MAGVATECH

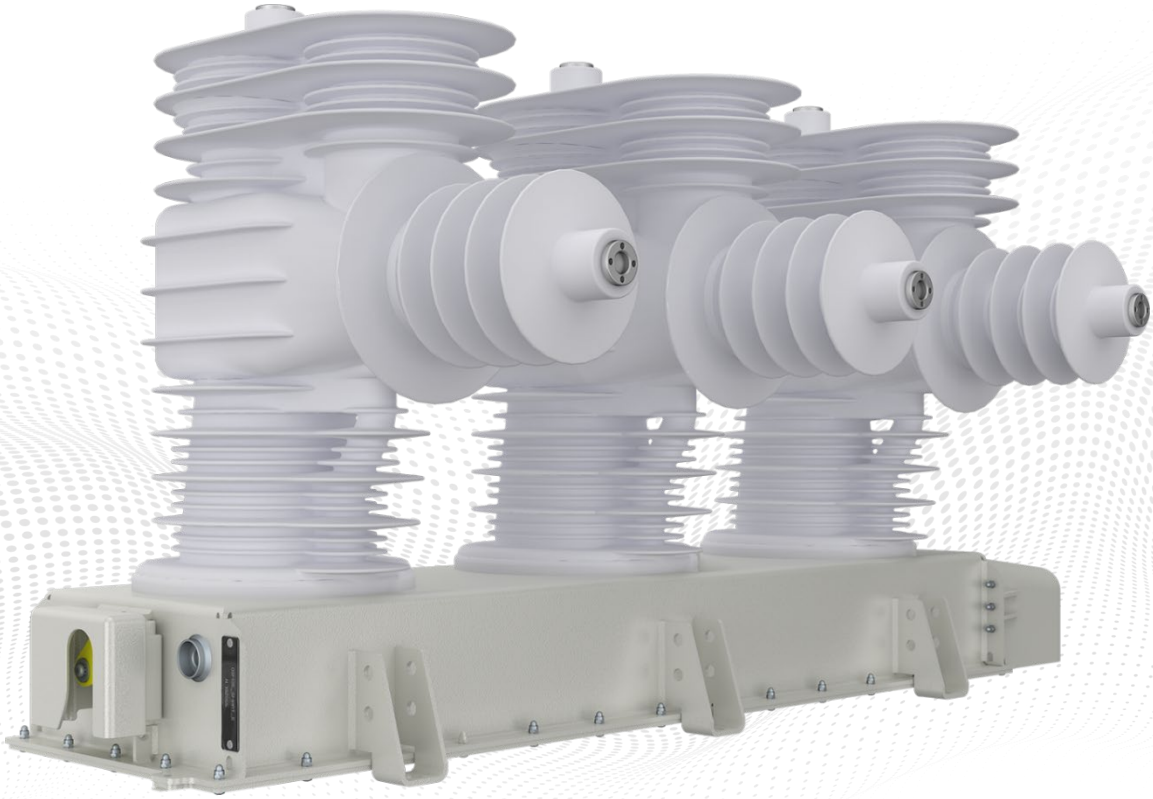
FAST PRECISE RELIABLE

TECHNICAL MANUAL

Rec35_Smart5_5p

AUTOMATIC CIRCUIT RECLOSER

38 kV, 16 kA, 1250 A



VERSION 8.2

The present Technical Manual contains information necessary for the installation, commissioning and operation. It is absolutely necessary for the proper use of the recloser to read the Technical Manual carefully before starting and to adhere to the instructions and the relevant regulations.

Safety first

- 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 IEC/DIN/VDE), accident prevention regulations and the connecting conditions of the electric utilities shall be followed.

- Take note that during operation of the recloser 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 recloser 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 Magvatech representative.

Contents

1 Introduction

1.1 Applicability

This Technical Manual applies to the following range of products manufactured by Magvatech:

- Automatic Circuit Recloser – Rec35_Smart5_5p
  - Outdoor Switching Module – OSM35_Smart_5
  - Recloser Control – RC5_4

The model numbers are shown on the equipment nameplates. If your equipment does not correspond to these numbers then this Technical Manual is not applicable.

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

Important! Due to continuous product improvement, specifications and design are subject to change without notice.

1.2 Safety Instructions:

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

DANGER! Contact with hazardous voltage can cause death or severe personal injury. Contact with switching module or recloser control terminals should only be undertaken when equipment is isolated from applicable sources of voltage.

WARNING! Follow all locally approved safety procedures when installing or operating this equipment. Improper handling, installation, operation or maintenance can result in death, severe personal injury or damage to equipment.

WARNING! Power distribution equipment must be properly selected and used only for the intended purpose.

1.3 Abbreviations

ABR	Automatic Backfeed (Backfeed) Restoration
AT	Auxiliary Transformer
BAT	Battery
BF	Bolted Fault
BFS	Backfeed (Back Feed) Supply
CC	Control Cable (Umbilical)
CCV	Close condition verifier
CLP	Cold Load Pickup
CPM	Control Panel Module
CT	Current Transformer
CU	Current unbalance
D	Delayed
EF	Earth Fault protection element
EF1	Low set Earth Fault protection element for Delayed trips
EF2	Low set Earth Fault protection element for Instantaneous trips
EF3	High set Earth Fault protection element for Instantaneous trips
EFID	Earth Fault Interruption Detection Element
EL	Event Log
ETH	Ethernet Module
HL	Hot Line protection element
I	Instantaneous
I/O	Input/Output
IOI	Input/Output Interface
IOM	Input/Output Module
LCD	Liquid Crystal Display
LP	Load Profile
LS	Loss of Supply protection element
ME	Measurement element
ML	Malfunction Log
MMI	Man-Machine Interface
MPM	Main Processor Module
NAP	Neutral Admittance Protection element
NSOC	Negative Sequence Overcurrent
NVS	Neutral Voltage Shift element
OC	Overcurrent protection element
OC1	Low set Overcurrent protection element for Delayed trips
OC2	Low set Overcurrent protection element for Instantaneous trips
OC3	High set Overcurrent protection element for Instantaneous trips
OCID	Phase Overcurrent Interruption Detection element
OCR	Overcurrent protection element with reclosing

OSM	Outdoor Switching Module
PCI	Personal Computer Interface
PSFM	Power Supply Filter Module
RC	Recloser Control
RCM	Recloser Control Module
RTC	Real Time Clock
ROCOF	Rate of Change of Frequency
RTU	Remote Telecommunication Unit
SA	Surge Arrester
SCADA	Supervisory Control and Data Acquisition
SD	Source Detector
SECR	Sectionalizer Reclosing
SEF	Sensitive Earth Fault
SEFID	Sensitive Earth Fault Interruption Detection Element
SEFR	Sensitive Earth Fault with reclosing
SI	Synchronization indicator
TCI	Telecommunication Interface
TDI	TELARM Dispatcher Interface
MVT	Magvatech
UF	Under Frequency
UV	Under Voltage
VRC	Voltage Reclosing Control
VT	Voltage Transformer
VU	Voltage Unbalance
VVS	Voltage Vector Shift
ZSC	Zone Sequence Coordination

2 Technical Parameters

Main technical data and recloser technical parameters are presented in tables below.

Table 1 – Recloser technical parameters

Parameter	Value
Rated data	
Rated maximum voltage (Ur)	38 kV
Rated short-duration powerfrequency withstand voltage (Ud), 1 min dry	70 kV
Rated short-duration powerfrequency withstand voltage, 10s wet	70 kV
Rated lightning impulse withstand voltage (peak) (Up)	170 kV
Rated continuous current (Ir)	1250 A
Rated cable-charging current switching	40 A
Rated line-charging current switching	5 A
Rated short-circuit breaking current (Isc)	16 kA
Rated peak withstand current (Ip)	65 kA
Rated short-time withstand current (Ik)	25 kA
Rated duration of short circuit (tk)	3 s
Rated frequency (fr)	50/60 Hz
Switching performance	
Mechanical life (CO-cycles)	30 000
Operating cycles, rated current (CO-cycles)	30 000
Electrical endurance, breaking current (O-CO cycles)	See Figure 1
Closing time, not more than	82 ms
Opening time for overcurrent protection according to IEC 62271-111/C37.60, not more than (at I>2xIp)	43 ms
Clearing time for overcurrent protection according to IEC 62271-111/C37.60, not more than (at I>2xIp)	51 ms
Rated operating sequence	O-0.1s-CO-2s-CO-2s-CO
General information	
Main circuit resistance	< 40 μOhm
Weight	95 kg
Altitude	4500 m (derating according to ANSI C37.60 applied above 1000 m)
Humidity	100%, condensing
Solar Radiation	≤ 1.1 kW/m²
Temperature Range	-40 °C ... +55 °C
Type of driving mechanism	Monostable magnetic actuator
Pollution level	Very heavy (as per IEC 60815)

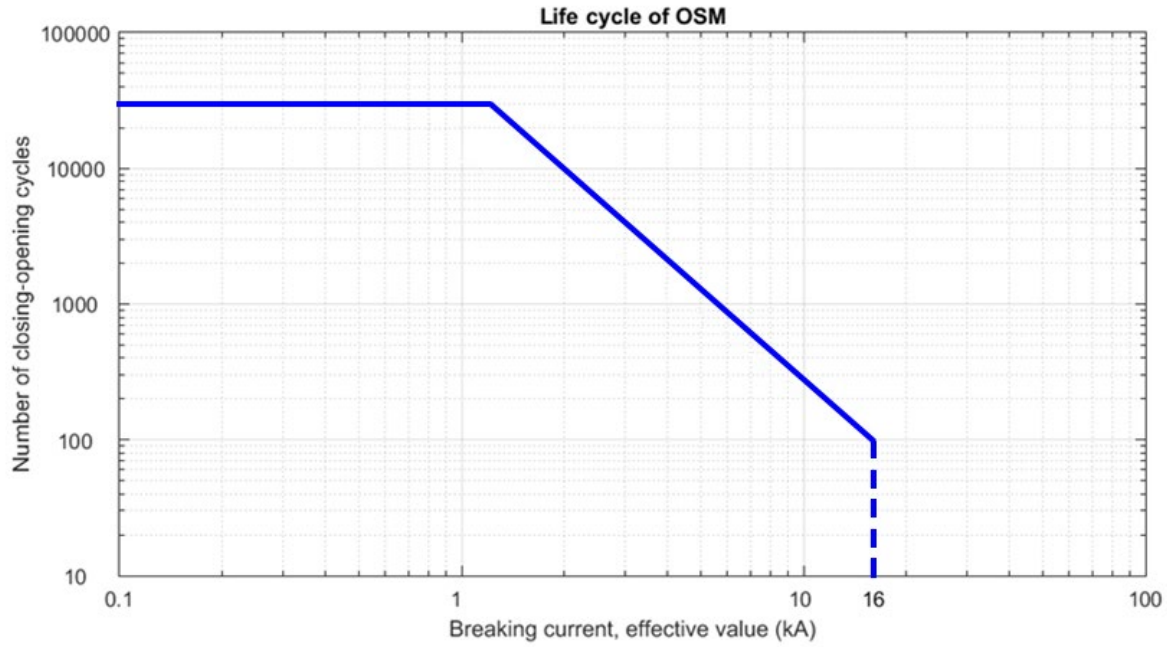


Figure 1

Vacuum interrupter switching life cycle

Table 2 – Sensors parameters

Parameter	Phase current sensors	Zero-sequence current sensor	Voltage sensors
Range where accuracy is provided	1 … 8000 A	1 … 8000 A	0.3 … 40 kV
Range of sensor coefficients at 20°C	1.8 … 2.2 V/kA	1.8 … 2.2 V/kA	0.025 … 0.2 V/kV

Table 3 – Measurement accuracy[1]

Parameter	Basic error	Range where accuracy is guaranteed
Phase currents	The greater of ±2% or ±2A	0 ... 1250 A
Residual current[2]	The greater of ±2% or ±0.5A	0 ... 1250 A
Phase to earth voltages	The greater of ±1% or ±0.1 kV	0.3 ... 23.0 kV
Line to line voltages	The greater of ±1% or ±0.1 kV	0.5 ... 40.0 kV
Frequency - at dF/dt<0.2 Hz/s - at dF/dt<0.5 Hz/s	 ±0.025 Hz ±0.05 Hz	45 ... 55 Hz, 55 ...65 Hz
Power factor	±0.02	0 ... 1
Active and reactive energy	±2%	40 … 1250A, 4.5 ... 40 kV
Active, reactive and total power	±2%	40 … 1250A, 4.5 ... 40 kV

Table 4 – Electromagnetic compatibility

Parameter	Rated value	Applicable standard
Rated power frequency voltage (1 min)	2 kV	IEC 60255-5
Rated impulse voltage, at 0.5J	5 kV	IEC 60255-5
Electrical fast transient/burst immunity	4 kV	IEC 60255-22-4 (Level IV)
Surge immunity (applied to external AC voltage terminals) - common - transverse	 4 kV 2 kV	IEC 61000-4-5 (Level IV)
Control elements surge withstand capability (SWC)	125 kV (6 kA)	IEEE C37.60-2012

[1] If RC5_4 sensor coefficient settings are configured in accordance with guidelines in Table 6 of this guide. Error is measured at normal climatic conditions.
[2] Note that overcurrent protection pickup setting value shall not exceed SEF pickup setting value times 300.

Table 5 – Power supply characteristics

Parameter	Value
Supply voltage range	85 … 265 V AC 110 … 220 V DC[3]
Rated power consumption, not more	40 VA
Maximum power consumption, not more	75 VA
Duration of operation without auxiliary supply	48 hours

Table 6 – Degree of protection

Component	Degree of protection
Outdoor switching module	IP66
Recloser control	IP66
Control cable	IP66

Table 7 – Rechargeable Battery (BAT) parameters

Parameter	Value			
Type[4]	G26EPX EnerSys 0765-2003 sealed lead acid	HAZE HZB12-26 sealed lead acid	GetPower GP12-26 sealed lead acid	UPLFP12-30 $LiFePO_4$
Rated voltage	12 V	12 V	12 V	12,8 V
Rated capacity	26 Ah	26 Ah	26 Ah	30 Ah
Temperature range	-40 °C ... +55 °C	-25 °C ... +50 °C	-15 °C ... +50 °C	-20 °C ... +60 °C
Relative capacity at different temperatures	25 % at -40 °C 65 % at -20 °C 84 % at 0 °C 100 % at +25 °C 110 % at +40 °C 120 % at +55 °C	50 % at -25 °C 65 % at -15 °C 85 % at 0 °C 100 % at +20 °C 102 % at +40 °C	65 % at -10 °C 86 % at 0 °C 100 % at 25 °C 103 % at +40 °C	62 % at -20 °C 80 % at -10 °C 100 % at 25 °C 103 % at +60 °C
Expected battery life at average operating temperature	10 years at +20 °C 10 years at +25 °C 6,5 years at +30 °C 2,7 years at +40 °C	12 years at +20 °C 9 years at +30 °C 4 years at +40 °C 0,8 years at +50 °C	4-6 years at +20 °C 2,5-4 years at +30 °C 1,5-2,2 years at +40 °C 0,8-1,5 years at +50 °C	10 years at +25 °C 5,5 years at +30 °C 2,5 years at +40 °C

Table 8 – Input/Output module (IOM) parameters

Parameter	Value
Digital inputs	
Rated voltages of signal applied to digital inputs - for IOM-04 - for IOM-03	 12/24/30/48/60 V DC 110/125/220 V DC
Pickup voltage of signal applied to digital inputs - for IOM-04 - for IOM-03	 Above 9 V Above 80 V
Reset voltage - for IOM-04 - for IOM-03	 Below 3 V Below 30 V
Maximum continuous voltage of signal applied to digital inputs - for IOM-04 - for IOM-03	 75 V 275 V
Input resistance - for IOM-04 - for IOM-03	 3 kOhm 125 kOhm
Recognition time, not more	20 ms
Reset time, not more	20 ms
Digital outputs	
Rated voltage	250 V AC
Rated current	16 A
Breaking capacity DC1 (at L/R=1ms): 30/110/220 V	16/0.3/0.12 A
Minimum switching load	500 mW (10V/5mA)

[3] Note that additional DC circuit breakers are required.
[4] Other types of batteries with identical parameters can be used in RC5_4 upon agreement with client.

Table 9 – Wired Ethernet Port (ETH) parameters

Parameter	Value
Applicable standard	IEEE 802.3 10Base-T IEEE 802.3u 100Base-T IEEE 802.3x Flow Control
Interface	RJ-45 10/100 Ethernet port
Maximum receive / transmit speed	Up to 70 Mbps (full duplex mode)

Table 10 – Optical Ethernet module (ETH) parameters

Parameter	Value
Applicable standard	USB 1.2 (according to RC5 specification) IEE802.3u 100Base-FX IEC 9314-3: 1990 ANSI X3.166-1990
Interface	ST
Maximum receive / transmit speed	100–125 Mbps (full duplex mode)
Dimensions	132 x 71 x 39 mm
Net weight, not more	115 g
Power consumption	1.0 W (max)
Operation temperature	-40…+85 °C

Table 11 – Wi-Fi module (WFM) parameters

Parameter	Value
Applicable standard	FCC/CE/TELEC/SRRC
Protocol	802.11b 802.11g 802.11n 802.11e 802.11i TCP/IP DHCP
Tx Power	802.11b: +20 dBm 802.11g: +17 dBm 802.11n: +14 dBm
Rx Sensitivity	802.11b: -91 dBm (11 Mbit/s) 802.11g: -75 dBm (54 Mbit/s) 802.11n: -72 dBm (MCS7)
Security	WPA/WPA2
Cipher Type	WEP/TKIP/AES
Power consumption (Pout = +17 dBm)	1.0 W
Operation range	50 m
Operation temperature	-40…+85 °C

3 Product Description

3.1 Outdoor Switching Module

The OSM35_Smart_5 is a three-phase vacuum circuit breaker designed for outdoor application with the rated maximum voltage of 38 kV. The circuit breaker poles are solidly insulated and encapsulated within a silicon rubber.

Three poles are installed on a lightweight aluminum enclosure with a superior corrosion protection and very heavy pollution areas application rating. The enclosure of the Outdoor Switching Module encapsulates a magnetic actuator, mechanical trip and lockout mechanism and auxiliary electric circuits that contain passive electronic components only.

The bushings are marked with the terminal designation X1, X2 or X3 for the default source side and X4, X5 or X6 for the default load side. The source and load side can be reversed in the Recloser Control settings if required.

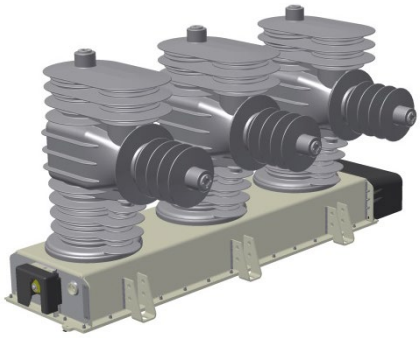


Figure 2

General arrangement of the OSM35_Smart_5

3.1.1 Mechanism Enclosure

The switching module mechanism enclosure is made of a corrosion resistant anodized aluminum alloy. The enclosure is coated with light gray powder coating.

Fixing holes (M12) on each side of the enclosure allow the application of various mounting kits and installation on poles and other structures.

The earthing provision (M12) is labelled for identification.

3.1.2 Magnetic Actuator

Magvatech has the most reliable mechanical structure of the vacuum circuit breaker. It uses single-coil magnetic actuators. All switching elements of a pole are assembled along a single axis. All mechanical movements are therefore direct and linear. Design of the magnetic actuator guarantee minimum contacts discrepancy at closing and electrical or mechanical tripping.

Due to the design, any typical failures of critical components, such as mechanical latching, gears, chains, bearings and levers, tripping and closing coils, motors to charge springs are completely avoided.

3.1.3 Vacuum Interrupter

Magvatech vacuum interrupters are the most compact in its class and show excellent mechanical, voltage withstand and current breaking capabilities. The use of a specially designed axial magnetic field distribution provides even current density over the contact surface and consequently substantial improvement of vacuum interrupting performance. Advanced technology and materials provide vacuum integrity in vacuum interrupter during the entire switching module lifetime (30 years).

3.1.4 Current and Voltage Sensing

Current sensing is performed by low power current sensors (LPCT as per IEC 61869-10 classification) that are inbuilt into each pole. It ensures a precise acquisition of both phase and neutral currents at a very wide range without saturation.

Six precise low power capacitive voltage sensors on source and load side terminals are inbuilt into poles. It allows the recloser to provide power quality monitoring and network self-healing algorithms implementation.

For details on sensor parameters refer to “Technical Parameters” section of this guide.

3.1.5 Mechanical Trip and Lockout Mechanism

A mechanical trip hook is located at the right side of the mechanism enclosure (Figure 3). When the hook is pulled down, the Outdoor Switching Module is mechanically opened, locked in the OPEN position and electrically isolated from the driver. The “Coil Isolated” warning event is generated by the RC5_4 to provide indication of the locked state. The Outdoor Switching Module remains locked and cannot be operated until the trip hook is pushed back into the operating position.

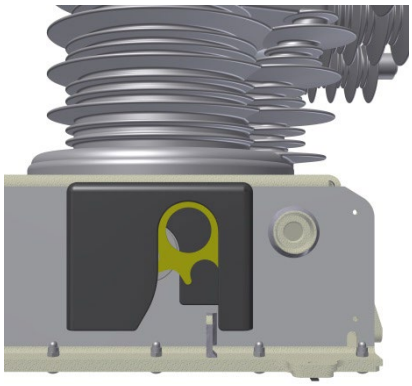


Figure 3

Mechanical trip hook

3.1.6 Main Contact Position Indicator

The position indicators are located under a protective cover at the rear and bottom sides of the mechanism enclosure and are clearly visible in any Outdoor Switching Module mounting position. The indicator color is red “I” when the main contacts are closed and green “O” when they are open.

