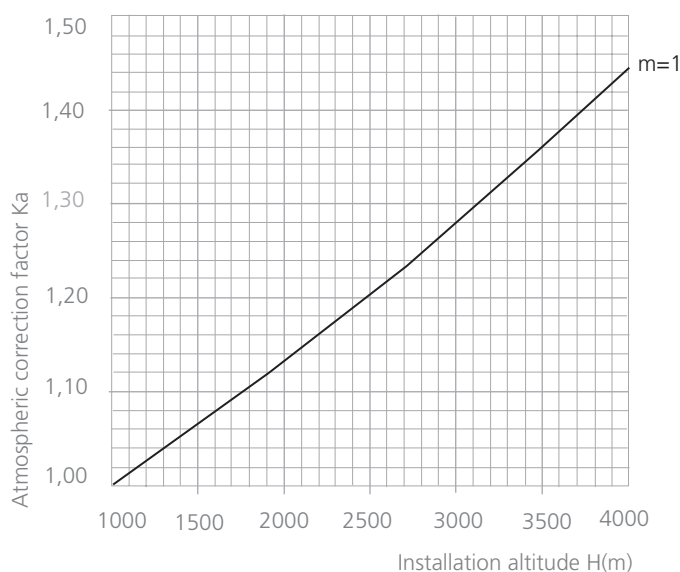


Figure 66

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.

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



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 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 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.

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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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TAVRIDA ELECTRIC AG

General Terms of Delivery

I. General

(1) Scope of Application Regarding Subject-Matter & Parties Concerned

The following terms apply to all our deliveries and services (including secondary services, such as e.g. proposals, planning aids, advice) provided to businesses as defined in German Civil Code [Bürgerliches Gesetzbuch - BGB s. 14,] legal entities under public law, and special trusts under public law. They do not apply to legal relationships with consumers as defined in German Civil Code s. 13.

(2) Exclusion of Other Terms of Business

Customer's diverging terms of business are herewith refuted, nor shall we be bound by them if we fail to expressly contradict them again on receipt. Our terms shall be deemed accepted on placement of the order, or on receipt of the confirmation of order, or at the latest on acceptance of our delivery.

(3) Validity

If any provisions are or become invalid, this shall not affect the validity of the remaining terms of these Terms of Delivery. In the event of any provision being invalid, an effective provision shall be deemed agreed such as approximates as nearly as possible that which was intended in business terms.

(4) Written

FormDivergences from the following terms, and other amendments or supplements to the order, must be confirmed by us in writing in order to become effective. This also applies to any cancellation of this requirement for written form.

II. Assignments

(1) Written Confirmation

Our quotations shall be without obligation until an assignment (order) placed on the basis of a quotation is confirmed by us in writing. Each and every assignment (order) must be confirmed by us in writing in order for acceptance to have legal effect. In the case of deliveries without any written confirmation, our invoice shall count as a confirmation of order at the same time.

(2) Essence of the Assignment

We reserve the right to make due technical and design-related changes to the goods ordered provided this does not impair or only slightly alters the goods' technical function, normal usage, and value. If any such change means that Customer may not reasonably be expected to accept delivery, then it may cancel the order. Further rights are excluded.

(3) Technical Data

The technical data given in our quotations, drawings and illustrations are approximate values, unless they have been expressly termed binding in writing and tolerance figures are given. In all other respects, the relevant technical regulations on acceptance and safety that apply in the country of origin shall apply exclusively to our deliveries.

III. Obligation to Deliver

(1) Subject to Own Deliveries

Our own obligation to deliver shall be contingent upon our being properly supplied on time with the necessary goods and materials. In the event of a permanent obstacle for reasons for which we are not responsible, in particular force majeure, strikes, lock-outs, import and export

restrictions, transport problems, intervention by government authorities and suchlike, we shall be entitled to rescind the contract on exclusion of all and any obligation to pay compensation. We shall also be entitled to rescind the contract on exclusion of all and any obligation to pay compensation if any more than insubstantial change occurs in the availability, pricing or quality of the goods delivered to us by our own suppliers or in the services provided by other third parties on which proper performance of the order placed with us largely depends.

(2) Part Deliveries, Excess & Short Deliveries

Part deliveries are permitted, and with regard to payments and complaints they shall be deemed separate independent deliveries. We are entitled to make excess or short deliveries of up to 10% of the amount ordered, insofar as Customer may be reasonably expected to accept this.