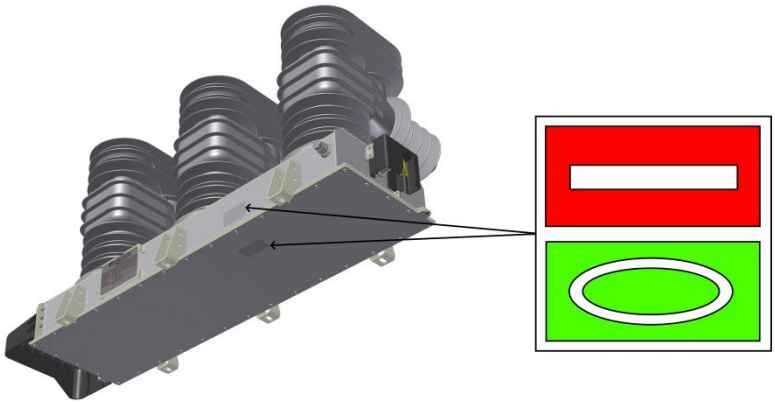


Figure 4

Main contact position indicators

3.2 Control Cable

Umbilical control cable connects the Outdoor Switching Module actuator, metering and auxiliary circuits to the RC5_4. Control cable wires are well protected from UV radiation and sharp objects. The cable is equipped with a heavy duty 42 pin male connector on the Outdoor Switching Module side and a heavy duty 32 pin female connector on the Recloser Control side.

Control cable length can be 5, 7, 12 or 20 meters.

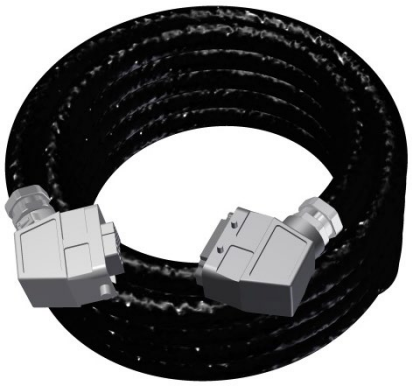


Figure 5
Control cable

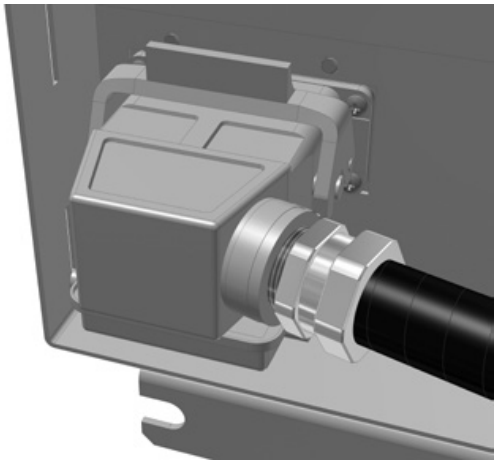


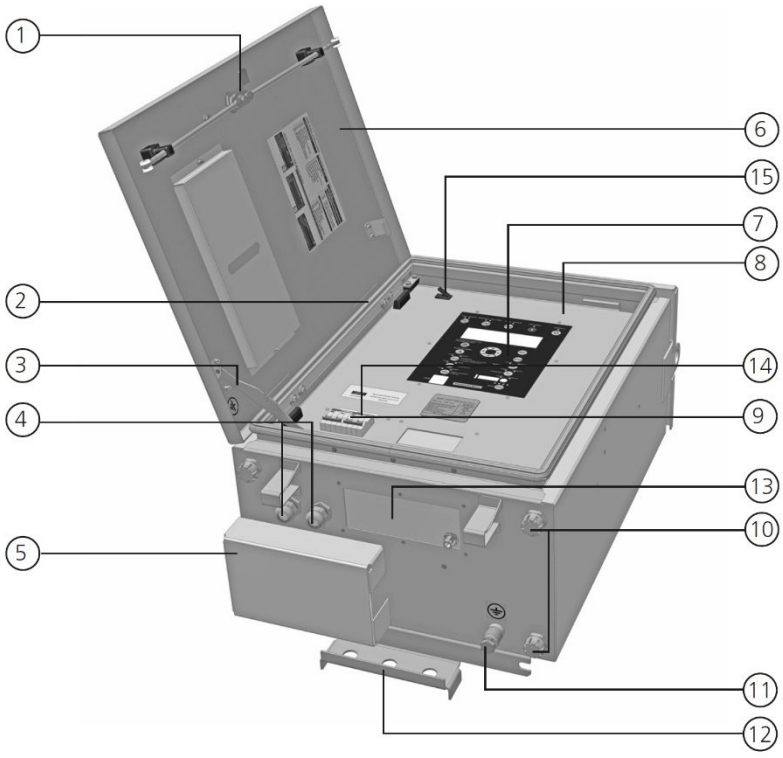
Figure 6
Heavy duty connector

3.3 Recloser Control

The RC5_4 recloser control cubicle is made from powder coated anodized aluminum alloy.

The RC5_4 has 4 drainage filters installed in the bottom, one per corner. It allows effective Recloser Control dehumidification without using any heaters. Advanced drainage filters design ensure IP66 for Recloser Control.

Removable customization plate 180x70 mm is placed at the bottom of Recloser Control. It is possible to modify customization plate and install additional modules or cable glands in case required.



1 Three-point locking system
2 Rubber seal
3 Fixing rod
4 2 x IP66 glands for Power supply cable (∅ 9…17 mm)
5 Anti-vandal cover for Control Cable
6 External door
7 Control panel module
8 Internal door
9 Thermal overcurrent circuit breakers
10 Dust proof drainage filter
11 Earthing stud
12 Mounting brackets
13 Bottom interface plate
14 Battery circuit breaker
15 Door position switch

Figure 7
RC5_4 with internal door closed

1 Remote telecommunication unit (RTU) mounting plate
2 Place for Input/Output module (IOM)
3 Recloser Control Module (RCM)
4 Battery
5 Power Supply Filter Module (PSFM)

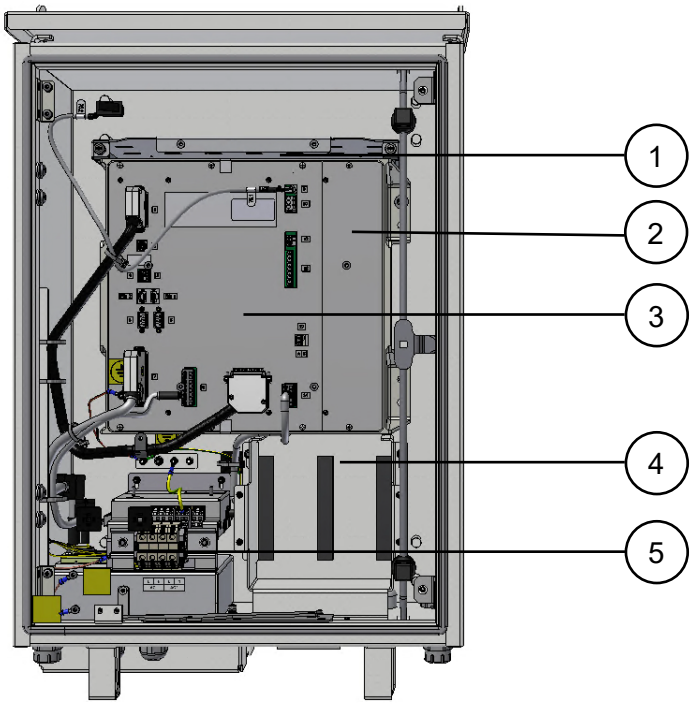


Figure 8

RC5_4 with internal door open

The external door has a padlock provision that is suitable for a shackle with up to a 12 mm diameter. The external and internal doors can be securely fixed in the open position.

The anti-vandal cover is fixed from inside the housing with one captive screw placed at the bottom of Recloser Control. It protects the Umbilical cable from unauthorized disconnection.

1 Control cable terminal
2 Anti-vandal cover
3 Locking holes
4 Captive screw

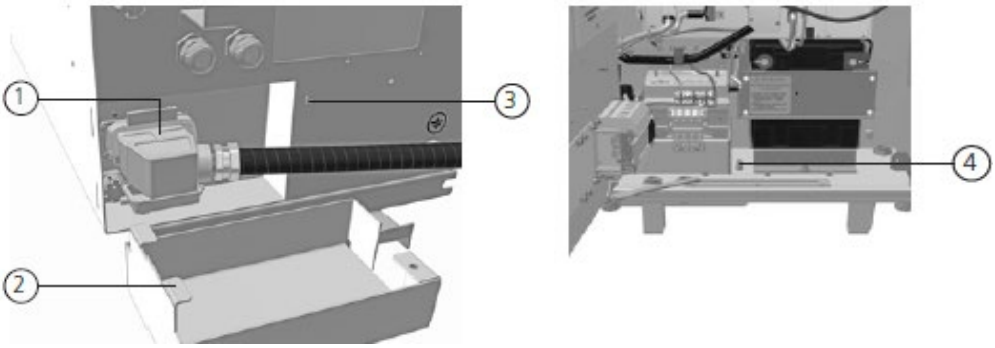
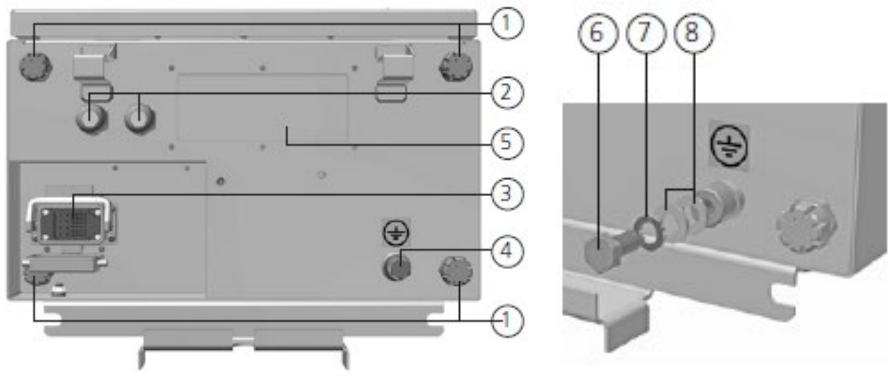


Figure 9

Anti-vandal cover installation

The RC5_4 is equipped with stainless steel earthing provision with M12x30 mm bolt. All internal components and parts are earthed to the main Recloser Control with 2.5 mm2 cooper earthing jumpers.



1 Dust proof drainage filters
2 Cable glands for auxiliary power supply connection
3 Control cable entrance
4 Earthing provision
5 Bottom interface plate
6 M12x30 stainless steel bolt
7 Stainless steel spring washer
8 2 pcs. Stainless steel washers

Figure 10

Recloser Control bottom view

The RC5_4 is equipped with a Door Position Switch which is used for disabling the CPM when the Recloser Control door is closed, as well as providing a SCADA indication of Recloser Control door position.

The door position switch is mounted on the inside of the door and is actuated by the lever mounted opposite to the switch on the inside of the door.

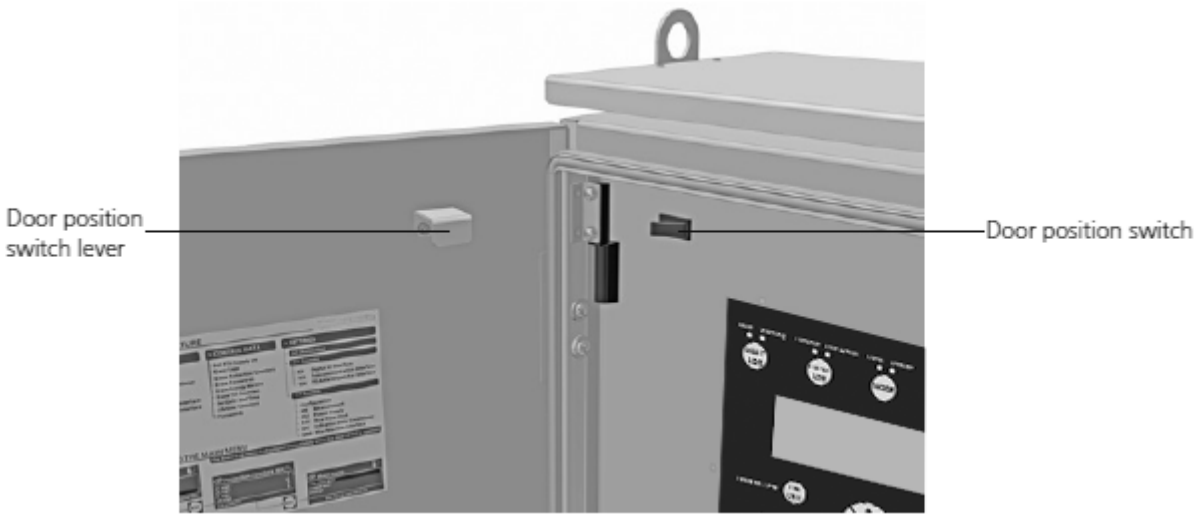


Figure 11

Door position switch

RC5_4 control cubicle has the following standard and optional internal components:

Table 12 – Standard and optional components of RC5_4

Module or Component	Standard	Optional
CPM	•	
RCM	•	
PSFM	•	
BAT		•
IOM		•
ETH	•	
WFM		•
LED		•

3.3.1 Control Panel Module (CPM)

The CPM provides local control and indication functions to the RC5_4.

The CPM has an integrated USB interface for PC connection.

Figure 12

CPM front (left) and back (right) views

3.3.2 Recloser Control Module (RCM)

The RCM is the recloser control module. The RCM provides protection, communication, measurement, power quality monitoring, automation and control functions.

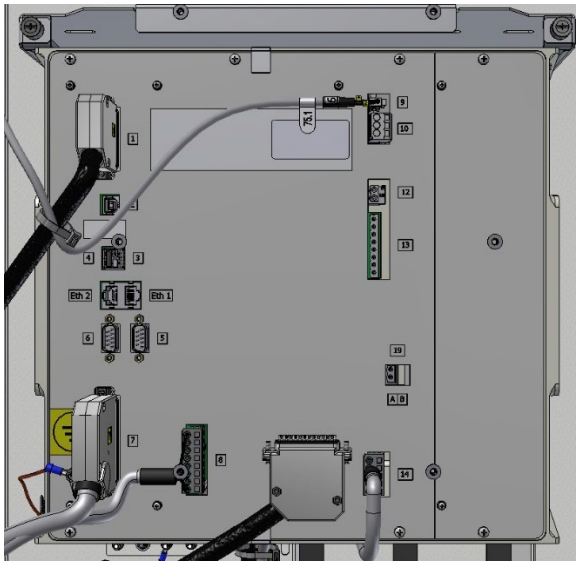


Figure 13

RCM connections with other Recloser Control modules

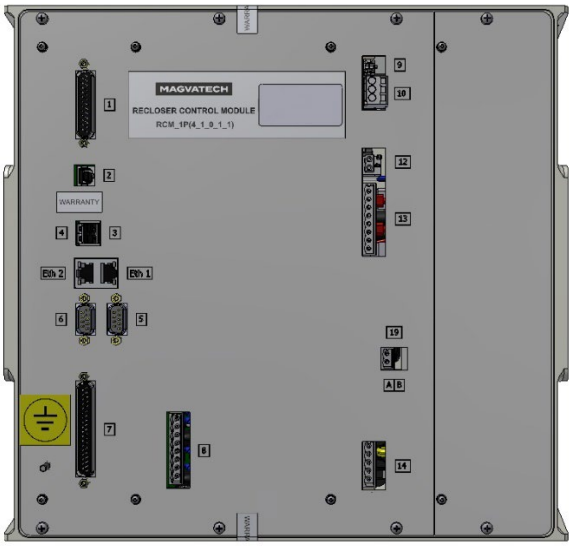


Figure 14

RCM without connections

3.3.3 Power Supply Filter Module (PSFM)

This module provides impulse noise protection for all internal modules of the RC5_4.

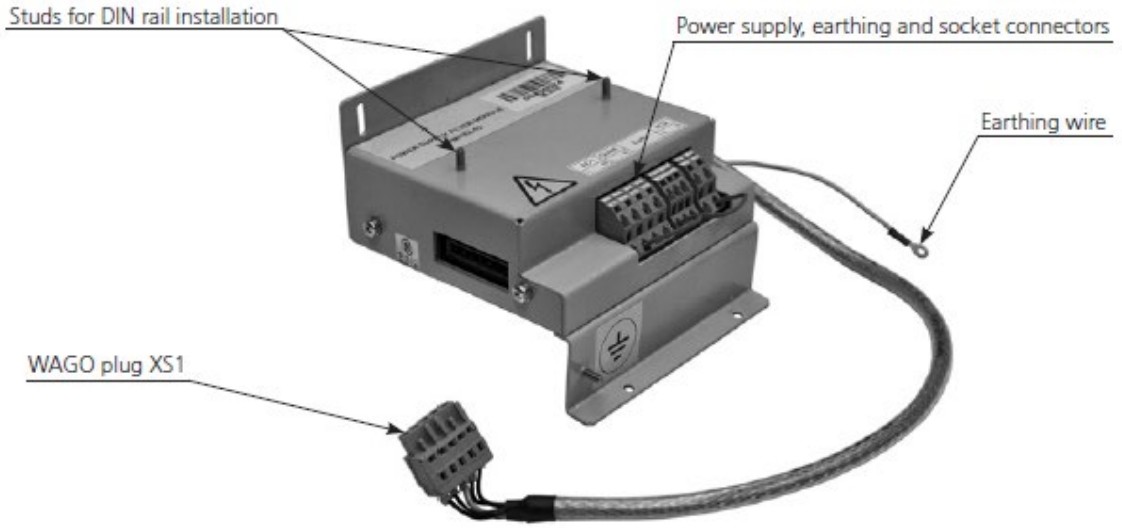


Figure 15

Power Supply Filter Module

The PSFM is connected to the RCM via a WAGO plug (Figure 15).

3.3.4 Rechargeable Battery (BAT)

The rechargeable battery provides the RC5_4 with auxiliary power when the main auxiliary power is not present.

The power supply system is designed to provide optimum battery charging and to optimize battery lifetime.

Technical parameters of Rechargeable Battery are in Table 7.

3.3.5 Input/Output Module (IOM)

The RC5_4 can be supplied with an IOM (Figure 16) on request (refer to section „3. Product coding“ of this guide). The IOM provides control and indication functions via digital inputs/outputs (for details on functionality refer to section „6.3.4 Digital Input/Output Interface (IOI)“ of this guide).

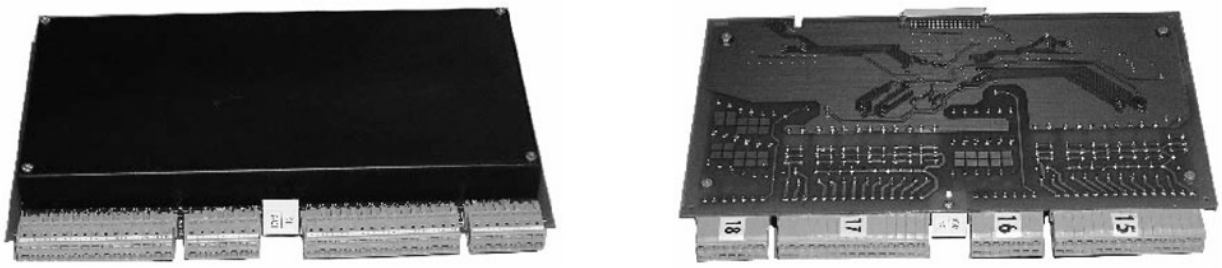


Figure 16

Overall view of IO module

The IOM has twelve digital inputs and twelve digital outputs. The location of connectors (marked „15“…“18“) with these inputs and outputs are shown in Figure 17.

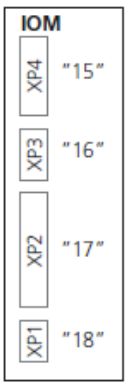


Figure 17

Location of IOM connectors

Digital inputs are electrically isolated by means of opto-couplers (Figure 18).

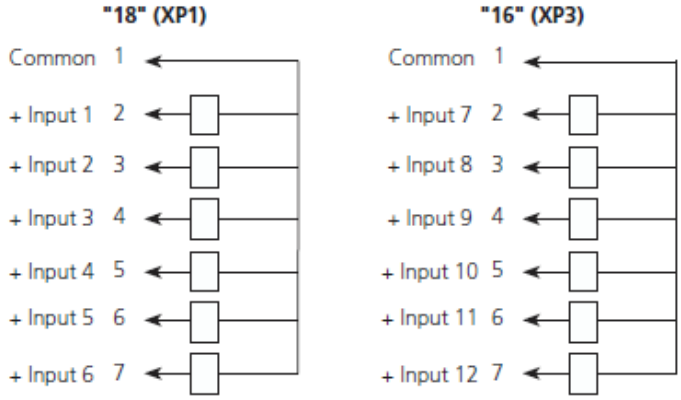


Figure 18

Digital inputs

Bistable relays with changeover contacts are used for the digital outputs as illustrated in Figure 19.

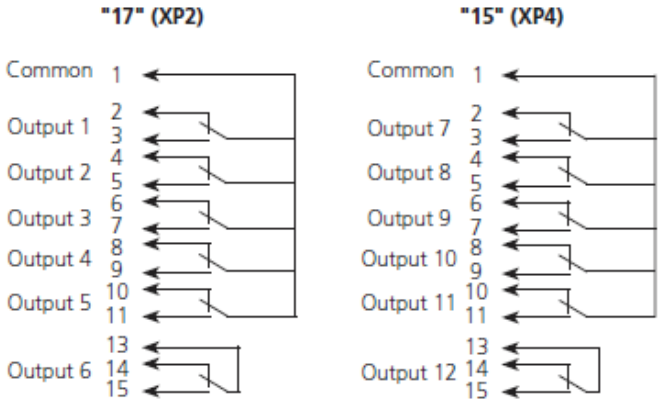


Figure 19

Digital outputs

Technical parameters of Input/Output Module are in Table 8.

3.3.6 Ethernet (ETH)

Wired Ethernet interface

One or Two wired Ethernet ports are provided as standard.

Wired Ethernet interface provides full remote (SCADA) and local communication and engineering functionality via RJ45 port.

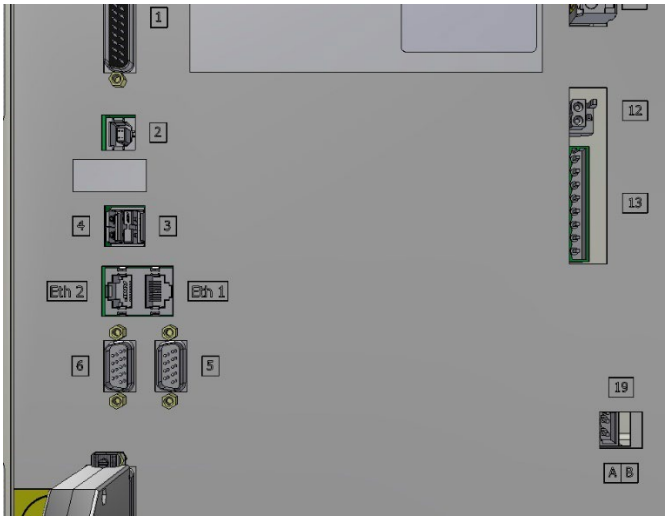


Figure 20

Wired Ethernet interface

Technical parameters for Wired Ethernet interface are in Table 9.

Optical Ethernet interface

Optical Ethernet module provides full remote (SCADA) and local communication and engineering functionality via optical fiber ST interface.

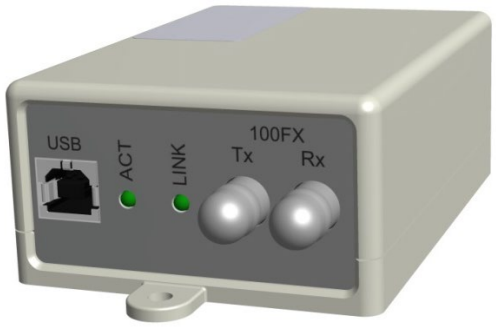


Figure 21

Optical Ethernet module

Technical parameters for Optical Ethernet interface in Table 10.

3.3.7 Wi-Fi Module (WFM)

The RC5_4 can be supplied with a Wi-Fi module in request.

The Wi-Fi module provides full remote (SCADA) and local communication and engineering functionality over wireless TCP/IP connection.

It is connected to the RCM via a USB cable (Figure 22).

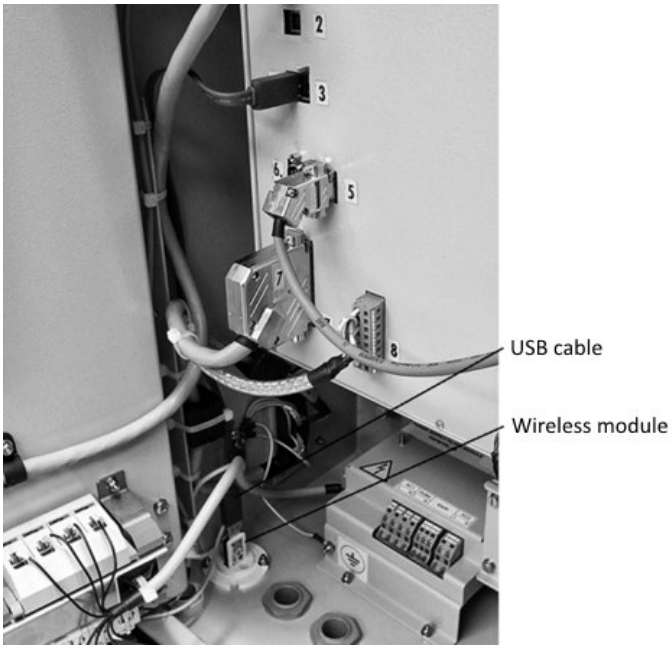


Figure 22

Wireless module with its USB cable

Technical parameters of Wireless module are in Table 11.

3.3.8 LED Lightning Strip

The RC5_4 can be supplied with a cabinet light (LED strip) that is activated when external door is opened.

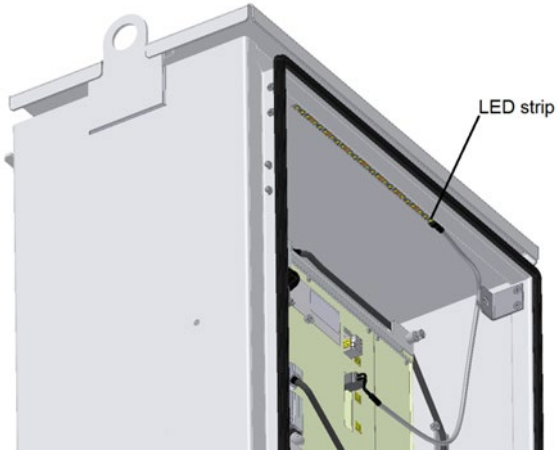


Figure 23

LED strip

3.3.9 Anti-vandal Housing

The RC5_4 can also be supplied with an additional reinforced Anti-vandal housing to prevent stealing and cabinet destruction. The locked Anti-vandal housing cannot be opened with an ordinary tool (screwdriver, wrench, etc.); and cannot be broken with a crowbar. The Anti-vandal housing has all necessary provisions for ventilation, cabling and earthing.

Figure 24

Anti-vandal housing

4 Functionality

4.1 Protection

4.1.1 Overview

The protection functionality is designed for the following key applications:

- Radial line recloser;
- Ring line recloser:
  - Normally closed,
  - Normally open,
  - The point of independent power producers' connection to the grid;
- Rezip recloser – provides protection and reconfiguration in radial, ring and meshed networks where conventional protection grading is impossible;
- Standard sectionalizer – provides automatic segregation of the faulty section basing on number of upstream recloser operations;
- Rezip sectionalizer – allows overcoming the limit of the number of sectionalizers in series and minimize upstream recloser operations to segregate the faulty section.

Protection device mode (Recloser or Sectionalizer) can be independently selected for each of four protection group.

Table 13 – List of protection elements

Protection element	Short name	ANSI code
Bolted Fault	BF	
Phase Overcurrent	OC	51/50/67/51C
Earth Fault	EF	51N/50N/67N
Phase and Earth Overcurrent Reclosing	AR OC	79
Sensitive Earth Fault	SEF	51Ns/67Ns
Sensitive Earth Fault Reclosing	AR SEF	79
Neutral Admittance Protection	NAP	21YN
Neutral Admittance Protection Reclosing	AR NAP	79
Neutral Voltage Shift	NVS	59N
Voltage Unbalance	VU	47
Current Unbalance	CU	46
Negative Sequence Overcurrent	NSOC	51Q/67Q
Rate of Change of Frequency	ROCOF	7F
Undervoltage	UV	27
Undervoltage Reclosing	AR UV	79
Overvoltage	OV	59
Overvoltage Reclosing	AR OV	79
Underfrequency	UF	81U
Underfrequency Reclosing	AR UF	79
Overfrequency	OF	81O
Overfrequency Reclosing	AR OF	79
Voltage Reclosing Control	VRC	
Autoreclosing Timeout	ART	
Cold Load Pickup	CLP	
Source Detector	SD	32
Automatic Backfeed Restoration	ABR	
Close Condition Verifier	CCV	
Synchronization Indicator	SI	25
Hot Line	HL	
Fault Locator	FL	21FL
Loss of Supply	LS	
Loss of Supply Autoreclosing	AR LS	79
Sectionalizing	SEC	
Overcurrent Interruption Detection	OCID	
Earth Fault Interruption Detection	EFID	
Sensitive Earth Fault Interruption Detection	SEFID	
Sags and Swells Detector		
Voltage Vector Shift	VVS	78
Back Feed Supply	BFS	32P

Radial line recloser

The Radial line recloser provides protection against the following faults:

- **Short circuit.** Phase-to-phase and three-phase short circuits;
- **Earth fault.** Single-phase and double-phase earth faults;
- **Bolted fault.** Very low impedance fault, typically caused by human factor or accident;
- **Low current earth fault** caused by a high impedance phase to ground short circuit;
- **Upstream broken conductor.** Conductor touching ground at the source side;
- **Downstream broken conductor.** Conductor touching ground at the load side;
- **Low system voltage** caused by an incorrect network operation mode, tap changer malfunction, under-generation, or islanding. This protection prevents sensitive loads, such as motors, from overload and failure;
- **Low system frequency** caused by local under-generation, islanding or generation system malfunctions;
- **High system voltage** caused by tap changer malfunction, over-generation or islanding. This protection prevents sensitive loads from damage;
- **High system frequency** caused by islanding.

Protection elements against short circuit, high impedance earth fault, low system voltage, and low system frequency faults are provided with independent reclosing elements.

Reclosing elements are controlled by the Voltage Reclosing Control (VRC). The VRC blocks autoreclosing if power quality fails to meet customer requirements.

Ring line recloser

The Ring line recloser is provided with a unique source detector with the source threshold voltage setting. This source detector continuously detects the direction of power flow through the recloser main contacts. The source threshold voltage setting provides possibility to define the live line voltage level according to particularities of the network configuration.

The Ring line recloser provides protection and automation as the radial line recloser. In addition the Ring line recloser has directional elements to determine power flow direction (direct/reverse). The Ring line recloser has independently configurable sets of settings for direct and reverse power flow.

In addition Ring line recloser provides the following functionalities involved in loop automation, self-healing schemes and independent power producers' connection to the grid:

- **Loss of Supply** – provides recloser tripping if it detects source lost.
- **Automatic Backfeed Restoration** – provides automatically closing a normally open recloser if it detects a source on the either side of the recloser and absence of a source on the other side
- **Live Load Blocking** – monitors power supply from the load and source side and only allows closing if a source is present at the correct side;
- **Synchronization Check** – provides closing command execution only if voltage parameters from both sides are within predefined ranges.

Rezip recloser

The Rezip recloser is used to automate various networks where traditional time and current grading is impossible. Unlike a conventional recloser, the Rezip recloser can be used in ring and meshed networks and self-healing schemes. Any number of Rezip reclosers can be connected in series.

Standard sectionalizer

Standard sectionalizer provides automatic segregation of the faulty segment of the radial or ring feeder basing on number of upstream recloser operations.

Standard sectionalizer provides detection and subsequent trip during the dead time of upstream recloser

- **Short circuit.** Phase-to-phase and three-phase short circuits;
- **Earth fault.** Single-phase and double-phase earth faults;
- **Low current Earth fault** caused by a high impedance phase to ground short circuit.

Rezip sectionalizer

The Rezip sectionalizer provides detection and subsequent trip during dead time of upstream recloser as the Standard sectionalizer.

In addition Rezip sectionalizer automatically finds and segregates the faulty segment of radial, ring or meshed feeder by opening all devices which have sensed fault current and then close them one by one till the faulty segment is found. When faulty segment is found, only the nearest device to the fault will open to lockout. Rezip sectionalizer can be used with other automation features to provide sophisticated network healing algorithms.

The Rezip sectionalizer allows to:

- Overcome the limit of the number of sectionalizers in series;
- Minimize protection settings design resources (same protection settings for all Rezip sectionalizers for the most applications can be programmed);
- Minimize the number of upstream recloser operations and power interruptions for healthy network sections.

4.1.2 Protection Elements

OCR mode

OCR mode defines whether device operates as Recloser with OCR element or as a Sectionalizer with SECR element.

OCR mode can be independently selected for each protection group.

OCR mode settings are described in Table 14.

Table 14 – OCR mode settings

Settings	Range	Default
OCR mode	Recloser/Sectionalizer	Recloser

Source Detector (SD)

The source detector element has two main functions:

- Provides power flow direction to directional protection elements (ring operation mode);
- Provides source side information for loss of supply protection element.

Protection elements: AR OC, HL, AR SEF, VU, CU, AR UV, AR UF, AR OV, AR OF, CCV and ABR operation depends on the source side being identified. If power flows from „Source +“ side, then „Set +“ protection settings are active, if power flows from „Source -“ side, then „Set -“ protection settings are active.

Source detector has a changeable voltage detection level. In case power source voltage is less than specified, it will not consider as a source.

Table 15 – Source Detector element settings

Settings	Designation	Range	Resolution	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Source threshold voltage, kV	Ust[5]	0.5–27.0	0.1	0.5
Repolarization mode	Mode	Enable/Disable	n.a	Enable

Bolted Fault (BF)

This element provides instantaneous tripping when bolted fault conditions are detected. As it deals both with positive sequence voltage and current it provides better sensitivity for bolted faults than conventional highset overcurrent elements.

Table 16 – Bolted Fault element settings

Settings	Designation	Range	Resolution	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Pickup current, A	Ip	20-12500	1	12500

[5] The value of Ust setting cannot exceed the value of Rated voltage configuration setting.

Phase Overcurrent (OC)

This element is available for OCR mode “Recloser” only.

This element provides protection against overloads, phase-to-phase and three-phase short circuits.

OC protection consists of six (6) individual overcurrent elements providing three stages of protection for both the Forward (Source+) and Reverse (Source-) power flow directions: OC1+, OC1-, OC2+, OC2-, OC3+, OC3- .

OC1

Phase overcurrent low set element OC1 is designated to provide time delayed trips. It is enabled in any selected sequence in the Overcurrent Reclosing element. „I“ (Instantaneous) stands for accelerated and „D“ (Delayed) for delayed step of overcurrent protection in an autoreclosing sequence.

OC2

Phase overcurrent low set element OC2 is designated to provide accelerated trips. If a sequence step in the Overcurrent Reclosing Element is set „D“ OC2 element is disabled. If a sequence step in the Overcurrent Reclosing element is set „I“ OC2 element is enabled.

OC1, OC2 settings are described in Table 17 and Table 18 .

Table 17 – Radial line recloser OC1, OC2 element settings

Settings	Designation	Range	Step size	Default
Type of time current characteristic	TCC	User-defined curves list	n.a.	TD
Hot line blocking mode	HLBM	Enable/Disable	n.a	Enable
Voltage restriction mode	VRM	Enable/Disable	n.a.	Disable

Table 18 – Ring line recloser C1, OC2 element settings

Settings	Designation	Range	Step size	Default
Type of time current Characteristic+	TCC+	User-defined curves list	n.a.	TD
Hot line blocking mode+	HLBM+	Enable/Disable	n.a.	Enable
Voltage restriction mode +	VRM	Enable/Disable	n.a.	Disable
Type of time current Characteristic-	TCC-	User-defined curves list	n.a.	TD
Hot line blocking mode-	HLBM-	Enable/Disable	n.a.	Enable
Voltage restriction mode -	VRM	Enable/Disable	n.a.	Disable

For details on available TCC refer to Table 27 of this guide.

OC3

Phase fault high set instantaneous element provides protection against phase high current faults with a reduced number of trips to lockout. If there is no intention to reduce the number of trips to lockout at high current faults, enabling this element is not recommended. OC1 and OC2 allow reduction of tripping time to any desired value at high currents.

OC3 settings are described in Table 19 and Table 20 .

Table 19 – Radial line recloser OC3 element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Disable
Pickup current, A	Ip	40-12500	1	12500
Tripping time, s	Tt	0.00-2.00	0.01	0
Hot line blocking mode	HLBM	Enable/Disable	n.a.	Enable

Table 20 – Ring line recloser C3 element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Disable
Pickup current+, A	Ip+	40-12500	1	12500
Tripping time+, s	Tt+	0.00-2.00	0.01	0
Hot line blocking mode+	HLBM+	Enable/Disable	n.a.	Enable

Settings	Designation	Range	Step size	Default
Operating mode-	Mode-	Enable/Disable	n.a.	Disable
Pickup current-, A	Ip-	40-12500	1	12500
Tripping time-, s	Tt-	0.00-2.00	0.01	0
Hot line blocking mode-	HLBM-	Enable/Disable	n.a.	Enable

Earth Fault (EF)

This element is available for OCR mode “Recloser” only.

This element provides protection against single phase and double phase earth faults.

EF protection consist of six (6) individual overcurrent protection elements providing three stages of protection for both the Direct (Source+) and Reverse power flow (Source-) directions: EF1+, EF1-, EF2+, EF2-, EF3+, EF3-.

EF1

Earth fault low set element EF1 is designated to provide time delayed trips. It is enabled in any selected sequence in the Overcurrent Reclosing element. „I“ (Instantaneous) stands for accelerated and „D“ (Delayed) for delayed step of overcurrent protection in an autoreclosing sequence.

EF2

Earth fault low set element EF2 is designated to provide accelerated trips. If a sequence step in the Overcurrent Reclosing Element is set „D“ EF2 element is disabled. If the sequence step in the Overcurrent Reclosing element is set „I“ EF2 element is enabled.

EF1, EF2 settings are described in Table 21 and Table 22 .

Table 21 – Radial line recloser EF1, EF2 element settings

Settings	Designation	Range	Step size	Default
Type of time current characteristic	TCC	User-defined curves list	n.a.	TD
Hot line blocking mode	HLBM	Enable/Disable	n.a	Enable

Table 22 – Ring line recloser EF1, EF2 element settings

Settings	Designation	Range	Step size	Default
Type of time current Characteristic+	TCC+	User-defined curves list	n.a.	TD
Hot line blocking mode+	HLBM+	Enable/Disable	n.a.	Enable
Type of time current Characteristic-	TCC-	User-defined curves list	n.a.	TD
Hot line blocking mode-	HLBM-	Enable/Disable	n.a.	Enable

For details on available TCC refer to Table 27 of this guide.

EF3

Earth fault high set instantaneous element provides protection against high earth current faults with a reduced number of trips to lockout. If there is no intention to reduce the number of trips to lockout at high current faults, enabling this element is not recommended. EF1 and EF2 allow reduction of tripping time to any desired value at high currents.

EF3 settings are described in Table 23 and Table 24 .

Table 23 – Radial line recloser EF3 element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Disable
Pickup current, A	Ip	40-12500	1	12500
Tripping time, s	Tt	0.00-2.00	0.01	0
Hot line blocking mode	HLBM	Enable/Disable	n.a.	Enable

Table 24 – Ring line recloser EF element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Disable
Pickup current+, A	Ip+	40-12500	1	12500
Tripping time+, s	Tt+	0.00-2.00	0.01	0
Hot line blocking mode+	HLBM+	Enable/Disable	n.a.	Enable
Operating mode-	Mode-	Enable/Disable	n.a.	Disable
Pickup current-, A	Ip-	40-12500	1	12500
Tripping time-, s	Tt-	0.00-2.00	0.01	0
Hot line blocking mode-	HLBM-	Enable/Disable	n.a.	Enable

Negative Sequence Overcurrent (NSOC)

Negative sequence overcurrent (NSOC) low set time delayed element provides delayed trips at phase-to-phase faults.

NSOC settings are described in Table 25 and Table 26.

Table 25 – Radial line recloser NSOC element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Disabled / Trip to LO / Trip with AROC	n.a.	Disable
Type of time current characteristic	TCC	User-defined curves list	n.a	TD
Hot line blocking mode	HLBM	Enable/Disable	n.a.	Disable

Table 26 – Ring line recloser NSOC element settings

dd	Designation	Range	Step size	Default
Operating mode+	Mode+	Disabled / Trip to LO / Trip with AROC	n.a.	Disabled
Type of time current characteristic+	TCC+	User-defined curves list	n.a.	TD
Hot line blocking mode+	HLBM+	Enable/Disable	n.a.	Disable
Operating mode-	Mode-	Disabled / Trip to LO / Trip with AROC	n.a.	Disabled
Type of time current characteristic-	TCC-	User-defined curves list	n.a.	TD

For details on available TCC refer to Table 27 of this guide.

Table 27 – TCC types

Settings	Designation	Range	Descriptions	Default
Type of time current characteristic	TCC	Definite Time (TD)	Table 28	TD
		IEC: EI, I, LTI, VI	Table 29, Table 30	
		ANSI: EI , I, LTEI, LTI, LTVIANIS MI, STEI, STI, VI	Table 31, Table 32	
		Custom: custom curves are available on request. Contact MAGVATECH representative.	Table 33	

TCC can be uploaded to the RC5_4 via TELARM configuration software.

Phase overcurrent and earth fault TD, IEC and ANSI time current curves settings are described in Table 28 - Table 33.

Table 28 – OC/EF/NSOC TD TCC settings

Settings	Designation	Protection elements	Range	Step size	Factory defaults
Tripping time, s	Tt	OC3, EF3	0.00-2.00	0.01	0.00
		Another	0.00-100.00	0.01	10.00

Settings	Designation	Protection elements	Range	Step size	Factory defaults
Pickup current, A	Ip	EF1, EF2	3-6000	1	100
		OC3, EF3	40-12500		
		NSOC	1-6000		
		Another	10-6000		

Table 29 – Available IEC TCC with parameters

TCC type	Designation	A	n
Extremely Inverse (IEC 60255-151 Ed.1.0)	IEC EI	80	2.0
Inverse (IEC 60255-151 Ed.1.0)	IEC I	0.14	0.02
Long Time Inverse (Obsolete)	IEC LTI	120	1
Very Inverse (IEC 60255-151 Ed.1.0)	IEC VI	13.5	1.0

Table 30 – OC/EF/NSOC IEC TCC settings

Setting	Designation	Protection elements	Range	Step size	Factory defaults
Asymptote current, A	Ias	EF1, EF2, NSOC	3-1280	1	100
		Another	10-1280		
Time multiplier	Tm	All	0.01-15.00	0.01	1.00
Minimum time, s	Tmin	All	0.05-100.00	0.01	0.05
Maximum time, s	Tmax	All	0.05-100.00	0.01	10.00
Pickup current, A	Ip	EF1, EF2, NSOC	3-6000	1	100
		Another	10-6000		
Time adder, s	Ta	All	0.00-2.00	0.01	0.00
Reset time, s	Tres	All	0.00-20.00	0.01	0.00

Table 31 – Available ANSI TCC with parameters

TCC type	Designation	A	B	D	n
Extremely Inverse (Obsolete)	ANSI EI	6,407	0,025	3	2
Extremely Inverse (IEEE Std C37.112-1996)	ANSI EI	28,2	0,1217	29,1	2
Inverse (Obsolete)	ANSI I	0,0086	0,0185	0,46	0,02
Long Time Extremely Inverse (Obsolete)	ANSI LTEI	64,07	0,25	30	2
Long Time Inverse (Obsolete)	ANSI LTI	0,086	0,185	4,6	0,02
Long Time Very Inverse (Obsolete)	ANSI LTVI	28,55	0,712	13,46	2
Moderately Inverse (IEEE Std C37.112-1996)	ANSI MI	0,0515	0,114	4,85	0,02
Short Time Extremely Inverse (Obsolete)	ANSI STEI	1,281	0,005	0,6	2
Short Time Inverse (Obsolete)	ANSI STI	0,0017	0,0037	0,092	0,02
Very Inverse (Obsolete)	ANSI VI	2,855	0,0712	1,346	2
Very Inverse (IEEE Std C37.112-1996)	ANSI VI	19,61	0,491	21,6	2

Table 32 – OC/EF/NSOC ANSI TCC settings

Setting	Designation	Protection elements	Range	Step size	Factory defaults
Asymptote current, A	Ias	EF1, EF2, NSOC	3-1280	1	100
		Another	10-1280		
Time multiplier	Tm	All	0.01-15.00	0.01	1.00
Minimum time, s	Tmin	All	0.05-100.00	0.01	0.05
Maximum time, s	Tmax	All	0.05-100.00	0.01	10.00
Pickup current, A	Ip	EF1, EF2, NSOC	3-6000	1	100
		Another	10-6000		
Time adder, s	Ta	All	0.00-2.00	0.01	0.00

Table 33 – OC/EF/NSOC custom TCC settings[6]

Setting	Designation	Protection elements	Range	Step size	Factory defaults
Number of sections	NA	All	1/2/3	NA	3
Maximum time, s	Tmax	All	0.05-100.00	0.01	10.00
First intermediate time, s	T1	All	0.05-100.00	0.01	3.00
Second intermediate time, s	T2	All	0.05-100.00	0.01	0.25
Minimum time, s	Tmin	All	0.05-100.00	0.01	0.05
Pickup current, A	Ip	EF1, EF2, NSOC	3-6000	1	100
		Another	10-6000		
First intermediate current, A	I1	EF1, EF2, NSOC	3-6000	1	500
		Another	10-6000		
Second intermediate current, A	I2	EF1, EF2, NSOC	3-6000	1	1000
		Another	10-6000		
Maximum current, A	Imax	EF1, EF2, NSOC	3-6000	1	3000
		Another	10-6000		
First section asymptote, A	Ias1	All	1-6000	1	10
Second section asymptote, A	Ias2	All	1-6000	1	10
Third section asymptote, A	Ias3	All	1-6000	1	10

Phase and Earth Overcurrent Reclosing (AR OC)

This element is available for OCR mode “Recloser” only.