(3) Substantial Deterioration in Customer's Financial Circumstances

If, after the contract has been concluded, any substantial deterioration in Customer's financial circumstances and/or liquidity occurs, or if any such circumstances or events existing prior to conclusion of the contract subsequently become known, then we may rescind the contract or demand immediate payment in cash of all outstanding bills, at our option, even if extra time has already been allowed for all or any invoiced amounts or if such amounts have already been fully or partly paid by bill of exchange. In particular, the following shall be deemed such deterioration: a reduced credit rating by a credit reporting agency, protests involving bills of exchange and cheques, liens, suspension of payments, institution of insolvency proceedings, and the dismissal of such proceedings due to lack of assets. In the event that we do not rescind the contract in spite of a deterioration in financial circumstances, we shall deliver only in return for ongoing instalments, and in the case of bigger orders only in return for advance payment.

IV. Delivery Date

(1) General Provisions on Delivery Dates

Unless otherwise agreed, all delivery dates and periods quoted are to be understood to be approximate and non-binding. The delivery date shall be deemed reasonably extended if it cannot be met due to circumstances for which we are not responsible, whereby as a matter of principle a period of one month shall be regarded as reasonable, unless some shorter period is agreed in writing in individual cases, taking both parties' interests into account.

(2) Fixed-Date Transactions

Agreements on binding fixed dates or fixed delivery periods must be explicitly labelled fixed-date transactions and confirmed in writing. Delivery periods commence on the date of our written confirmation, but not before all the implementation details and other requirements having to be met by Customer for proper handling of the contract have been sorted out. The same applies to delivery dates.

(3) Obligation to Cooperate

Customer is under obligation to provide all the data, records and other instructions needed for performing the contract along with the placement of order or immediately thereafter. If such records and data are not received on time, Customer may not insist on delivery dates or periods being met. In any such case, the assertion of compensation for delay is excluded. The delivery date or period shall be deemed reasonably extended.

V. Passing of Risk

(1) Passing of Risk on Dispatch

The risk of the delivery's destruction or deterioration shall pass to Customer as soon as it has left the works from which it is being dispatched. This shall also apply if the consignment is made at our expense or with our means of transport. Dispatch shall in any event be at Customer's risk, even if freight-paid delivery has been agreed.

(2) Passing of Risk on Notification of Readiness for Dispatch

If dispatch of the consignment is delayed at Customer's request or for reasons for which we are not responsible, then the risk shall pass to Customer on notification of readiness for dispatch.

VI. Prices

(1) General Terms on Prices

Our prices are ex works plus packaging and statutory value added tax [Mehrwertsteuer]. Agreement of fixed prices must be expressly confirmed in writing. Unless otherwise agreed, our prices for all deliveries, including ones outside the European Currency Union, shall be in Euro.

(2) Packaging & Packaging Materials

We shall take back packaging and packaging materials. The cost of return transport shall be paid by Customer. In the case of deliveries outside Germany, returning any manner of packaging is excluded.

VII. Terms of Payment

(1) Payment Dates

Unless otherwise agreed, the invoiced amounts are payable without deduction within 30 days of the date of invoice, and with 2% discount within 10 days of the date of invoice.

(2) Default Interest

In the event of Customer defaulting in payment, it shall pay interest on the outstanding amount at a rate of 8% over and above the European Central Bank's base rate; the right to claim further default damages is reserved.

(3) Payment by B/E and Cheque

Bills of exchange shall only be taken if expressly agreed, and - like cheques - by way of payment only, subject to our acceptance in each individual case. Discount fees and other charges must be paid by Customer.

(4) Other Factors

Interfering with Counter-Performance Deliveries shall be made contingent upon Customer's credit standing and liquidity. In the event of default in payment, non-payment of cheques or bills of exchange, the suspension of payments, the institution of proceedings for settling debts, non-compliance with the terms of payment, a poorer credit rating by a credit reporting agency, and in the event of circumstances likely to impair Customer's credit standing, we shall be entitled at any time to reasonably amend the contractual terms and to rescind the contract if performance is ultimately refused.

(5) Set-Off, Right of Retention

In respect of our due claims, Customer shall only be entitled to a right of set-off or retention based its own counter-claims up to the amount of demands which have been established res judicata or acknowledged in writing.

VIII. Reservation of Title

(1) Agreement on Reservation of Title

The goods delivered (goods subject to reservation of title) shall remain our property until such time as all and any claims to which we are entitled vis-à-vis Customer on the basis of the business relationship have been satisfied. Bills of exchange and cheques shall only be deemed to effect payment once they have been honoured.