The AR OC element provides reclosing initiated by tripping of one of OC1, OC2, OC3, EF1, EF2 or EF3 elements. The user set delay between trip and reclose is called „reclose time“ (Tr) and can be set independently for each trip in the sequence. If the fault is not cleared during „reclose time“, the recloser will trip again. This will repeat a number of times until the fault is cleared or the AR OC element reaches the end of the user defined reclose sequence. At this point the recloser remains open and will no longer reclose automatically. This is known as „lockout“ and the recloser can only be closed by local or remote operator command, which clears the lockout condition.

Zone Sequence Coordination

The AR OC provides Zone Sequence Coordination (ZSC). ZSC forces the AR OC element to step to the next count in the reclose sequence on reset of all protection elements if it detects a downstream protection device has operated. This functionality is required for applications where a fuse-saving philosophy is used.

AR OC settings are described in Table 34 and Table 35.

Table 34 – Radial line recloser AR OC element settings

Settings	Designation	Range		Default
Operating mode	Mode	Normal/Rezip/ZSC		ZSC
Include SEF mode	Include SEF	Enable/Disable		Disable
Number of trips to lockout	Nt	Mode = Normal/ZSC	1/2/3/4	4
		Mode = Rezip	2/3/4	2
Number of highset trips to lockout	Nhs	1/2/3/4		1
Reclosing sequence	Seq	Mode = Normal/ZSC	For 4 trips to lockout: IIII/IIID/IIDD/IDDD/DDDD/DDDI/DDII/ DIII/ IIDI/IDII/IDDI For 3 trips to lockout: III/IID/IDD/DDD/DDI/DII/IDI For 2 trips to lockout: II/ID/DD/DI For 1 trip to lockout: I/D	IIDD
		Mode = Rezip	n.a.	For 4 trips to lockout: DIII For 3 trips to lockout: DII For 2 trips to lockout: DI
First closure mode	SST mode	Mode = Normal/ZSC	Accelerate, Decelerate, Normal, Unconditional AR	Normal
		Mode = Rezip	n.a.	Accelerate
First closure time	SST time	Mode = Normal/ZSC	1-180	1

[6] Custom TCC could be configured via user software TELARM only.

Settings	Designation	Range		Default
		Mode = Rezip	n.a.	0.1
First reclose time, s	Tr1	Mode = Normal/ZSC	0.10–1800.00	1.00
		Mode = Rezip	0.20–1800.00	0.20
Second reclose time, s	Tr2	1.00–1800.00		10.00
Third reclose time, s	Tr3	1.00–1800.00		30.00
Reset time, s	Tres	Mode = Normal/ZSC	1-180	1
		Mode = Rezip	n.a.	0.10

Table 35 – Ring line recloser AR OC element settings

Settings	Designation	Range		Default
Operating mode	Mode	Normal/Rezip/ZSC		ZSC
Include SEF mode	Include SEF	Enable/Disable		Disable
Number of trips to lockout+	Nt+	Mode = Normal/ZSC	1/2/3/4	4
		Mode = Rezip	2/3/4	2
Number of highset trips to lockout+	Nhs+	1/2/3/4		1
Reclosing sequence+	Seq+	Mode = Normal/ZSC	For 4 trips to lockout: IIII/IIID/IIDD/IDDD/DDDD/DDDI/DDII/DIII/ IIDI/IDII/IDDI For 3 trips to lockout: III/IID/IDD/DDD/DDI/DII/IDI For 2 trips to lockout: II/ID/DD/DI For 1 trip to lockout: I/D	IIDD
		Mode = Rezip	n.a.	For 4 trips to lockout: DIII For 3 trips to lockout: DII For 2 trips to lockout: DI
First closure mode+	SST mode+	Mode = Normal/ZSC	Accelerate, Decelerate, Normal, Unconditional AR	Normal
		Mode = Rezip	n.a.	Accelerate
First closure time+	SST time+	Mode = Normal/ZSC	1-180	1
		Mode = Rezip	n.a.	0.1
First reclose time+, s	Tr1+	Mode = Normal/ZSC	0.10–1800.00	1.00
		Mode = Rezip	0.20–1800.00	0.20
Second reclose time+, s	Tr2+	1.00–1800.00		10.00
Third reclose time+, s	Tr3+	1.00–1800.00		30.00
Reset time+, s	Tres+	Mode = Normal/ZSC	1-180	1
		Mode = Rezip	n.a.	0.10
Number of trips to lockout-	Nt-	Mode = Normal/ZSC	1/2/3/4	4
		Mode = Rezip	2/3/4	2
Number of highset trips to lockout-	Nhs-	1/2/3/4	1	
Reclosing sequence-	Seq-	Mode = Normal/ZSC	For 4 trips to lockout: IIII/IIID/IIDD/IDDD/DDDD/DDDI/DDII/DIII/ IIDI/IDII/IDDI For 3 trips to lockout: III/IID/IDD/DDD/DDI/DII/IDI For 2 trips to lockout: II/ID/DD/DI For 1 trip to lockout: I/D	IIDD
		Mode = Rezip	n.a.	For 4 trips to lockout: DIII For 3 trips to lockout: DII For 2 trips to lockout: DI
First closure mode-	SST mode-	Mode = Normal/ZSC	Accelerate, Decelerate, Normal, Unconditional AR	Normal
		Mode = Rezip	n.a.	Accelerate
First closure time-	SST time-	Mode = Normal/ZSC	1-180	1
		Mode = Rezip	n.a.	0.1
First reclose time-, s	Tr1-	Mode = Normal/ZSC	0.10–1800.00	1.00
		Mode = Rezip	0.20–1800.00	0.20
Second reclose time-, s	Tr2-	1.00–1800.00	10.00	
Third reclose time-, s	Tr3-	1.00–1800.00	30.00	
Reset time-, s	Tres-	Mode = Normal/ZSC	1-180	1
		Mode = Rezip	n.a.	0.10

Reset time

The Reset time setting in the autoreclosing element controls the time elapsed between the closing command execution generated by the relay to the breaker and the time the auto-reclose function resets to the initial cycle. This timer is used to withstand fault restrikes in case an intermittent fault has been detected.

The First closure time setting controls how quickly autoreclosing will be enabled after an operator (local or remote) closing command is executed.

Reset time for autoreclosing sequence

The Reset timer for the autoreclosing sequence starts counting when the close command is initiated by the AR OC protection element that has been executed and no-fault current is detected after closing. If the measured current does not exceed the pickup setting and the Reset timer stops counting, a current reclosing cycle will be continued. In the case that, after closing, the measured current does not exceed the pickup setting within the Reset time period, a new autoreclosing sequence will be enabled and will be executed for consequent faults. The Reset time counter starts counting from zero for each automatic closing event in an autoreclosing sequence.

First closure time (SST timer)

The Single shot to lockout algorithm is supported by the AR OC element. This function allows tripping and lockout (preventing autoreclosing) if a fault has been detected by the operator during the First closure time.

The Single shot to lockout function will be disabled in case “Unconditional AR” is selected for First closure mode. Recloser can make up to 4 closing operations including the first close initiated by operator.

Overcurrent Interruption Detection (OCID)

This element is available for OCR mode “Sectionalizer” only.

This element provides detection of the overload, phase-to-phase and three phase short circuit fault passage and interruption due to operation of upstream device. OCID operates according to definite time TCC.

OCID settings are described in Table 36 and Table 37 .

Table 36 – Radial line recloser OCID element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Detection time, s	Td	0.00–100.00	0.01	0.1
Pickup current, A	Ip	10–6000	1	100
Reset time, s	Tres	0.00–100.00	0.01	0.1
Fault interruption reset time, s	Tfir	0.10–100.00	0.01	1.00

Table 37 – Ring line recloser OCID element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Detection time+, s	Td+	0.00–100.00	0.01	0.1
Pickup current+, A	Ip+	10–6000	1	100
Reset time+, s	Tres+	0.00–100.00	0.01	0.1
Fault interruption reset time+, s	Tfir+	0.10–100.00	0.01	1.00
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Detection time-, s	Td-	0.00–100.00	0.01	0.1
Pickup current-, A	Ip-	10–6000	1	100
Reset time-, s	Tres-	0.00–100.00	0.01	0.1
Fault interruption reset time-, s	Tfir-	0.10–100.00	0.01	1.00

Earth Fault Interruption Detection (EFID)

This element is available for OCR mode “Sectionalizer” only.

This element provides detection of the earth fault current passage and interruption due to operation of upstream device. EFID operates according to definite time TCC.

EFID settings are described in Table 38 and Table 39 .

Table 38 – Radial line recloser EFID element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Detection time, s	Td	0.00–100.00	0.01	0.1
Pickup current, A	Ip	3–6000	1	100
Reset time, s	Tres	0.00–100.00	0.01	0.1
Fault interruption reset time, s	Tfir	0.10–100.00	0.01	1.00

Table 39 – Ring line recloser EFID element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Detection time+, s	Td+	0.00–100.00	0.01	0.1
Pickup current+, A	Ip+	3–6000	1	100
Reset time+, s	Tres+	0.00–100.00	0.01	0.1
Fault interruption reset time+, s	Tfir+	0.10–100.00	0.01	1.00
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Detection time-, s	Td-	0.00–100.00	0.01	0.1
Pickup current-, A	Ip-	3–6000	1	100
Reset time-, s	Tres-	0.00–100.00	0.01	0.1
Fault interruption reset time-, s	Tfir-	0.10–100.00	0.01	1.00

Sensitive Earth Fault Interruption Detection (SEFID)

This element is available for OCR mode “Sectionalizer” only.

This element provides earth fault interruption detection in the networks with insulated/compensated neutral. It is also applicable in earthed neutral systems for high-impedance earth fault protection. Current based as well as current and angle based detection option is provided with corresponding settings. SEFID operates according to definite time TCC.

SEFID settings are described in Table 40 and Table 41 .

Table 40 – Radial line recloser SEFID element settings

Settings	Designation	Range		Default
Operating mode	Mode	Enable/Disable		Enable
Detection type	Type	Current/Current and angle		Current
Pickup current, A	Ip	0.5–80		4
Torque angle, deg	At	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0
Detection time, s	Td	0.15–100.00		1.00
Reset time, s	Tres	0.15–100.00		0.15
Fault interruption reset time, s	Tfir	0.10–100.00		1.00

Table 41 – Ring line recloser SEFID element settings

Settings	Designation	Range		Default
Operating mode+	Mode+	Enable/Disable		Enable
Detection type+	Type+	Current/Current and angle		Current
Pickup current+, A	Ip+	0.5–80		4
Torque angle+, deg	At+	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0
Detection time+, s	Td+	0.15–100.00		1.00

Settings	Designation	Range		Default
Reset time+, s	Tres+	0.15–100.00		0.15
Fault interruption reset time+, s	Tfir+	0.10–100.00		1.00
Operating mode-	Mode-	Enable/Disable		Enable
Detection type-	Type-	Current/Current and angle		Current
Pickup current-, A	Ip-	0.5–80		4
Torque angle-, deg	At-	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0
Detection time-, s	Td-	0.15–100.00		1.00
Reset time-, s	Tres-	0.15–100.00		0.15
Fault interruption reset time-, s	Tfir-	0.10–100.00		1.00

Sectionalizing (SEC)

This element is available for OCR mode “Sectionalizer” only.

This element provides count of upstream recloser operations during the fault and after predefined number of counts device will trip and lockout if mode is Standard/Rezip or reclose if mode is Rezip.

Standard (with up to 3 series sections in use) and Rezip (with unlimited devices number) modes are supported.

SEC settings are described in Table 42 and Table 43 .

Table 42 – Radial line recloser SEC element settings

Settings	Designation	Range		Default
Operating mode	Mode	Standard/Rezip/FPI[7]		Standard
Number of fault detections to trip	Nd	Mode = Standard/Rezip	1/2/3/4	1
		Mode = FPI	n.a.	n.a.
Sequence reset time, s	Tsr	Mode = Standard/Rezip	1.00–180.00	10.00
		Mode = FPI	n.a.	n.a.
Reset time, s	Tres	Mode = Standard/Rezip	0.10–180.00	0.10
		Mode = FPI	n.a.	n.a.
Tripping time, s	Tt	Mode = Standard/Rezip	0.00–100.00	0.00
		Mode = FPI	n.a.	n.a.
Reclose time, s	Tr	Mode = Rezip	0.20–1800.00	1.00
		Mode = Standard/FPI	n.a.	n.a.
Blocking time, s	Tbl	Mode = Rezip	1–1800	10
		Mode = Standard/FPI	n.a.	n.a.

Table 43 – Ring line recloser SEC element settings

Settings	Designation	Range		Default
Operating mode	Mode	Standard/Rezip/FPI		Standard
Number of fault detections to trip	Nd	Mode = Rezip	1/2/3/4	1
		Mode = Standard/FPI	n.a.	n.a.
Sequence reset time, s	Tsr	Mode = Rezip	1.00–180.00	10.00
		Mode = Standard/FPI	n.a.	n.a.
Reset time, s	Tres	Mode = Rezip	0.10–180.00	0.10
		Mode = Standard/FPI	n.a.	n.a.
Tripping time, s	Tt	Mode = Rezip	0.00–100.00	0.00
		Mode = Standard/FPI	n.a.	n.a.
Reclose time, s	Tr	Mode = Rezip	0.20–1800.00	1.00
		Mode = Standard/FPI	n.a.	n.a.
Blocking time, s	Tbl	Mode = Rezip	1–1800	10
		Mode = Standard/FPI	n.a.	n.a.
Number of fault detections to trip+	Nd+	Mode = Standard	1/2/3/4	1
		Mode = Rezip/FPI	n.a.	n.a.
Sequence reset time+, s	Tsr+	Mode = Standard	1.00–180.00	10.00

[7] Fault Passage Indicator

Settings	Designation	Range		Default
		Mode = Rezip/FPI	n.a.	n.a.
Reset time+, s	Tres+	Mode = Standard	0.10–180.00	0.10
		Mode = Rezip/FPI	n.a.	n.a.
Tripping time+, s	Tt+	Mode = Standard	0.00–100.00	0.00
		Mode = Rezip/FPI	n.a.	n.a.
Number of fault detections to trip	Nd	Mode = Standard	1/2/3/4	1
		Mode = Rezip/FPI	n.a.	n.a.
Sequence reset time, s	Tsr	Mode = Standard	1.00–180.00	10.00
		Mode = Rezip/FPI	n.a.	n.a.
Reset time, s	Tres	Mode = Standard	0.10–180.00	0.10
		Mode = Rezip/FPI	n.a.	n.a.
Tripping time, s	Tt	Mode = Standard	0.00–100.00	0.00
		Mode = Rezip/FPI	n.a.	n.a.

Flag Reset

This element is available for OCR mode “Sectionalizer” only.

This element is used by OCID, EFID and SEFID elements and common for all of them. Interruption detection element is to remain in corresponding “Flag” state until user-defined time elapsed or manual reset via control panel or communications.

Flag Reset settings are described in Table 44.

Table 44 – Flag Reset settings

Settings	Designation	Range	Step size	Default
Reset Flags by Trip	ResetF_Open_Mode	Enable/Disable	n.a.	Disable
Reset Flags by timer	ResetF_Tf_Mode	Enable/Disable	n.a.	Disable
Flag reset time, s	Tf	0.10–3600.00	0.01	0.10

Loss of Supply (LS)

This element trips recloser if the source is lost (no HV voltage is present).

LS settings are described in Table 45.

Table 45 – LS element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Disable/SD/VRC/SD&VRC	n.a.	SD&VRC
Tripping time, s	Tt	0.10–100.00	0.01	10.00
LS off after lockout	OFFLS	Enable/Disable	n.a.	Disable
Prot control mode	PC mode	Enable/Disable	n.a.	Disable
PC mode timeout, Hours:Minutes:Seconds	Tpc	00:00:01 – 06:00:00	0:00:01	0:00:10

Loss of Supply Autoreclosing (AR LS)

The AR LS element provides reclosing initiated by the LS element tripping.

The delay between power supply restoration and reclose is called „reclose time“ (Tr). Tr time setting is configured by the user. If loss of supply occurs again prior to reset time expiration, the recloser will trip again and will not reclose automatically. This is known as „lockout“ and the recloser can only be closed by local or remote operator command, which clears the lockout condition.

AR LS settings are described in Table 46.

Table 46 – AR LS element settings

Settings	Designation	Range		Default
Operating mode	Mode	Normal/Rezip		Normal
Number of trips to lockout[8]	Nt	Mode = Normal	1/2	1
		Mode = Rezip	n.a.	2
Reclose time, s	Tr	Mode = Normal	0.10–180.00	10.00
		Mode = Rezip	0.20–180.00	10.00

REZIP

Rezip is the automation algorithm that enables complex distribution network automation. Rezip can be used in networks where the recloser application is not possible due to protection coordination restrictions. The algorithm is initiated by an upstream recloser trip. Once the loss of supply is detected, all Rezip reclosers will trip during recloser dead-time. When the recloser closes, it restores supply to the closest Rezip recloser(s). It activates the AR LS timer and after a preset time Rezip reclosers will close restoring the power supply to downstream Rezip recloser(s). Immediately after closure Rezip the recloser(s) are operating in Instantaneous protection mode and if any of them detects the fault, it will trip before the upstream protection device will. By the time next Rezip recloser is closer by the AR LS, the upstream Rezip OC/EF protection is disabled, so no grading between Rezip reclosers is needed.

The algorithm provides the set-up simplicity of a traditional sectionalizer and at the same time reducing the fault clearing time and network reconfiguration time application in far more complex networks and provide an unlimited number of sections to limit the number of customers affected.

Rezip is applicable in meshed grid automation schemes together with ABR functionality. Rezip enables the building of self-healing networks where it is not possible with conventional reclosers and sectionalizers.

Hot Line (HL)

This element consists of two sub-elements which provide protection against short circuit faults during Hot Line maintenance. It generally has more sensitive settings than corresponding OCR settings and it has no reclosing functions. HL consists of two Overcurrent elements, one for Phase Overcurrent (HLOC) and one for Earth Fault (HLEF). Operation of either element results in the trip to lockout.

HL settings are described in Table 47 - Table 52 .

Table 47 – Radial line recloser HLOC element settings

Settings	Designation	Range	Step size	Default
Operation mode	Mode	Enable/Disable	n.a.	Enable
Pickup current, A	Ip	10-1280	1	10
Tripping time, s	Tt	0.00–2.00	0.01	0.00

Table 48 – Ring line recloser HLOC element settings

Settings	Designation	Range	Step size	Default
Operation mode+	Mode	Enable/Disable	n.a.	Enable
Pickup current+, A	Ip+	10-1280	1	10
Tripping time+, s	Tt+	0.00–2.00	0.01	0.00
Operation mode-	Mode	Enable/Disable	n.a.	Enable
Pickup current-, A	Ip-	10-1280	1	10
Tripping time-, s	Tt-	0.00–2.00	0.01	0.00

[8] In Rezip mode this setting has a fixed value and is unavailable (hidden).

Table 49 – Radial line recloser HLEF element settings

Settings	Designation	Range	Step size	Default
Operation mode	Mode	Enable/Disable	n.a.	Enable
Pickup current, A	Ip	4-1280	1	4
Tripping time, s	Tt	0.00–2.00	0.01	0.00

Table 50 – Ring line recloser HLEF element settings

Settings	Designation	Range	Step size	Default
Operation mode+	Mode	Enable/Disable	n.a.	Enable
Pickup current+, A	Ip+	4-1280	1	4
Tripping time+, s	Tt+	0.00–2.00	0.01	0.00
Operation mode-	Mode	Enable/Disable	n.a.	Enable
Pickup current-, A	Ip-	4-1280	1	4
Tripping time-, s	Tt-	0.00-2.00	0.01	0.00

Table 51 – Radial line recloser HLNSOC element settings

Settings	Designation	Range	Step size	Default
Operation mode	Mode	Enable/Disable	n.a.	Enable
Pickup current, A	Ip	4-1280	1	4
Tripping time, s	Tt	0.00-2.00	0.01	0.00

Table 52 – Ring line recloser HLNSOC element settings

Settings	Designation	Range	Step size	Default
Operation mode+	Mode	Enable/Disable	n.a.	Enable
Pickup current+, A	Ip+	4-1280	1	4
Tripping time+, s	Tt+	0.00-2.00	0.01	0.00
Operation mode-	Mode	Enable/Disable	n.a.	Enable
Pickup current-, A	Ip-	4-1280	1	4
Tripping time-, s	Tt-	0.00-2.00	0.01	0.00

Sensitive Earth Fault (SEF)

This element provides protection against high impedance earth faults.

SEF settings are described in Table 53 and Table 54 .

SEF TD and custom time current curves settings are described in Table 55 and Table 56 .

Table 53 – Radial line recloser SEF element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Disable/Alarm/Trip		Trip
EF blocking mode	EFB mode	OCR mode = Sectionaliser	Enable	Enable
		OCR mode = Recloser	Enable/Disable	Enable
Fault identification type	Type	Current/Current and angle		Current
Time current characteristic	TCC	Type = Current	TD/MVT I[9]	TD
		Type = Current and angle	TD	TD
Torque angle, deg	At	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0

[9] Custom inverse type curve that is available on request. Contact Magvatech representative.

Table 54 – Ring line recloser SEF element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Disable/Alarm/Trip		Trip
EF blocking mode+	EFB mode+	OCR mode = Sectionaliser	Enable	Enable
		OCR mode = Recloser	Enable/Disable	Enable
Fault identification type+	Type+	Current/Current and angle		Current
Time current characteristic+	TCC+	Type = Current	TD/MVT I[15]	TD
		Type = Current and angle	TD	TD
Torque angle+, deg	At+	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0
Operating mode-	Mode-	Disable/Alarm/Trip		Trip
EF blocking mode-	EFB mode-	OCR mode = Sectionaliser	Enable	Enable
		OCR mode = Recloser	Enable/Disable	Enable
Fault identification type-	Type-	Current/Current and angle		Current
Time current characteristic-	TCC-	Type = Current	TD/MVT I[15]	TD
		Type = Current and angle	TD	TD
Torque angle-, deg	At-	Type = Current	n.a.	n.a.
		Type = Current and angle	0–359	0

Table 55 – SEF TD TCC settings

Settings	Designation	Range	Step size	Default
Tripping time, s	Tt	0.01–100.00	0.01	10.00
Pickup current, A	Ip	0.5–80	1	4
Reset time, s	Tres	0.00-100.00	0.01	0.00

Table 56 – SEF MVT I TCC settings[10]

Settings	Designation	Range	Step size	Default
Number of sections	n.a.	1/2/3	n.a.	3
Maximum time, s	Tmax	0.10–100.00	0.01	10.00
First intermediate time, s	T1	0.10–100.00	0.01	3.00
Second intermediate time, s	T2	0.10–100.00	0.01	0.25
Minimum time, s	Tmin	0.10–100.00	0.01	0.10
Pickup current, A	Ip	0.5–80	1	4
First intermediate current, A	I1	1–6000	1	500
Second intermediate current, A	I2	1–6000	1	1000
Maximum current, A	Imax	1–6000	1	3000
First section asymptote, A	Ias1	1–80	1	4
Second section asymptote, A	Ias2	1–6000	1	10
Third section asymptote, A	Ias3	1–6000	1	10
Reset time, s	Tres	0.00-100.00	0.01	0.00

Sensitive Earth Fault Reclosing (AR SEF)

This element provides reclosing initiated by the SEF element operation. It also supports single shot to lockout functionality. AR SEF settings are described in Table 57 and Table 58 .

Table 57 – Radial line recloser AR SEF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2/3/4	n.a.	1
First reclose time, s	Tr1	0.10–180.00	0.01	1.00
Second reclose time, s	Tr2	1.00–180.00	0.01	10.00
Third reclose time, s	Tr3	1.00–180.00	0.01	30.00
Reset time, s	Tres	1–180	1	1

[10] Custom TCC could be configured via user software TELARM only.

Table 58 – Ring line recloser AR SEF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2/3/4	n.a.	1
First reclose time+, s	Tr1+	0.10–180.00	0.01	1.00
Second reclose time+, s	Tr2+	1.00–180.00	0.01	10.00
Third reclose time+, s	Tr3+	1.00–180.00	0.01	30.00
Reset time+, s	Tres+	1–180	1	1
Number of trips to lockout-	Nt-	1/2/3/4	n.a.	1
First reclose time-, s	Tr1-	0.10–180.00	0.01	1.00
Second reclose time-, s	Tr2-	1.00–180.00	0.01	10.00
Third reclose time-, s	Tr3-	1.00–180.00	0.01	30.00
Reset time-, s	Tres-	1–180	1	1

Neutral Admittance Protection (NAP)

This element operates from either the SEF or EF to provide single stage of admittance (Y0), conductance (G0) and susceptance (B0) elements which provides delayed trips when the magnitude of (Y0/G0/B0) exceeds the set value.

NAP settings are described in Table 59 and Table 60 .

Table 59 – Radial line recloser NAP element settings

Settings	Designation	Range		Default
Protection type	Type	Y0/G0/B0		Y0
Direction mode	Dmode	Type = Y0	n.a.	n.a.
		Type = G0/B0	Bidirectional/Forward/ Reverse	Bidirectional
Operating mode	Mode	Enable/Disable		Enable
Pickup admittance, mS	Y0	Type = Y0	0.1-100.0	0.1
		Type = G0/B0	n.a.	n.a.
Pickup conductance, mS	G0	Type = G0	0.1-100.0	0.1
		Type = Y0/B0	n.a	n.a.
Pickup susceptance, mS	B0	Type = B0	0.1-100.0	0.1
		Type = Y0/G0	n.a.	n.a.
Correction angle, deg	Ac	Type = G0/B0 Dmode = Forward/Reverse	-179–179	0
		Type = Y0	n.a.	n.a.
Minimum U0, kV	U0min	0.5–10.0		0.5
Tripping time, s	Tt	0.05–100.00		0.05
Reset time, s	Tres	0.00–100.00		0.00

Table 60 – Ring line recloser NAP element settings

Settings	Designation	Range		Default
Protection type+	Type+	Y0/G0/B0		Y0
Direction mode+	Dmode+	Type = Y0	n.a.	n.a.
		Type = G0/B0	Bidirectional/Forward/ Reverse	Bidirectional
Operating mode+	Mode+	Enable/Disable		Enable
Pickup admittance+, mS	Y0+	Type = Y0	0.1-100.0	0.1
		Type = G0/B0	n.a.	n.a.
Pickup conductance+, mS	G0+	Type = G0	0.1-100.0	0.1
		Type = Y0/B0	n.a	n.a.
Pickup susceptance+, mS	B0+	Type = B0	0.1-100.0	0.1
		Type = Y0/G0	n.a.	n.a.
Correction angle+, deg	Ac	Type = G0/B0 Dmode = Forward/Reverse	-179–179	0
		Type = Y0	n.a.	n.a.
Minimum U0+, kV	U0min+	0.5–10.0		0.5
Tripping time+, s	Tt+	0.05–100.00		0.05

Settings	Designation	Range		Default
Reset time+, s	Tres+	0.00–100.00		0.00
Protection type-	Type-	Y0/G0/B0		Y0
Direction mode-	Dmode-	Type = Y0	n.a.	n.a.
		Type = G0/B0	Bidirectional/Forward/ Reverse	Bidirectional
Operating mode-	Mode-	Enable/Disable		Enable
Pickup admittance-, mS	Y0-	Type = Y0	0.1-100.0	0.1
		Type = G0/B0	n.a.	n.a.
Pickup conductance-, mS	G0-	Type = G0	0.1-100.0	0.1
		Type = Y0/B0	n.a	n.a.
Pickup susceptance-, mS	B0-	Type = B0	0.1-100.0	0.1
		Type = Y0/G0	n.a.	n.a.
Correction angle-, deg	Ac-	Type = G0/B0 Dmode = Forward/Reverse	-179–179	0
		Type = Y0	n.a.	n.a.
Minimum U0-, kV	U0min-	0.5–10.0		0.5
Tripping time-, s	Tt-	0.05–100.00		0.05
Reset time-, s	Tres-	0.00–100.00		0.00

Neutral Admittance Protection Reclosing (AR NAP)

This element provides reclosing initiated by the NAP element operation. It also supports single shot to lockout functionality.

AR NAP settings are described in Table 61 and Table 62 .

Table 61 – Radial line recloser AR NAP element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2/3/4	n.a.	2
First reclose time, s	Tr1	0.10–180.00	0.01	1.00
Second reclose time, s	Tr2	1.00–180.00	0.01	10.00
Third reclose time, s	Tr3	1.00–180.00	0.01	30.00
Reset time, s	Tres	1–180	1	1

Table 62 – Ring line recloser AR NAP element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2/3/4	n.a.	2
First reclose time+, s	Tr1+	0.10–180.00	0.01	1.00
Second reclose time+, s	Tr2+	1.00–180.00	0.01	10.00
Third reclose time+, s	Tr3+	1.00–180.00	0.01	30.00
Reset time+, s	Tres+	1–180	1	1
Number of trips to lockout-	Nt-	1/2/3/4	n.a.	2
First reclose time-, s	Tr1-	0.10–180.00	0.01	1.00
Second reclose time-, s	Tr2-	1.00–180.00	0.01	10.00
Third reclose time-, s	Tr3-	1.00–180.00	0.01	30.00
Reset time-, s	Tres-	1–180	1	1

Neutral Voltage Shift (NVS)

This element provides phase to earth overvoltage protection of electrical equipment in networks with insulated/ compensated neutral caused by earth fault. It also provides islanding detection for network sections with distributed generation.

NVS settings are described in Table 63 and Table 64 .

Table 63 – Radial line recloser NVS element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Pickup voltage	Up	0.05–1.00	0.01	0.30
Tripping time, s	Tt	0.10–100.00	0.01	10.00

Table 64 – Ring line recloser NVS element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Pickup voltage+	Up+	0.05–1.00	0.01	0.30
Tripping time+, s	Tt+	0.10–100.00	0.01	10.00
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Pickup voltage-	Up-	0.05–1.00	0.01	0.30
Tripping time-, s	Tt-	0.10–100.00	0.01	10.00

Voltage Unbalance (VU)

This element provides sensitive load protection and detects an upstream broken conductor condition.

VU settings are described in Table 65 and Table 66 .

Table 65 – Radial line recloser VU element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Voltage unbalance	Uu	0.05–1.00	0.01	1
Tripping time, s	Tt	0.10–100.00	0.01	10.00

Table 66 – Ring line recloser VU element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Voltage unbalance+	Uu+	0.05–1.00	0.01	1
Tripping time+, s	Tt+	0.10–100.00	0.01	10.00
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Voltage unbalance-	Uu-	0.05–1.00	0.01	1
Tripping time-, s	Tt-	0.10–100.00	0.01	10.00

Current Unbalance (CU)

This element provides three phase load protection and detects a downstream broken conductor condition.

CU settings are described in Table 67 and Table 68 .

Table 67 – Radial line recloser CU element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Current unbalance	Iu	0.05–1.00	0.01	0.20
Minimum I2, A	I2min	1–80	1	10
Tripping time, s	Tt	0.10–300.00	0.01	10.00

Table 68 – Ring line recloser CU element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Current unbalance+	Iu+	0.05–1.00	0.01	0.20
Minimum I2+, A	I2min+	1–80	1	10
Tripping time+, s	Tt+	0.10–300.00	0.01	10.00

Settings	Designation	Range	Step size	Default
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Current unbalance-	Iu-	0.05–1.00	0.01	0.20
Tripping time-, s	Tt-	0.10–300.00	0.01	10.00
Minimum I2-, A	I2min-	1–80	1	10

Rate of Change of Frequency (ROCOF)

Rate of change of frequency (ROCOF) is the time derivative of the power system frequency (df/dt).

ROCOF settings are described in Table 69 and Table 70 .

Table 69 – Radial line recloser ROCOF element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable / Disable	n.a.	Disable
Minimum voltage threshold, p.u. (per Urated/√3)	Umin	0.20 – 1.00	0,01	0.80
Time step, s	dT	0.04 – 2.00	0,01	1.00
Change of frequency pickup, Hz/s	dFp	0.10 - 10.00	0,01	1.00
Dead zone, Hz	Fdz	0.00-1.00	0,01	0.50
Working zone, Hz	Fwz	1.00 – 5.00	0,01	3.00
Tripping time, s	Tt	0.00-180.00	0,01	1.00

Table 70 – Ring line recloser ROCOF element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable / Disable	n.a.	Disable
Minimum voltage threshold+, p.u. (per Urated/√3)	Umin+	0.20 – 1.00	0,01	0.80
Time step+, s	dT+	0.04 – 2.00	0,01	1.00
Change of frequency pickup+, Hz/s	dFp+	0.10 - 10.00	0,01	1.00
Dead zone+, Hz	Fdz+	0.00-1.00	0,01	0.50
Working zone+, Hz	Fwz+	1.00 – 5.00	0,01	3.00
Tripping time+, s	Tt+	0.00-180.00	0,01	1.00
Operating mode-	Mode–	Enable / Disable	n.a.	Disable
Minimum voltage threshold-, p.u. (per Urated/√3)	Umin–	0.20 – 1.00	0,01	0.80
Time step-, s	dT–	0.04 – 2.00	0,01	1.00
Change of frequency pickup-, Hz/s	dFp–	0.10 - 10.00	0,01	1.00
Dead zone-, Hz	Fdz–	0.00-1.00	0,01	0.50
Working zone-, Hz	Fwz–	1.00 – 5.00	0,01	3.00
Tripping time-, s	Tt–	0.00-180.00	0,01	1.00

For the protection to work correctly, the settings (dT, dFp, Fdz, Fwz) must be selected in such a way that the following condition is met:

$$\mathbf{0.06}\,\boldsymbol{Hz} < (\boldsymbol{dFp} * \boldsymbol{dT}) < (\boldsymbol{Fwz} - \boldsymbol{Fdz}).$$

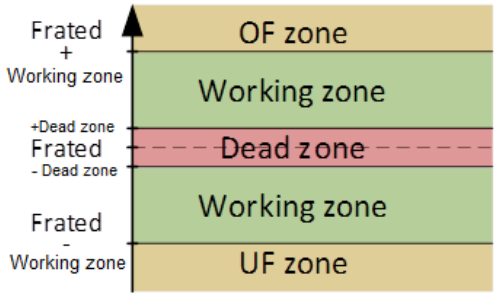


Figure 25 ROCOF zones

Voltage Reclosing Control (VRC)

This element monitors the quality of the high voltage power supply. It blocks reclosing initiated by any AR element when voltage and/or frequency do not meet user set values. VRC state is also used by Close Condition Verifier element to determine allowable closing conditions. Close blocking mode (in case enabled) will block device closing initiated by any interfaces (local or remote) in case VRC conditions are not fulfilled.

VRC settings are described in Table 71 and Table 72 .

Table 71 – Radial line recloser VRC element settings

Settings	Designation	Range	Default
Voltage unbalance mode	VU control mode	Enable/Disable	Disable
Neutral voltage shift mode	NVS control mode	Enable/Disable	Disable
Over voltage mode	OV control mode	Enable/Disable	Disable
Under voltage mode	UV control mode	Enable/Disable	Disable
Under frequency mode	UF control mode	Enable/Disable	Disable
Over frequency mode	OF control mode	Enable/Disable	Disable
Close blocking mode	Close blocking mode	Enable/Disable	Disable
Voltage unbalance	VUp	0.05–1.00	0.20
Neutral voltage shift (zero sequence voltage)	NVSp	0.05–1.00	0.40
Pickup overvoltage multiplier	OVp	1.00–1.30	1.20
Pickup undervoltage multiplier	UVp	0.60–1.00	0.80
Pickup underfrequency, Hz	UFp	45.00 - 49.99 for Frated=50Hz 55.00 - 59.99 for Frated=60Hz	49.50 for Frated=50Hz 59.50 for Frated=60Hz
Pickup overfrequency, Hz	OFp	50.01 - 55.00 for Frated=50Hz 60.01 - 65.00 for Frated=60Hz	50.50 for Frated=50Hz 60.50 for Frated=60Hz

Table 72 – Ring line recloser VRC element settings

Settings	Designation	Range	Default
Voltage unbalance mode	VU control mode	Enable/Disable	Disable
Neutral voltage shift mode	NVS control mode	Enable/Disable	Disable
Over voltage mode	OV control mode	Enable/Disable	Disable
Under voltage mode	UV control mode	Enable/Disable	Disable
Under frequency mode	UF control mode	Enable/Disable	Disable
Over frequency mode	OF control mode	Enable/Disable	Disable
Close blocking mode	Close blocking mode	Enable/Disable	Disable
Voltage unbalance+	VUp+	0.05–1.00	0.20
Neutral voltage shift+	NVSp+	0.05–1.00	0.40

Settings	Designation	Range	Default
(zero sequence voltage)			
Pickup overvoltage multiplier+	OVp+	1.00–1.30	1.20
Pickup undervoltage multiplier+	UVp+	0.60–1.00	0.80
Pickup underfrequency+, Hz	UFp+	45.00 - 49.99 for Frated=50Hz 55.00 - 59.99 for Frated=60Hz	49.50 for Frated=50Hz 59.50 for Frated=60Hz
Pickup overfrequency+, Hz	OFp+	50.01 - 55.00 for Frated=50Hz 60.01 - 65.00 for Frated=60Hz	50.50 for Frated=50Hz 60.50 for Frated=60Hz
Voltage unbalance-	VUp-	0.05–1.00	0.20
Neutral voltage shift- (zero sequence voltage)	NVSp-	0.05–1.00	0.40
Pickup overvoltage multiplier-	OVp-	1.00–1.30	1.20
Pickup undervoltage multiplier-	UVp-	0.60–1.00	0.80
Pickup underfrequency-, Hz	UFp-	45.00 - 49.99 for Frated=50Hz 55.00 - 59.99 for Frated=60Hz	49.50 for Frated=50Hz 59.50 for Frated=60Hz
Pickup overfrequency-, Hz	OFp-	50.01 - 55.00 for Frated=50Hz 60.01 - 65.00 for Frated=60Hz	50.50 for Frated=50Hz 60.50 for Frated=60Hz

Autoreclosing Timeout (ART)

Reclosing will be made only if the voltage from source side of protection device (protection device is Open) meets the requirements of VRC element. Otherwise, device will not reclose. If the voltage did not recover until Autoreclosing timeout is expired, protection device will go to lockout.

ART settings are described in Table 73 .

Table 73 – ART element settings

Settings	Designation	Range	Step size	Default
Autoreclosing timeout, min	ART	00.00.01–06.00.00	00.00.01	00.01.00

Undervoltage (UV)

This element provides a trip command when the voltage falls below a set value.

UV settings are described in Table 74 and Table 75 .

Table 74 – Radial line recloser UV element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Pickup voltage multiplier	Up	0.60–1.00	0.01	0.80
Tripping time, s	Tt	0.10–100.00	0.01	10.00

Table 75 – Ring line recloser UV element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Pickup voltage multiplier+	Up+	0.60–1.00	0.01	0.80
Tripping time+, s	Tt+	0.10–100.00	0.01	10.00
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Pickup voltage multiplier-	Up-	0.60–1.00	0.01	0.80
Tripping time-, s	Tt-	0.10–100.00	0.01	10.00

Undervoltage Reclosing (AR UV)

This element provides reclosing initiated by the UV element operation.

AR UV settings are described in Table 76 and Table 77 .

Table 76 – Radial line recloser AR UV element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2	n.a.	1
Reclose time, s	Tr	0.10–180.00	0.01	10.00

Table 77 – Ring line recloser AR UV element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2	n.a.	1
Reclose time+, s	Tr+	0.10–180.00	0.01	10.00
Number of trips to lockout-	Nt-	1/2	n.a.	1
Reclose time-, s	Tr-	0.10–180.00	0.01	10.00

Overvoltage (OV)

This element provides load protection and detects high source voltage.

OV settings are described in Table 78 and Table 79 .

Table 78 – Radial line recloser OV element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Disable
Pickup voltage multiplier	Up	1.00–1.40	0.01	1.05
Tripping time, s	Tt	0.10–100.00	0.01	10.00

Table 79 – Ring line recloser OV element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Disable
Pickup voltage multiplier+	Up+	1.00–1.40	0.01	1.05
Tripping time+, s	Tt+	0.10–100.00	0.01	10.00
Operating mode-	Mode-	Enable/Disable	n.a.	Disable
Pickup voltage multiplier-	Up-	1.00–1.40	0.01	1.05
Tripping time-, s	Tt-	0.10–100.00	0.01	10.00

Overvoltage Reclosing (AR OV)

This element provides reclosing initiated by the OV element operation.

AR OV settings are described in Table 80 and Table 81 .

Table 80 – Radial line recloser AR OV element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2	n.a.	1
Reclose time, s	Tr	0.10–300.00	0.01	10.00

Table 81 – Ring line recloser AR OV element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2	n.a.	1
Reclose time+, s	Tr+	0.10–300.00	0.01	10.00
Number of trips to lockout-	Nt-	1/2	n.a.	1
Reclose time-, s	Tr-	0.10–300.00	0.01	10.00

Underfrequency (UF)

This element provides load protection and detects low system frequency.

UF settings are described in Table 82 and Table 83 .

Table 82 – Radial line recloser UF element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Enable
Pickup frequency, Hz	Fp	45.00-50.00 Hz for rated frequency=50 Hz 55.00-60.00 Hz for rated frequency=60 Hz	0.01	45.00 55.00
Tripping time, s	Tt	0.10–180.00	0.01	0.10

Table 83 – Ring line recloser UF element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Enable
Pickup frequency+, Hz	Fp+	45.00–50.00 Hz for rated frequency=50 Hz 55.00–60.00 Hz for rated frequency=60 Hz	0.01	45.00 55.00
Tripping time+, s	Tt+	0.10–180.00	0.01	0.10
Operating mode-	Mode-	Enable/Disable	n.a.	Enable
Pickup frequency-, Hz	Fp-	45.00–50.00 Hz for rated frequency=50 Hz 55.00–60.00 Hz for rated frequency=60 Hz	0.01	45.00 55.00
Tripping time-, s	Tt-	0.10–180.00	0.01	0.10

Underfrequency Reclosing (AR UF)

This element provides reclosing initiated by the UF element operation.

AR UF settings are described in Table 84 and Table 85 .

Table 84 – Radial line recloser AR UF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2	n.a.	1
Reclose time, s	Tr	0.10–180.00	0.01	10.00

Table 85 – Ring line recloser AR UF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2	n.a.	1
Reclose time+, s	Tr+	0.10–180.00	0.01	10.00
Number of trips to lockout-	Nt-	1/2	n.a.	1
Reclose time-, s	Tr-	0.10–180.00	0.01	10.00

Overfrequency (OF)

This element provides protection against a high system frequency.