(2) Extended Reservation of Title

If the goods subject to reservation of title are processed or combined by Customer with other goods not belonging to us to make a new single object, then we shall be entitled to co-ownership of the new object up to the value of our goods in proportion to the other processed and/or added goods at the time of processing and/or combination. Our coownership thus created shall be deemed reservation of title as defined in these provisions.

(3) Sale, Advance Assignment

Customer may only sell the goods subject to our reservation of title during the course of normal business, and only as long as it does not default in settling all our claims. Customer here and now assigns to us its claims based on a resale of the goods subject to reservation of title by way of securing all our claims arising from the business relationship. We herewith accept such assignment. If Customer sells the goods subject to reservation of title along with other goods not belonging to us or in which we have no rights of co-ownership, then the claim arising from such resale shall be assigned to us only up to the value of our goods subject to reservation of title. The value of the goods subject to reservation of title shall be assessed on the basis of the invoiced amount. Customer is entitled to collect the claims based on resale that have been assigned to us, unless we revoke such entitlement at any time.

(4) Threat to Ownership Rights

As long as we have reservation of title, Customer is not allowed to pledge the goods or assign them by way of security. In the event of liens, seizures or other third-party disposition or interference, in particular by way of levying execution, Customer must notify us as once in writing.

(5) Obligation to Surrender

If Customer defaults in settling our claims in whole or in part, then we shall be entitled to demand at any time that the goods subject to reservation of title be surrendered and to otherwise dispose thereof, and to withhold outstanding deliveries, even if we do not cancel the sales contract. No further reminder or deadline shall be required. Our assertion of rights to reservation of title shall not be deemed rescission of the contract.

(6) Release of Security

If the value of the security to which we are entitled under the above provisions exceeds outstanding invoiced amounts by more than 20%, then at Customer's request we shall be obliged to release excess security at our own option, subject to the proviso however that, except for deliveries in an actual current account relationship, release of security shall only apply to deliveries or equivalents which have been paid in full.

IX. Material Defects

(1) Specification of Characteristics

The characteristics of the product to be supplied by us are conclusively specified in our written or electronic quotation records and/or in/on our catalogues, CDs or other data carriers. Unless otherwise agreed in writing, the usage given in our quotation shall be deemed the sole subject-matter of the contract.

(2) Customer's Obligation to Inspect & Lodge Complaints

Customer must inspect our products immediately on receipt and lodge written complaints about any obvious defects within a period of two weeks of delivery. Defects which are not discovered within this period despite careful inspection must be reported to us in writing without delay, at the latest within two weeks of being discovered. If Customer fails to report defects in good time, then our delivery shall be deemed made in accordance with the contract and free of defects.

(3) Minor Defects, Wear & Tear, Improper Usage, External Factors

Claims based on defects shall not be deemed to exist if there is only a minor deviation from the agreed characteristics, if usability is only slightly impaired, in cases of natural wear and tear or damage caused subsequent to passing of risk as a result of wrong or negligent handling, in cases of excess usage, unsuitable materials, defective building work, unsuitable building land, chemical, electrochemical, electronic, electric or other specific external influences which are not provided for under the contract, and in the case of non-reproducible software errors. If alterations or repairs are carried out improperly by Customer or third parties, there shall similarly be no claims for defects in respect of such alterations or repairs or for the consequences resulting therefrom.

All claims under the warranty shall lapse if the Tavrida seal affixed to the defective product has been damaged, unless such damage is not due to the deliberate acts of one or more persons.

Customer may not refuse to accept deliveries of goods due to minor defects.

(4) Liability for Material Defects

Our goods or services shall be subsequently improved or resupplied - at our option - free of charge if any material defect occurs during the prescriptive period, provided the cause for such defect already existed at the time of passing of risk, furnishing proof of which shall be incumbent upon Customer. We must initially be granted a reasonable period for such post-performance. If our attempts at post-performance fail more than three times, Customer may rescind the contract or reduce the payment. Claims to compensation shall remain unaffected.

(5) Warranty Period

Claims based on material defects shall become statute-barred after twelve months. This shall not apply if longer periods are prescribed by law (German Civil Code s. 438 (1) no. 2 Buildings & Objects for Buildings, s. 479 (1) Claims under Right of Recourse, and s. 634 a) (1) no. 2 Constructional Defects), or in cases of loss of life or limb or health hazards, or in instances of wilful or gross violation of duty on our part, or in the event of malicious non-disclosure of defects. The statutory regulations on the suspension, interruption and recommencement of periods with a fixed deadline shall remain unaffected.