OF settings are described in Table 86 and Table 87 .

Table 86 – Radial line recloser OF element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Disable
Pickup frequency, Hz	Fp	50.00–55.00 for rated frequency=50 Hz 60.00–65.00 for rated frequency=60 Hz	0.01	55.00 65.00
Tripping time, s	Tt	0.10–180.00	0.01	0.10

Table 87 – Ring line recloser OF element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Disable
Pickup frequency+, Hz	Fp+	50.00–55.00 for rated frequency=50 Hz 60.00–65.00 for rated frequency=60 Hz	0.01	55.00 65.00
Tripping time+, s	Tt+	0.10–180.00	0.01	0.10
Operating mode-	Mode-	Enable/Disable	n.a.	Disable

Settings	Designation	Range	Step size	Default
Pickup frequency-, Hz	Fp-	50.00–55.00 for rated frequency=50 Hz 60.00–65.00 for rated frequency=60 Hz	0.01	55.00 65.00
Tripping time-, s	Tt-	0.10–180.00	0.01	0.10

Overfrequency Reclosing (AR OF)

This element provides reclosing initiated by the OF element operation.

AR OF settings are described in Table 88 and Table 89 .

Table 88 – Radial line recloser AR OF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout	Nt	1/2	n.a.	1
Reclose time, s	Tr	0.10–180.00	0.01	10.00

Table 89 – Ring line recloser AR OF element settings

Settings	Designation	Range	Step size	Default
Number of trips to lockout+	Nt+	1/2	n.a.	1
Reclose time+, s	Tr+	0.10–180.00	0.01	10.00
Number of trips to lockout-	Nt-	1/2	n.a.	1
Reclose time-, s	Tr-	0.10–180.00	0.01	10.00

Automatic Backfeed Restoration (ABR)

Automatic Backfeed Restoration is used to automatically close a normally open recloser if it detects a source (via the SD element) on the either side of the recloser and absence of a source on the other side.

ABR function is designed to provide maximum safety for operators and equipment. Restoration disarm function will prevent circuit-breaker closing for the ABR function in case power supply is absent from both sides longer than specified Restoration disarm timeout (Trd) setting.

This element is only applicable for ring line type reclosers.

ABR element settings are described in Table 90 .

Table 90 – ABR element settings

Setting	Designation	Range		Step size	Default
Operating mode	Mode	AUTOCOG mode = Disable	Disable / Both / Only+ / Only-	n.a.	Disable
		AUTOCOG mode = Enable	Disable / Only+ / Only-		
AUTOCOG mode	AUTOCOG	Disable / Enable		n.a	Disable
Restoration disarm mode	RD mode	AUTOCOG mode = Disable	Disable / Both Sides Dead	n.a	Disable
		AUTOCOG mode = Enable	Disable		
Prot control mode	PC mode	AUTOCOG mode = Disable	Disable / Enable	n.a	Disable
		AUTOCOG mode = Enable	Disable		
Restoration disarm timeout, Hours:Minutes:Seconds	Trd	00:00:01 – 06:00:00		00:00:01	00:00:10
Restoration time+, s	Tr+	0.10-180.00		0.01	60.00
Restoration time-, s	Tr-	0.10-180.00		0.01	60.00
PC mode timeout, Hours:Minutes:Seconds	Tpc	00:00:01 – 06:00:00		00:00:01	00:00:10

Close Condition Verifier (CCV)

The Close Condition Verifier element controls breaker closing requests generated from local or remote interfaces, an input/output module, or protection elements. If the network situation complies with the CCV closing settings, closing is unblocked and vice versa.

A Hot tag for side + or – is generated if the Source Detector identifies that a source is found and the Voltage Reclosing Control element identifies that the power quality is within the acceptable limits.

A Dead tag for side + or – is generated if the Source Detector identifies that a source is lost.

The CCV functionality can be Enabled or Disabled via the configuration menu. The CCV element settings are described in Table 91 .

Table 91 – CCV element settings

Settings	Designation	Range	Step size	Default
CCV enabled/disabled				
Hot+ / Dead- allowed	Hot+ / Dead- allowed	Enable/Disable	n.a.	Disable
Hot- / Dead+ allowed	Hot- / Dead+ allowed	Enable/Disable	n.a.	Disable
Dead- / Dead+ allowed	Dead- / Dead+ allowed	Enable/Disable	n.a.	Disable
Hot+ / Hot- allowed	Hot+ / Hot- allowed	Enable/Disable	n.a.	Disable

Synchronization Indicator (SI)

The Synchronization Indicator is active only if the CCV setting Hot+ / Hot- allowed = Enabled. The SI element monitors voltage magnitude and phase angle differences from both sides of the recloser. The CCV element will allow breaker closing if the voltage magnitude and phase angle difference is static and both parameters do not exceed the predefined thresholds described in Table 92 .

Table 92 – SI element settings

Settings	Designation	Range	Step size	Default
Maximum voltage difference, p.u.	dU	0.01–0.30	0.01	0.05
Maximum phase angle difference, deg	dP	5–90	1	5

Fault Locator (FL)

This element calculates three data points:

- Xf – estimated distance from the recloser to the fault location in kilometers;
- X1_fault – estimated positive sequence reactance of the fault in primary ohms;
- X0_fault – estimated zero sequence reactance of the fault in primary ohms.

These points are calculated based on the selected phasor (phasor selection method is developed by MAGVATECH). Fault details are available in case of short circuit fault dropout or the recloser open to lockout after unsuccessful reclosing. The indicated value of the estimated distance to fault (Xf) is limited with maximum fault distance setting. Values indicated are updated after one of the OC1, EF1, OC2, EF2, OC3, EF3, SEF pickups firstly in autoreclosing sequence.

Data points calculated based on the optimal phasor are available locally and remotely (in Event log, System status, or via SCADA).Data points calculated at the moment of the protection device pickup or the protection device tripping are available via SCADA only. Full list of the indicated data is presented in Table 93 .

Table 93 – Fault Locator data points

Data point	Designation	Indication availability		
		Event log	System status	SCADA
Values calculated based on the optimal phasor (according to Magvatech algorithm)				
Estimated distance from the recloser to the fault location in kilometers	Xf	✓	✓	✓
Estimated positive sequence reactance of the fault in ohms	X1_fault	✓	✓	✓
Estimated zero sequence reactance of the fault in ohms	X0_fault	✓	✓	✓
Values calculated based at the moment of the protection device pickup				
Estimated distance from the recloser to the fault location in kilometers	Xf		✓	✓
Values calculated based at the moment of the protection device tripping				
Estimated distance from the recloser to the fault location in kilometers	Xf		✓	✓

Data point	Designation	Indication availability		
		Event log	System status	SCADA
Overcurrent fault AB resistance in ohms	Rab		✓	✓
Overcurrent fault AB reactance in ohms	Xab		✓	✓
Overcurrent fault BC resistance in ohms	Rbc		✓	✓
Overcurrent fault BC reactance in ohms	Xbc		✓	✓
Overcurrent fault CA resistance in ohms	Rca		✓	✓
Overcurrent fault CA reactance in ohms	Xca		✓	✓
Earth fault A resistance in ohms	Rag		✓	✓
Earth fault A reactance in ohms	Xag		✓	✓
Earth fault B resistance in ohms	Rbg		✓	✓
Earth fault B reactance in ohms	Xbg		✓	✓
Earth fault C resistance in ohms	Rcg		✓	✓
Earth fault C reactance in ohms	Xcg		✓	✓

FL settings are described in Table 94 and Table 95 .

Table 94 – Radial line recloser FL element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable/Disable	n.a.	Disable
Downstream line X1, Ohm/km	X1	0.0000–2.0000	0.0001	0.3500
Downstream line X0, Ohm/km	X0	0.0000–4.0000	0.0001	1.5000
Maximum fault distance, km	Lm	0.0–1000.0	0.1	1.0

Table 95 – Ring line recloser FL element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable/Disable	n.a.	Disable
Downstream line X1+, Ohm/km	X1+	0.0000–2.0000	0.0001	0.3500
Downstream line X0+, Ohm/km	X0+	0.0000–4.0000	0.0001	1.5000
Maximum fault distance+, km	Lm+	0.0–1000.0	0.1	1.0
Operating mode-	Mode-	Enable/Disable	n.a.	Disable
Downstream line X1-, Ohm/km	X1-	0.0000–2.0000	0.0001	0.3500
Downstream line X0-, Ohm/km	X0-	0.0000–4.0000	0.0001	1.5000
Maximum fault distance-, km	Lm-	0.0–1000.0	0.1	1.0

Sags and Swells Detector

This element provides indication data for sags and swells.

Sags and Swells Detector settings are described in Table 96 .

Table 96 – Sags and Swells Detector element settings

Settings	Designation	Range	Step size	Default
Swell detection mode	Swell mode	Enable/Disable	n.a	Disable
Swell detection time	Tdet_ swell	0.01-100	0.01	1
Swell reset time	Tres_swell	0.01-10	0.01	0.05
Swell pickup level	Up_swell	1.02 – 2.00	0.01	1.10
Swell limit time	Tlim_swell	60.0- 16383.0	0.1	180.0
Sag detection mode	Sag mode	Enable/Disable	n.a	Disable
Sag detection time	Tdet_sag	0.01-100	0.01	1
Sag reset time	Tres_sag	0.01-10	0.01	0.05
Sag pickup level	Up_sag	0.50 – 0.98	0.01	0.90
Sag limit time	Tlim_sag	60.0- 16383.0	0.1	180.0

Cold Load Pickup (CLP)

In some cases, when power supply is restored after prolonged outage, this results in greater than normal power demand. The main cause of this problem is the large number of electric heaters, furnaces, refrigerators, air conditioners and other thermostat-controlled loads. Higher current is often seen by protection as short circuit or overload, that result in circuit breakers automatically tripping to protect the system from overload, and the power goes off again. The CLP element enables temporary increasing current pickup setting to sustain cold load current and avoid tripping without compromising protection sensitivity. This functionality is applicable for radial recloser as only in this case can the duration of power interruption for a group of customers be observed.

CLP settings are described in Table 97 .

Table 97 – CLP element settings

Parameter	Designation	Range	Resolution
Recognition time, min	Trec	0–60	1
Reset time, min	Tres	1–400	1
Cold load multiplier	CLM	1.0–2.0	0.1

Voltage Vector Shift (VVS)

Vector Shift (VS) protection detects sudden changes in the mains voltage angle caused by a change in output from the generating plant or changes to demand connected to the network.

VVS settings are described in Table 98 and Table 99 .

Table 98 – Radial line recloser VVS element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Trip/Disable	n.a	Disable
Minimum voltage threshold, p.u. (per Urated/√3)	Umin	0.20 – 1.00	0.01	0.80
Voltage angle shift pickup	dA	6 – 90	1.0	12
Recognition delay time, s	Trec	0.10-5.00	0.01	0.50

Table 99 – Ring line recloser VVS element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Trip/Disable	n.a	Disable
Minimum voltage+, p.u. (per Urated/√3)	Umin+	0.20 – 1.00	0.01	0.80
Voltage angle shift pickup+,	dA+	6 – 90	1.0	12
Recognition delay time+, s	Trec+	0.10-5.00	0.01	0.50
Operating mode-	Mode-	Trip/Disable	n.a	Disable
Minimum voltage threshold-, p.u. (per Urated/√3)	Umin-	0.20 – 1.00	0.01	0.80
Voltage angle shift pickup-,	dA-	6 – 90	1.0	12
Recognition delay time-, s	Trec-	0.10-5.00	0.01	0.50

Back Feed Supply (BFS)

This element provides feeder trip at appearance of negative active power (power flow from load to source).

BFS settings are described in Table 100 and Table 101 .

Table 100 – Radial line recloser BFS element settings

Settings	Designation	Range	Step size	Default
Operating mode	Mode	Enable / Disable	n.a	Disable
Tripping time, s	Tt	0.50-180.00	0.01	1.00
Pickup power, kW	kWp	3-3600	1.0	3000

Table 101 – Ring line recloser BFS element settings

Settings	Designation	Range	Step size	Default
Operating mode+	Mode+	Enable / Disable	n.a	Disable
Tripping time+, s	Tt+	0.50-180.00	0.01	1.00
Pickup power+, kW	kWp+	3-3600	1.0	3000
Operating mode-	Mode-	Enable / Disable	n.a	Disable
Tripping time-, s	Tt-	0.50-180.00	0.01	1.00
Pickup power-, kW	kWp-	3-3600	1.0	3000

4.2 Measurement

4.2.1 Overview

The Main Processor gets the analog signals from the Outdoor Switching Module current and voltage sensors, converts them into digital format. The RMS values of the filtered signals are used for protection and indication as shown in the table below.

Table 102 – Applicability of RMS values of the signals

Settings	Designation	Range	Resolution	Applicability	
				Protection	Indication
Phase currents, A	Ia, Ib, Ic	0 … 12500	1 A	✓	✓
Residual current[11], A	In	0 … 12500	0.1 A	✓	✓
Positive sequence current, A	I1	0 … 12500	1 A	✓	✓
Negative sequence current, A	I2	0 … 12500	1 A	✓	✓
Neutral voltage shift measured from Source + side, kV	Un+	0 … 50	0.1 kV	✓	✓
Neutral voltage shift measured from Source - side, kV	Ub-	0 … 50	0.1 kV	✓	✓
Positive sequence voltage measured from Source + side, kV	U1+	0 … 50	0.1 kV	✓	✓
Positive sequence voltage measured from Source - side, kV	U1-	0 … 50	0.1 kV	✓	✓
Negative sequence voltage measured from Source + side, kV	U2+	0 … 50	0.1 kV	✓	✓
Negative sequence voltage measured from Source - side, kV	U2-	0 … 50	0.1 kV	✓	✓
Frequency measured from Source + side[12], Hz	F+	40-60 at 50Hz 50-70 at 60Hz	0.01 Hz	✓	✓
Frequency measured from Source – side[13], Hz	F-	40-60 at 50Hz 50-70 at 60Hz	0.01 Hz	✓	✓
Single-phase power factor	PFa, PFb, PFc	-1 … 1	0.01		✓
Three-phase power factor	PF3ph	-1 … 1	0.01		✓
Phase-to-earth voltages measured from Source + side, kV	Ua+, Ub+, Uc+	0 … 50	0.1 kV		✓
Phase-to-earth voltages measured from Source - side, kV	Ua-, Ub-, Uc-	0 … 50	0.1 kV		✓
Phase-to-phase voltages measured from Source + side, kV	Uab+, Ubc+, Uac+	0 … 50	0.1 kV		✓
Phase-to-phase voltages measured from Source - side, kV	Uab-, Ubc-, Uac-	0 … 50	0.1 kV		✓
Positive sequence active power, kW	P1	-65535 … 65535	1 kW		✓
Single-phase active power, kW	Pa, Pb, Pc	-65535 … 65535	1 kW		✓
Three-phase active power, kW	P3ph	-65535 … 65535	1 kW		✓
Single-phase reactive power, kVAr	Qa, Qb, Qc	-65535 … 65535	1 kVAr		✓
Three-phase reactive power, kVAr	Q3ph	-65535 … 65535	1 kVAr		✓
Single-phase active energy, kWh	Wa, Wb, Wc	0 … 9999999	1 kWh		✓
Three-phase active energy, kWh	W3ph	0 … 9999999	1 kWh		✓
Single-phase active energy - side, kWh	Wa-, Wb-, Wc-	0 … 9999999	1 kWh		✓
Three-phase active energy - side, kWh	W3ph-	0 … 9999999	1 kWh		✓

[11] Residual current In is equal to three times the zero sequence current Io.
[12] Voltage and frequency memory is used if all three phase to earth voltages on any side drop below approximately 0.5 kV.

Settings	Designation	Range	Resolution	Applicability	
				Protection	Indication
Single-phase reactive energy, kVArh	Ea, Eb, Ec	0 … 9999999	1 kVArh		✓
Three-phase reactive energy, kVArh	E3ph	0 … 9999999	1 kVArh		✓
Single-phase reactive energy - side, kVArh	Ea-, Eb-, Ec-	0 … 9999999	1 kWh		✓
Three-phase reactive energy - side, kVArh	E3ph-	0 … 9999999	1 kWh		✓
Phase angle difference between U1+ and U1-, degrees	PhAngDifU1	0 … 180 or “Undefined”	1 degree		✓
Angle between Un and In, degrees	An	-179 … 180 or “Undefined”	1 degree	✓	✓
Single-phase apparent power, kVA	Sa, Sb, Sc	0 … 65535	1 kVA		✓
Three-phase apparent power, kVA	S3ph	0 … 65535	1 kVA		✓
Max Ia during last fault, A	ϟ Ia max	0 … 12500	1 A		✓
Max Ib during last fault, A	ϟ Ib max	0 … 12500	1 A		✓
Max Ic during last fault, A	ϟ Ic max	0 … 12500	1 A		✓
Max In during last fault, A	ϟ In max	0.0 … 12500.0	0.1 A		✓
Max dF/dt during last fault, Hz/s	ϟ dF/dt max	0.0 … 40.00 or “Undefined	0,01 Hz/s		✓
Max dA/dt during last fault, degrees	ϟ dA/dt max	6.0…90.0 or “Undefined”	0.1 degree		✓

4.2.2 Inrush Filter

Reclosers described in the current product guide incorporate a unique inrush filter. This allows filtering of magnetizing currents occurring at energizing transformers or distribution feeders with step-down-transformers.

In contrast to the widely used inrush restraint, which blocks the operation of protection for the period of inrush, the filter leaves all protection active and sensitive to faults for the whole period of line energizing.

The advantages are:

- This feature makes it possible to select the settings of current-based protection elements based on actual load and fault levels, not considering any side effects due to transformer load energizing;
- If, after maintenance closing or performing backfeed restoration for a faulty feeder part, the fault clearing time is significantly reduced as all protection elements operate correctly without any delays.

Figure 26 and Figure 27 demonstrate the comparison of current measurement results at load energizing captured by the recloser without and with inrush filter enabled.

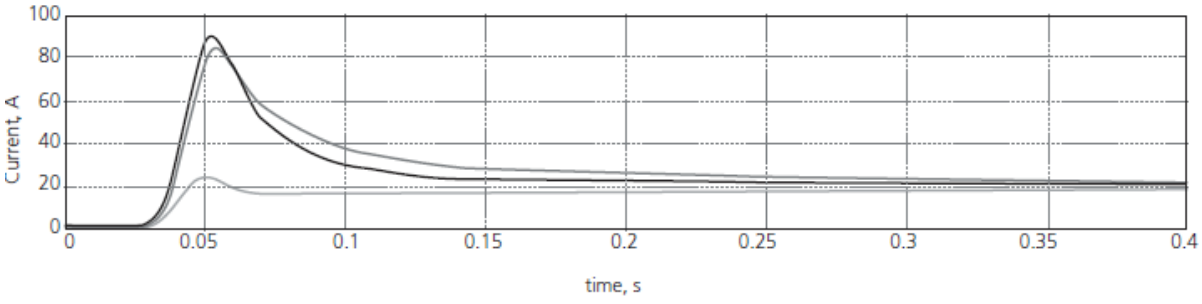


Figure 26

Basic frequency phase currents RMS. No inrush filter applied

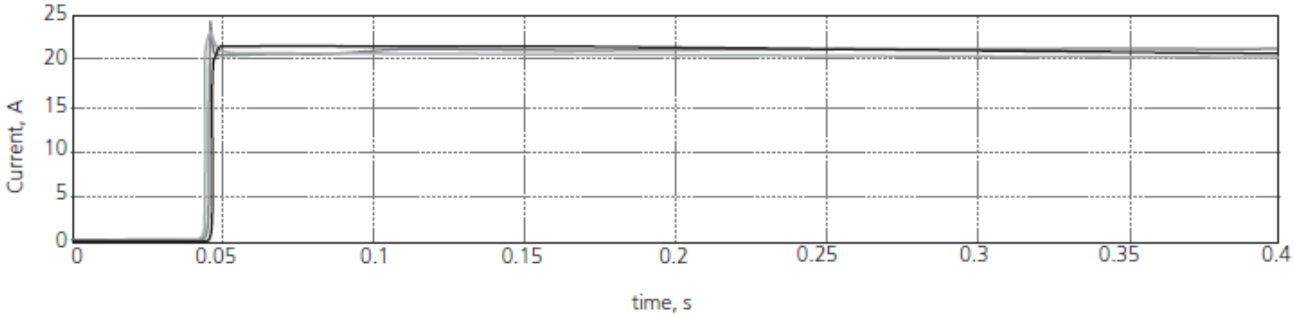


Figure 27

Basic frequency phase currents RMS. Magvatech inrush filter applied

4.2.3 Harmonics

Harmonics are measured if (Ia>10A AND Ib>10A AND Ic>10A AND Ua+>4kV AND Ub+>4kV AND Uc+>4kV) OR (Ua->4kV AND Ub->4kV AND Uc->4kV).

Table 103 – Measurement of harmonic parameters for voltage and current

Parameter	Designation	Range	Resolution
A-phase to earth voltage (Source + side) 3rd harmonic, %	Ua+ 3h	0 … 100	1 %
A-phase to earth voltage (Source + side) 5th harmonic, %	Ua+ 5h	0 … 100	1 %
A-phase to earth voltage (Source + side) 7th harmonic, %	Ua+ 7h	0 … 100	1 %
A-phase to earth voltage (Source + side) 9th harmonic, %	Ua+ 9h	0 … 100	1 %
A-phase to earth voltage (Source + side) THD, %	Ua+ THD	0 … 100	1 %
B-phase to earth voltage (Source + side) 3rd harmonic, %	Ub+ 3h	0 … 100	1 %
B-phase to earth voltage (Source + side) 5th harmonic, %	Ub+ 5h	0 … 100	1 %
B-phase to earth voltage (Source + side) 7th harmonic, %	Ub+ 7h	0 … 100	1 %
B-phase to earth voltage (Source + side) 9th harmonic, %	Ub+ 9h	0 … 100	1 %
B-phase to earth voltage (Source + side) THD, %	Ub+ THD	0 … 100	1 %
C-phase to earth voltage (Source + side) 3rd harmonic, %	Uc+ 3h	0 … 100	1 %
C-phase to earth voltage (Source + side) 5th harmonic, %	Uc+ 5h	0 … 100	1 %
C-phase to earth voltage (Source + side) 7th harmonic, %	Uc+ 7h	0 … 100	1 %
C-phase to earth voltage (Source + side) 9th harmonic, %	Uc+ 9h	0 … 100	1 %
C-phase to earth voltage (Source + side) THD, %	Uc+ THD	0 … 100	1 %
A-phase to earth voltage (Source - side) 3rd harmonic, %	Ua- 3h	0 … 100	1 %
A-phase to earth voltage (Source - side) 5th harmonic, %	Ua- 5h	0 … 100	1 %
A-phase to earth voltage (Source - side) 7th harmonic, %	Ua- 7h	0 … 100	1 %
A-phase to earth voltage (Source - side) 9th harmonic, %	Ua- 9h	0 … 100	1 %
A-phase to earth voltage (Source - side) THD, %	Ua- THD	0 … 100	1 %
B-phase to earth voltage (Source - side) 3rd harmonic, %	Ub- 3h	0 … 100	1 %
B-phase to earth voltage (Source - side) 5th harmonic, %	Ub- 5h	0 … 100	1 %
B-phase to earth voltage (Source - side) 7th harmonic, %	Ub- 7h	0 … 100	1 %
B-phase to earth voltage (Source - side) 9th harmonic, %	Ub- 9h	0 … 100	1 %
B-phase to earth voltage (Source - side) THD, %	Ub- THD	0 … 100	1 %
C-phase to earth voltage (Source - side) 3rd harmonic, %	Uc- 3h	0 … 100	1 %
C-phase to earth voltage (Source - side) 5th harmonic, %	Uc- 5h	0 … 100	1 %
C-phase to earth voltage (Source - side) 7th harmonic, %	Uc- 7h	0 … 100	1 %
C-phase to earth voltage (Source - side) 9th harmonic, %	Uc- 9h	0 … 100	1 %
C-phase to earth voltage (Source - side) THD, %	Uc- THD	0 … 100	1 %
A-phase current 3rd harmonic, %	Ia 3h	0 … 100	1 %
A-phase current 5th harmonic, %	Ia 5h	0 … 100	1 %
A-phase current 7th harmonic, %	Ia 7h	0 … 100	1 %
A-phase current 9th harmonic, %	Ia 9h	0 … 100	1 %
A-phase current THD, %	Ia THD	0 … 100	1 %
B-phase current 3rd harmonic, %	Ib 3h	0 … 100	1 %
B-phase current 5th harmonic, %	Ib 5h	0 … 100	1 %
B-phase current 7th harmonic, %	Ib 7h	0 … 100	1 %
B-phase current 9th harmonic, %	Ib 9h	0 … 100	1 %
B-phase current THD, %	Ib THD	0 … 100	1 %
C-phase current 3rd harmonic, %	Ic 3h	0 … 100	1 %
C-phase current 5th harmonic, %	Ic 5h	0 … 100	1 %
C-phase current 7th harmonic, %	Ic 7h	0 … 100	1 %
C-phase current 9th harmonic, %	Ic 9h	0 … 100	1 %
C-phase current THD, %	Ic THD	0 … 100	1 %

4.3 Communication

4.3.1 Overview

Indication and control are provided through the following interfaces:

- Personal Computer Interface (PCI)
- Telecommunication Interface (TCI)
- Digital Input/Output Interface (IOI)
- TELARM dispatcher Interface (TDI)

In the „Local“ mode, the recloser is controlled via the MMI or PCI. In the „Remote“ mode the recloser is controlled via TCI, TDI or IOI. Indication is provided via all interfaces in both modes.

4.3.2 Personal Computer Interface (PCI)

The PCI provides Indication and control via a PC (with installed TELARM software). The connection is established via the USB port located on the front the Control Panel Module (CPM), RS-232 serial port, RJ45 interface of Wired Ethernet module, ST interface of Optical Ethernet module or WiFi module.

The PCI provides the following functionality (refer to TELARM software):

- Data upload/download;
- Firmware upload.

Uploading/Downloading data

Data can be uploaded/downloaded via the PC (refer also to the description of the on-line mode of TELARM software) when the communication link is established. The communication link is password protected. The password is configured via the PCI at the time of the first communication session and stored in the MPM flash memory. If the control signal „Erase passwords“ has been activated the password is erased. A new password can be uploaded from the PC during the next communication session.

Uploading firmware

A PC with installed TELARM is required for firmware uploading.

Minimum System Requirements for TELARM Software

- OS: Windows XP / 7 / 10 x32/64
- .NET 4.0
- 1GB RAM

4.3.3 Telecommunication Interface (TCI)

TCI is an embedded RTU interface that can be used for remote indication and control.

The RTU is connected to the SCADA via a radio modem, phone modem, GSM modem, RS485-RS232 converter or directly.

Available communication protocols are DNP3, Modbus and IEC 60870-5-104.

4.3.4 Digital Input/Output Interface (IOI)

The IOI provides control and indication via the digital Input-Output Module (IOM). The IOM provides 12 digital inputs and 12 digital outputs for SCADA control and indication. Each input/output function is individually customizable.

4.4 Remote Engineering

The TELARM Dispatcher Interface (TDI) enables multiple recloser connections to Magvatech TELARM Dispatcher® for remote control and supervision. TELARM Dispatcher can be installed on one or multiple PCs with full or limited access to all or some of the reclosers. Connection via Internet or Local Area Network (LAN) is available. Physical connection of an RC5_4 to the Internet can be done via wireless connection - GPRS modem (Figure 28) or wired connection - USB-Ethernet module (Figure 29).

Both the RC5_4 recloser control(s) and PC(s) with TELARM software can connect to RC Internet Server software (RCIS). This software provides communication between a PC and multiple RC5_4. RCIS itself is a Windows® service. Connection between TELARM software and RCIS is protected with SSL encryption. Individual certificates are issued for each PC with TELARM which will connect to RCIS.

Benefits of using a TDI are the following:

- Remote control is available even without a SCADA system in place (or as backup for existing SCADA system).
- SCADA is usually available in dispacther centers only. With TDI regional operators can check protection devices remotely without any support request form the Dispatcher Center.

- Potential problems can be identified and eliminated faster because all logs from protection device, including Event log, detailed Fault profile and fault oscillography are available remotely and can be analyzed by an operator immediately after protection device has operated.

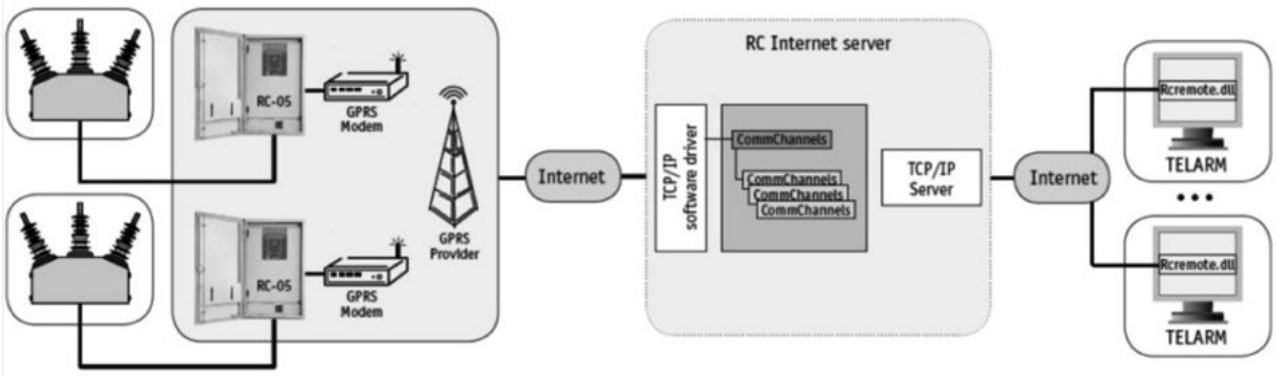


Figure 28

Structure of the system with wireless connection

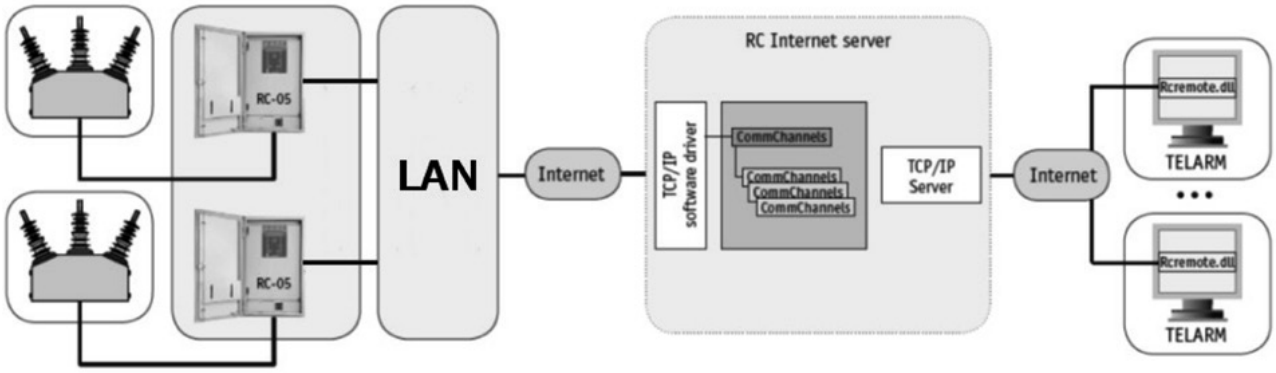


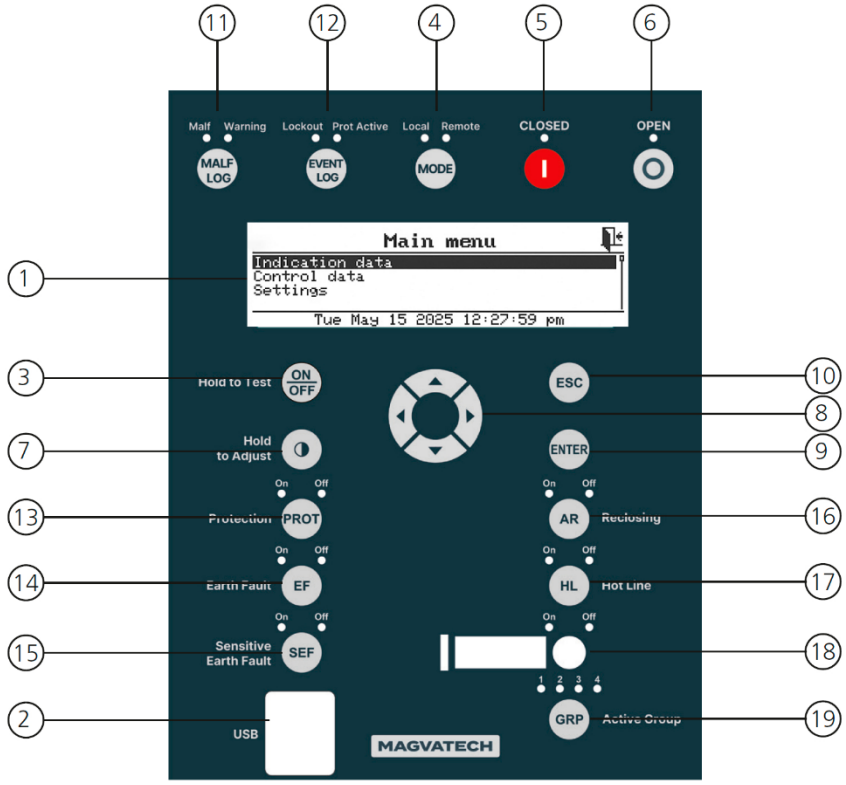
Figure 29

Structure of the system with wired connection

4.5 Indication

4.5.1 Man-Machine Interface (MMI)

The MMI provides control and indication via the Control Panel Module (CPM) if the CPM is enabled. If the CPM is disabled, no control and indication functions are supported by the MMI.



1 LCD
2 USB Port

General Control Pushbuttons

3 ON / OFF / Test
4 Control Mode
5 Closed
6 Open

LCD Control Pushbuttons

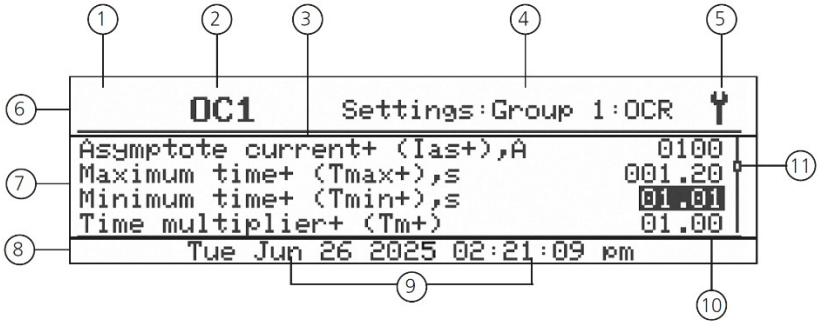
7 LCD Contrast
8 Navigation
9 Enter
10 Escape

Fast Key Pushbuttons

11 Malfunction Log
12 Event Log
13 Protection ON/OFF
14 Earth Fault ON/OFF
15 Sensitive Earth Fault ON/OFF
16 Reclosing ON/OFF
17 Hot Line ON/OFF
18 Backfeed Restoration ON/OFF or Customized protection ON/OFF[13]
19 Active [Protection] Group

Figure 30

Control Panel Module (CPM)



LCD Display

1 MVT Logo
2 Title string
3 Label of Indication data, Control data or Settings
4 Path
5 Context icon
6 Title Bar
7 Menu Bar
8 Status Bar
9 Date and Time
10 Parameter values of Indication data, Control data or Settings
11 Scroll Bar

Figure 31

Liquid Crystal Display (LCD)

The Title bar is shown in all menus and includes the following elements:

- MVT logo icon
- Title string defining menu type
- Path to the current menu
- Context icon

[13] Following protections can be appointed on “ABR” pushbutton in TELARM: ABR, CCV, UV, OV, UF, OF, VU, CU, BF, LS, NVS, VVS, NAP, NSOC, ROCOF.

5 Product Handling

5.1 Transportation

The serviceability of the equipment is critically dependent on safe and careful handling during transportation sudden impacts or shocks during loading and unloading can lead to damage of critical components.

It is important to adequately secure the equipment to minimize the risk of damage during transportation. Fixation may be secured by using web slings.

The Rec35_Smart5_5p package consists of a wooden pallet fumigated according to ISPM 15 rules, galvanized steel collars and cover (see Figure 32). For details on package dimensions and weight refer to Appendix 3 of this guide.

Figure 32

Rec35_Smart5_5p package

WARNING! It is not permitted to stack more than two packages during transportation.

To move the Rec35_Smart5_5p package, use a hydraulic lift or fork lift truck (Figure 33).

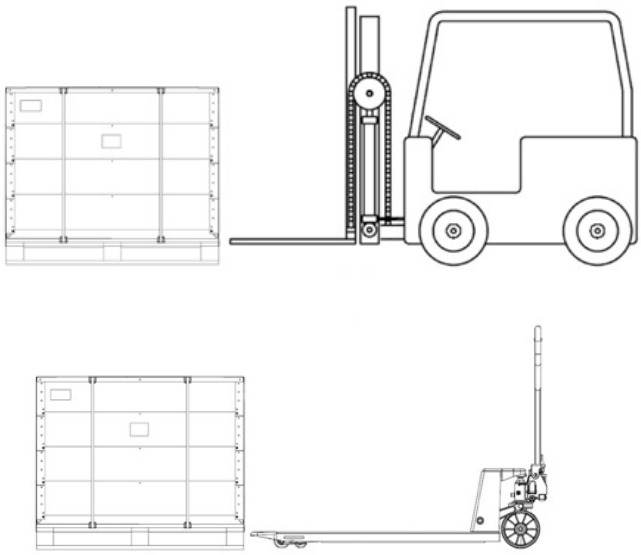


Figure 33

Rec35_Smart5_5p package lifting methods

5.2 Storage Conditions

The packaged Rec35_Smart5_5p should be stored in dry storage areas with natural ventilation.

WARNING! It is not permitted to stack more than two packages during storage.

Unpacked and assembled equipment can be stored before installation. Keep it in a clean, dry location with sufficient air circulation and temperature to prevent condensation. Insulation must be protected against dirt and moisture.

5.3 Inspection

Each Rec35_Smart5_5p is completely assembled, tested, and inspected at the factory. It is in good condition when accepted by the carrier for shipment. Upon receipt, inspect the package for signs of damage. After unpacking the Rec35_Smart5_5p, inspect its components thoroughly for damage incurred during shipment. If damage is discovered, file a claim with the carrier immediately.

The inspection process is described in the table below:

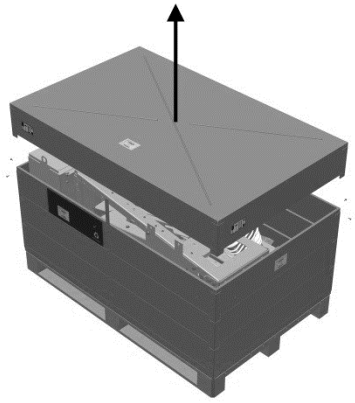
Table 104 – Inspection list

#	Object	Inspection description
1	Plastic details	Absence of mechanical damages, scratches, spots
2	Silicon insulation	Absence of mechanical damages
3	Metal parts	Absence of mechanical damages, rust and spots

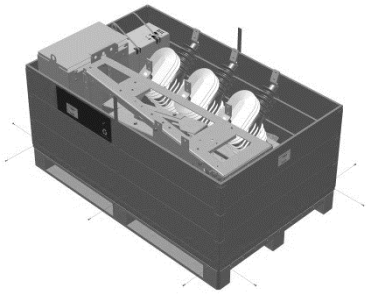
5.4 Unpacking

Follow the recommendation below to unpack:

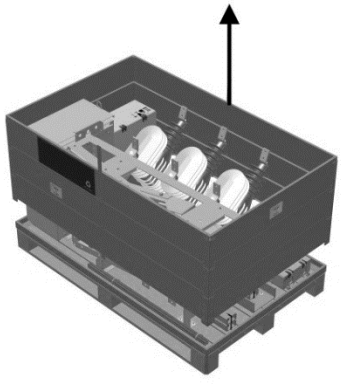
5.4.1 Pole Mounted Recloser



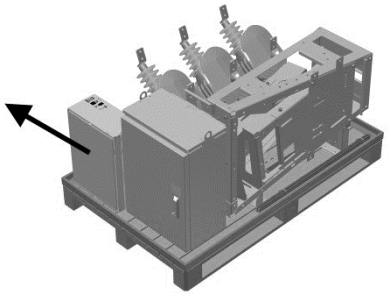
1. Unscrew screws from upper collar and take it off



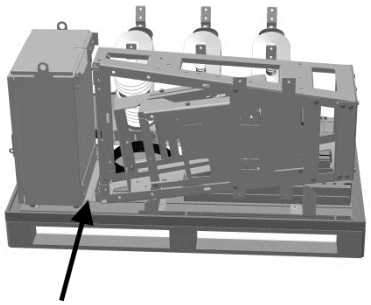
2. Unscrew screws from lower collar



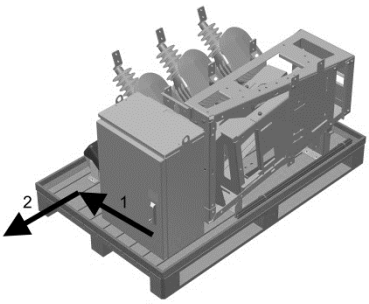
3. Remove all other collars



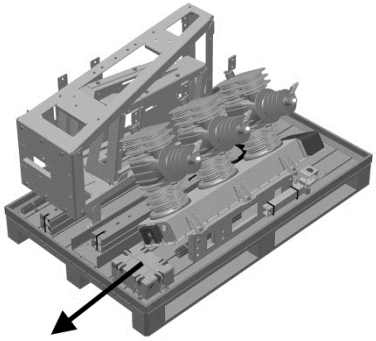
4. Remove a box with control cable



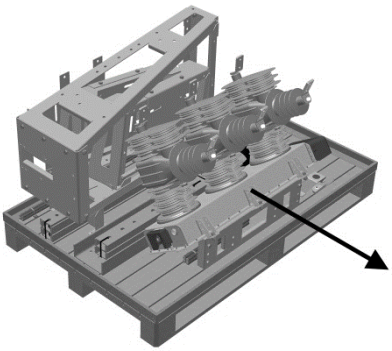
5. Unscrew fastener that holds the Recloser Control



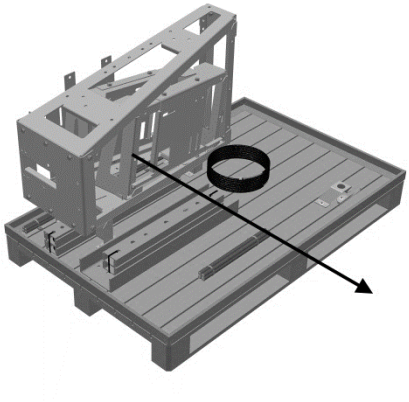
6. Remove the Recloser Control by pushing from right to left, then forward



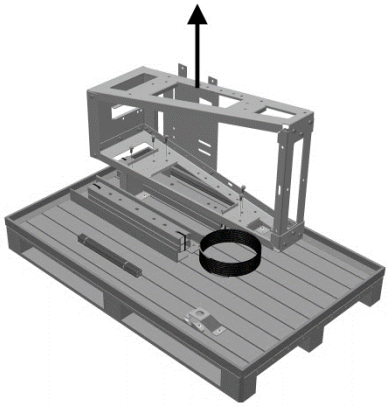
7. Cut plastic straps and remove a fasteners box



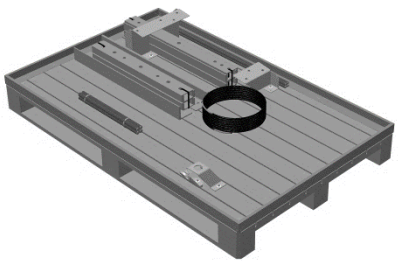
8. Unscrew the Outdoor Switching Module from a pallet and remove it using lifting provisions