(6) Reimbursement of Expenses

Customer's claims to expenses required for the purpose of postperformance, in particular costs for transport, travel, labour and materials, are excluded insofar as such costs are increased due to the delivery object subsequently being removed to a place other than Customer's establishment, unless such removal is in line with its intended usage.

(7) Exclusion of Claims to Recourse

Customer shall only be entitled to have recourse to us pursuant to German Civil Code s. 478 (Contractor's Recourse) insofar as Customer has not reached any agreements with its own customer going beyond the statutory claims for defects, and/or insofar as equivalent arrangements on compensation pursuant to German Civil Code s. 478 (4) have not otherwise been reached between Customer and ourselves.

(8) Returning Defective Products

Insofar as Customer justifiably asserts warranty claims on us, it shall be under obligation to return the defective products to us freight paid, or to keep them ready for inspection and checking at the place where its establishment is located, at our option.

(9) Other Compensation

In all other respects, Section XII of these Terms of Delivery (Other Claims to Compensation) shall apply to claims to damages. Claims based on material defects other than or going beyond those regulated in this Section IX that are imposed by Customer on ourselves and on those assisting us in performing our obligations, are excluded.

X. Additional Product Warranty

(1) General Terms of Warranty

Over and above the warranty rights pursuant to Section IX of these Terms, we shall grant a product warranty for material and/or manufacturing defects. Unless otherwise agreed in writing, we permit Customer and each of its own customers to impose claims for material and/or manufacturing defects on us:

- a) if the Tavrida Electric product has been bought from us or from an authorised Tavrida Electric dealer;
- b) if the product has been properly employed by the user with the care of a diligent businessman in accordance with the normal usage stipulated in the product specifications;
- c) if damaging factors in the environment and/or surroundings - such as excessive heat, cold or moisture (going beyond the limits given in the manufacturer's specifications) - can be ruled out, or if the user proves that such factors have had no influence on the product's ability to function properly;
- d) if no force has been exerted due to accident, lightning or excess voltage (going beyond the range tested for the respective product);
- e) if the wrong functioning of our product due to installation errors, operating errors - in particular derogation from the rules laid down in the operating instructions - or other culpable third-party conduct can be ruled out;
- f) if the Tavrida seal is still affixed to the product undamaged.

(2) Warranty Period

The warranty period lasts 5 (five) years and commences on the day after the purchase date given on our invoice or on the invoice issued by an authorised Tavrida Electric dealer. The warranty period for a Tavrida Electric product shall not be extended due to the rendering of postperformance or warranty services, which shall not have the effect of the warranty period being interrupted or re-commencing.

(3) Warranty Services

If during the warranty period we are given proof of a warranty claim pursuant to the General Terms of Warranty (Section X, Item (1)), then we shall provide Customer/Buyer with a replacement of equal value. All the costs for transport, disassembly and installation and all other

costs incurred in connection with the replacement of the part covered by the warranty shall be borne by Customer/Buyer. Customer's contractual or statutory warranty rights shall remain unaffected by the handling of the warranty.

(4) Obligation to Return

If Customer/Buyer justifiably imposes claims on us under a warranty, it shall be obliged to return the replaced defective product to our main branch at its own expense.

XI. Legal Defects, Industrial Property Rights, Copyright

(1) Third-Party Protective Rights

Unless otherwise agreed, we are only under obligation to make deliveries free of third-party industrial property rights and copyrights (referred to hereafter as "protective rights") inside Germany. If a third party asserts on Customer legitimate claims due to a infringement of protective rights caused by deliveries made by us and used in accordance with the contract, then we shall be liable vis-à-vis Customer as follows during the period stipulated in Section IX, Item 5:

a) At our own option and at our own expense, we shall either obtain a usufructuary right for the deliveries concerned, or alter the latter in such a manner that the protective right is not infringed, or exchange it. If we are unable to do so on reasonable terms, then Customer shall be entitled to its statutory right to rescind the contract or reduce the price.

b) Any obligation on our part to pay damages shall be governed by Section XII of these Terms of Delivery.

c) We shall only have the aforementioned obligations provided Customer informs us without delay in writing about the claims being asserted by third parties, fails to acknowledge any infringement, and leaves all the defence measures and settlement negotiations up to us. If Customer ceases using the delivered object so as to minimise losses or for other important reasons, then it shall be under obligation to point out to the third party that suspension of usage does not constitute any manner of acknowledgement.

(2) Customer's Responsibility

Customer's claims are excluded if it is responsible for the infringement of protective rights.

(3) Other Grounds for Exclusion

Customer's claims shall moreover be excluded if the infringement of protective rights is due to Customer's specific instructions, or due to a form of usage not predicted by us, or due to the delivery being altered or used by Customer in conjunction with other products not supplied by us.

(4) Other Legal Defects

In the event of other legal defects, the provisions laid down in Section IX shall apply mutatis mutandis.

(5) Exclusion of Further Claims

Claims due to legal defects asserted by Customer on us and on those assisting us in performing our obligations which go beyond or differ from those regulated in this Section IX and in Section X above are excluded.

XII. Other Claims to Compensation

(1) Exclusion of Liability

Customer's claims to compensation and reimbursement of costs, for

whats oever legal cause, in particular due to violation of the obligations ensuing from the contractual relationship or in tort, are excluded.

(2) Mandatory Liability

This shall not apply insofar as liability is mandatory, e.g. under the Product Liability Act, in cases of intent or gross negligence, in the event of loss of life or limb or health hazards, due to the violation of

cardinal duties, or due to the assumption of warranties. However, claims to compensation and reimbursement of costs in the event of the violation of cardinal duties are limited to predictable damage typical for the type of contract, provided intent or gross negligence do not apply, and provided no liability arises by reason of loss of life or limb or health hazards. The foregoing arrangements do not shift the onus of proof to Customer's disadvantage.

(3) Prescription

Insofar as Customer is entitled to claims to compensation pursuant to this Section XII, such claims shall become statute-barred on expiry of the prescriptive period for claims for material defects pursuant to Section IX, Item 5 above. In the case of claims to compensation under the Product Liability Act, the statutory regulations on prescription shall apply.

XIII. Information about Products

(1) Information about Products in Printed Matter & Advertising

Unless expressly termed warranted characteristics, everything contained in our quotation records and other printed matter or on data carriers shall merely constitute a description of the product, and not imply any offer to conclude a warranty agreement. The same applies to information given in our advertisements.

XIV. Miscellaneous

(1) Rescission by Customer

Customer's statutory right to rescind the contract shall not depend on fault if the delivery is defective. In all other instances, Customer may only rescind the contract in the event of a violation of duty for which we are responsible.

(2) Data Protection

We draw our customers' attention to the fact that with the help of EDP we process and disclose personal data for business purposes in line with the regulations laid down in the Data Protection Act.

XV. Place of Performance, Venue, Governing Law

(1) Place of Performance

Place of performance for the services owing under the contract by both parties shall be Erlangen.

(2) Venue

Exclusive venue for all disputes arising directly or indirectly from the contractual relationship shall be Erlangen. However, we are also entitled to bring action at the location of Customer's registered establishment.

(3) Governing Law

Legal relations between Customer and ourselves shall be exclusively governed by Federal German law on exclusion of CISG.

NON-CONFORMITY REPORT

To:	TAVRIDA ELECTRIC AG Service Department	From:	
Phone:	+49 (0)9131/ 97 20 79- 0	Address:	
Fax:	+49 (0)9131/ 97 20 79- 9		
E-Mail:	service@tavrida.de	Name:	
Web:	www.tavrida.de		
		Phone:	
		Fax:	
		E-Mail:	

Type designation:	Serial No.:
ISM/TEL -	
CM/TEL -	

Date of commissioning:	Date when non-conformity was noticed:
When did the non-conformity occur:	Place of installation of CM/TEL:
☐ Incoming inspection ☐ Installation/Commissioning ☐ Service	☐ Low voltage compartment of panel ☐ High voltage compartment of panel ☐ Separate control cubicle ☐ 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:

Please note:

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

NON-CONFORMITY REPORT

To:	TAVRIDA ELECTRIC AG Service Department	From:	
Phone:	+41 (0) 52 625 0315	Address:	
Fax:	+41 (0) 52 625 2035		
E-Mail:	service@tavrida.ch	Name:	
Web:	www.tavrida.de		
		Phone:	
		Fax:	
		E-Mail:	

Type designation:	Serial No.:
ISM/TEL -	
CM/TEL -	

Date of commissioning:	Date when non-conformity was noticed:
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

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:

Please note:

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

[illegible]

[illegible]

Applicable for the following types:

ISM/TEL ...-053	CM/TEL ... -12-01A
ISM/TEL ...-055	CM/TEL ... -12-02A
ISM/TEL ...-055F	CM/TEL ... -12-03A
ISM/TEL ...-057	CM/TEL ... -14-01
ISM/TEL ...-058	
ISM/TEL ...-066	
ISM/TEL ...-067	
ISM/TEL ...-081	
ISM/TEL ...-085	
ISM/TEL ...-086	
ISM/TEL ...-087	
ISM/TEL ...-089	

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