9. Remove VT holders from inside of a mounting frame

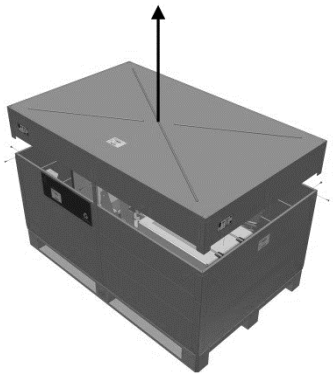


10. Unscrew the mounting frame from metal holders and remove it from the pallet

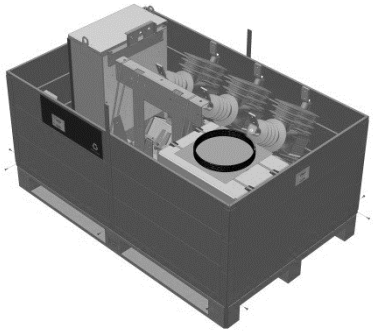


11. Cut plastic straps and remove remaining components from the pallet

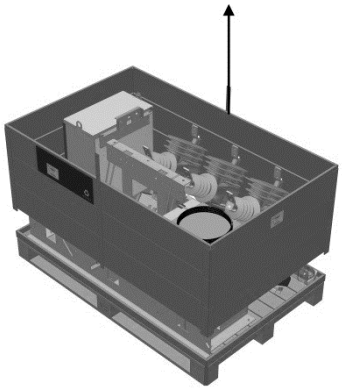
5.4.2 Substation Recloser



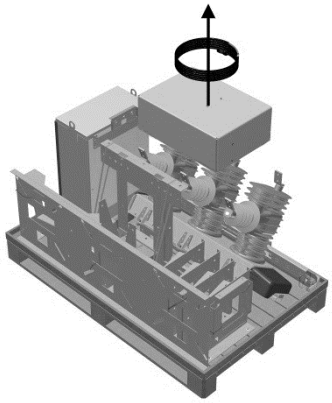
1. Unscrew screws from upper collar and take it off



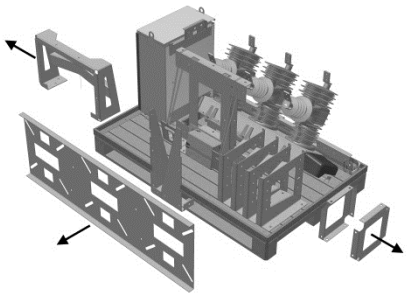
2. Unscrew screws from bottom collar



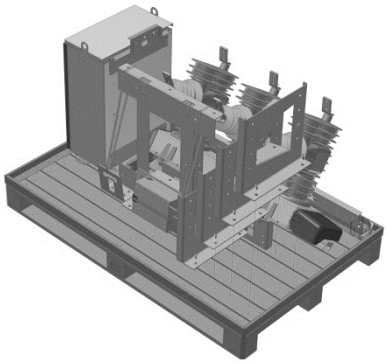
3. Remove all other collars



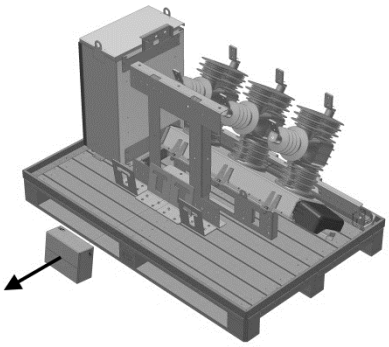
4. Cut plastic straps and remove cables



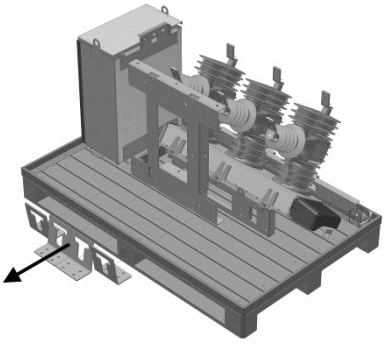
5. Cut plastic straps and remove auxiliary transformer holders and cable tie-fixed components



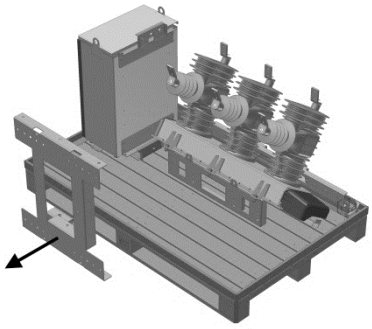
6. Unscrew four central components of the mounting kit



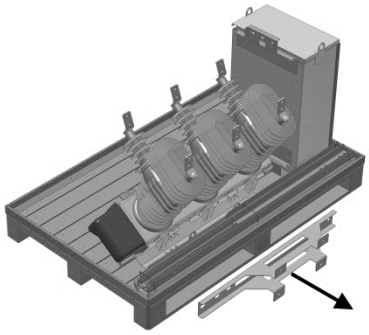
7. Cut plastic straps and remove a fasteners box



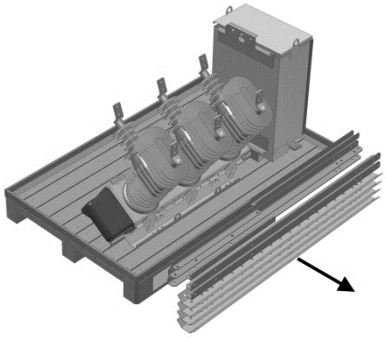
8. Unscrew mounting kit legs holders



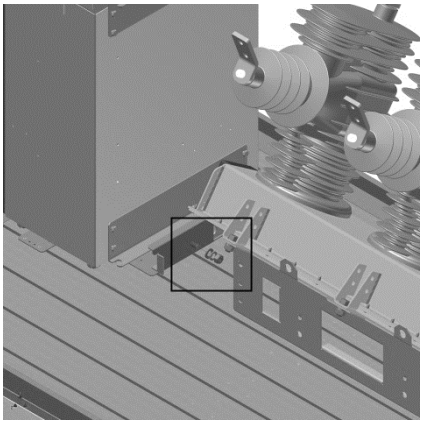
9. Unscrew the Outdoor Switching Module holder



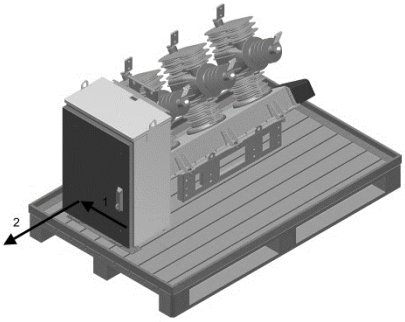
10. Cut plastic straps and remove the Recloser Control holder



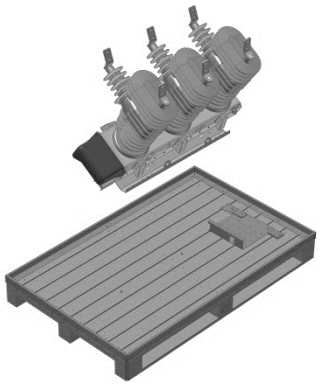
11. Unscrew eighteen fasteners holding the mounting kit accessories



12. Unscrew fastener that hold the Recloser Control



13. Remove the Recloser Control by pushing from right to left, then forward



14. Unscrew the Outdoor Switching Module from a pallet and remove it using lifting provisions

5.5 Handling Requirements

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

1. In case a crane is used, the Rec35 components should be lifted using special lifting provisions located at the Recloser Control cubicle and the Outdoor Switching Module mounting kit. See Handling and Installation guide for details.

2. The HV assembly and the Recloser Control should be appropriately fixed/lifted to avoid equipment damage.

3. In case the Rec35 components are delivered on a pallet, it can be moved using a properly rated forklift vehicle.

5.5.1 Outdoor Switching Module Handling

To lift the Outdoor Switching Module separately from the frame use four lifting provisions located on lower holders.

WARNING! Do not use the Outdoor Switching Module bushings for lifting and handling. Failure to comply may result in damage to the equipment.

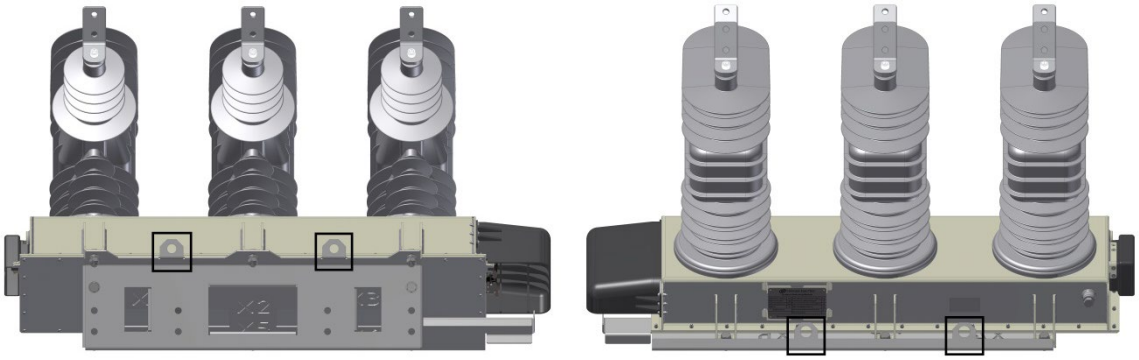


Figure 34

Outdoor Switching Module lifting provisions

5.5.2 Recloser Control Handling

The RC5_4 has two holders with lifting provision. Two holders placed at the bottom of the Recloser Control together with a mounting bracket allowing it to stand in the vertical position without any additional equipment.

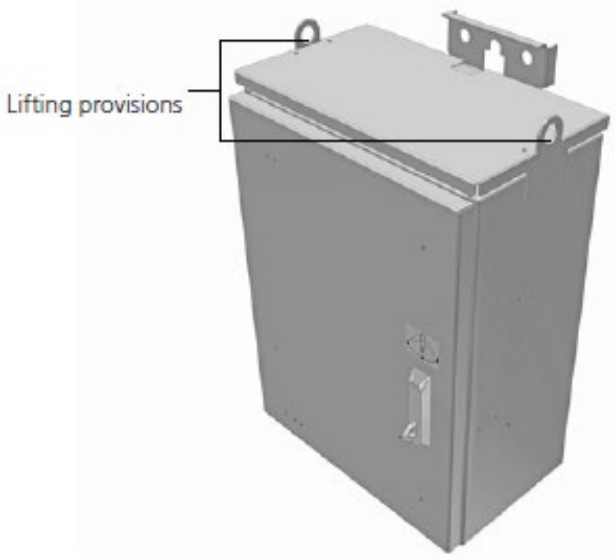


Figure 35

Recloser Control handling

5.5.3 Pole Mounting Kit Preparation

After unpacking the mounting kit, it should be assembled into single lift structure on the ground. In general the pole mounting kit preparation should consist of the following:

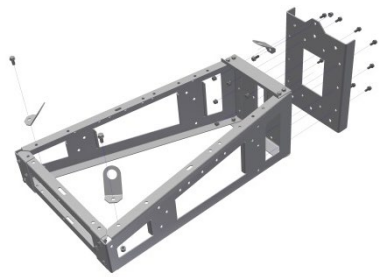
- Interface bracket attachment
- Lifting lugs attachment
- Outdoor Switching Module attachment
- VT holders attachment
- Surge arrester holders attachment
- VTs attachment
- Surge arresters attachment

Through-pole and Around-pole Mount Bracket Installation

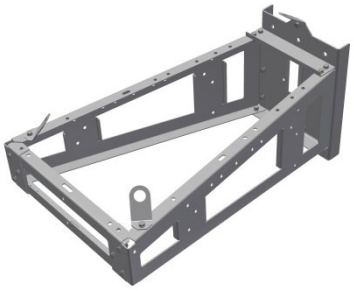
1. Fasten the pole interface bracket and lifting provisions

2. Tightening torque should be not less than 40 Nm

Clamp Mount Bracket Installation

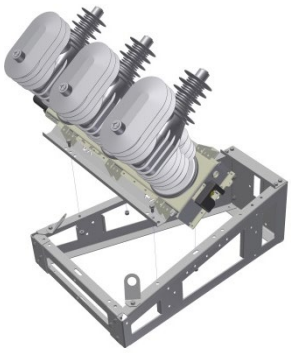


1. Fasten the pole interface bracket and lifting provisions

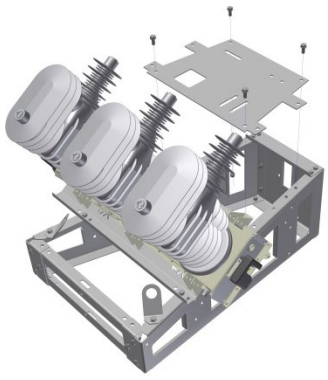


2. Tightening torque should be not less than 40 Nm

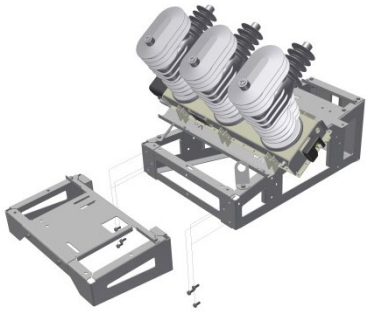
Frontal Installation



1. Fasten the Outdoor Switching Module

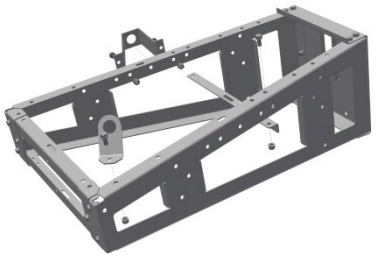


3. Fasten the first VT holder

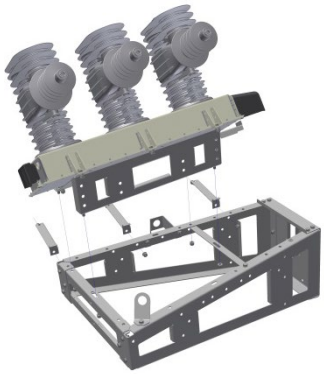


4. Fasten the second VT holder (if applicable)

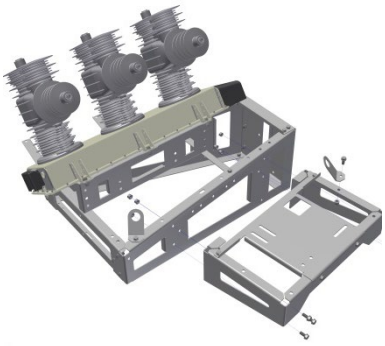
Lateral Installation with a Single VT



1. Fasten the Outdoor Switching Module holder and lifting lugs



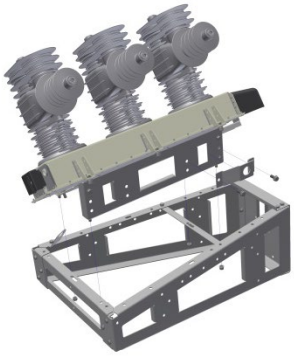
2. Fasten the Outdoor Switching Module and surge arrester holders



3. Fasten the VT holder and a lifting lug

Lateral Installation with Two VTs

1. Fasten the Outdoor Switching Module holder and a lifting lug

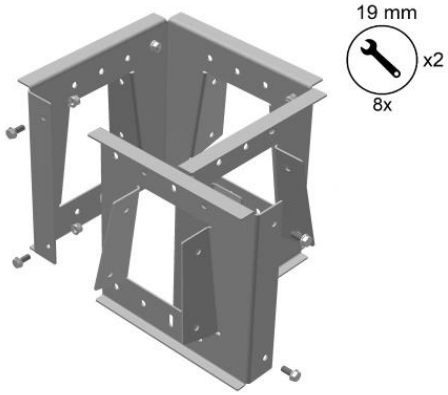


2. Fasten the Outdoor Switching Module and a lifting lug

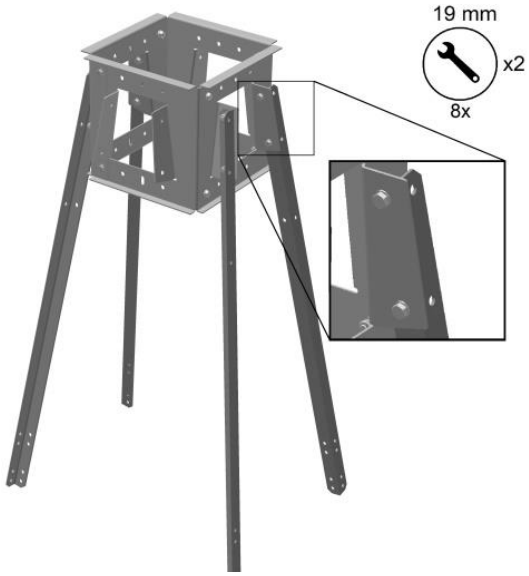
3. Fasten both VT holders and a lifting lug

5.5.4 Substation Mounting Kit Preparation

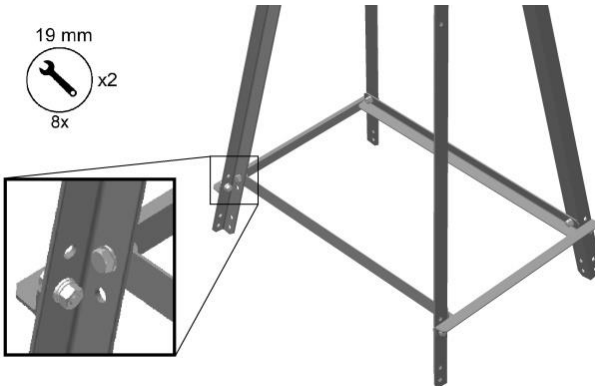
It is recommended to assemble the mounting kit in horizontal position. Use M12 fasteners included. Tightening torque for M12 should be not less than 40 Nm.



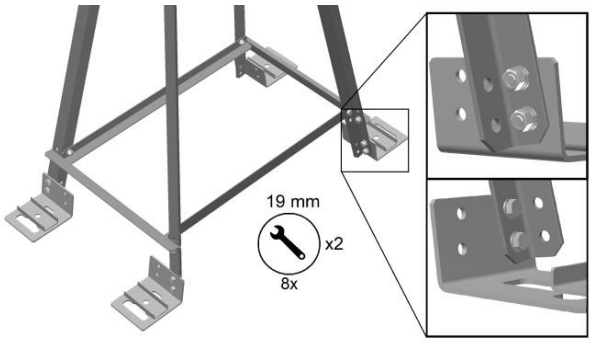
1. Fasten four holders for structure height adjustment to each other



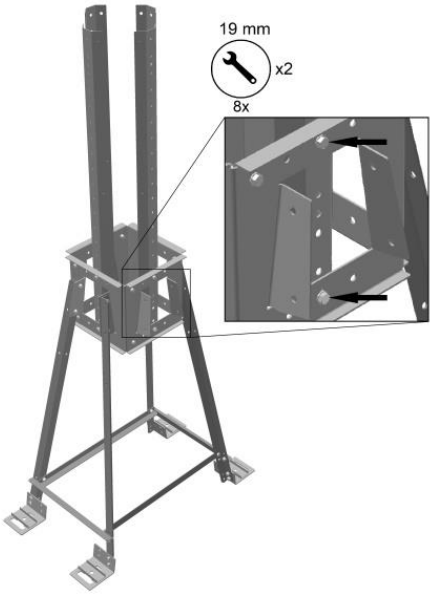
2. Fasten four base holders



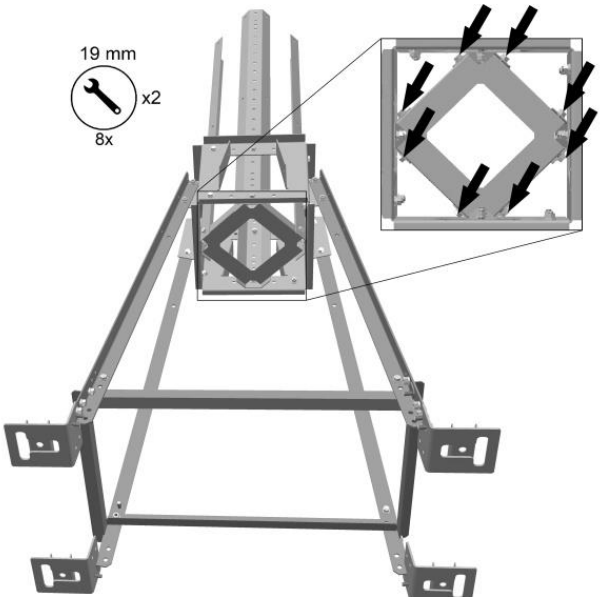
3. Connect bottom of the base holders using four horizontal holders



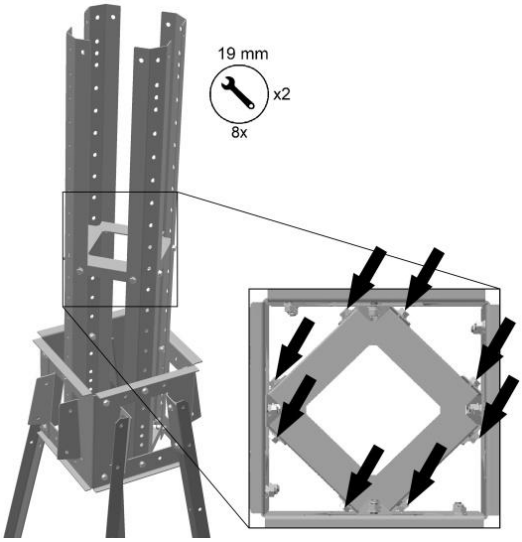
4. Fasten four support parts according to substation bay installation pinouts



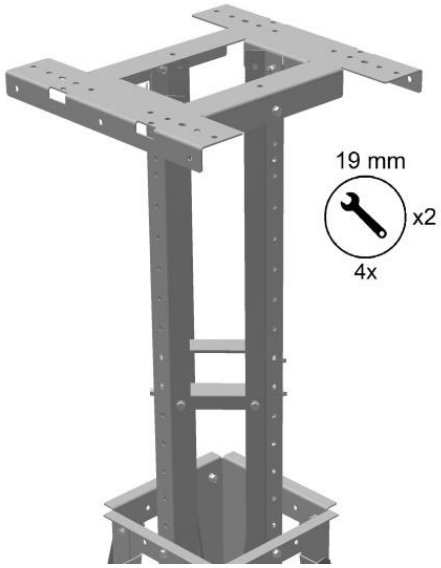
5. Fasten four channels at required height



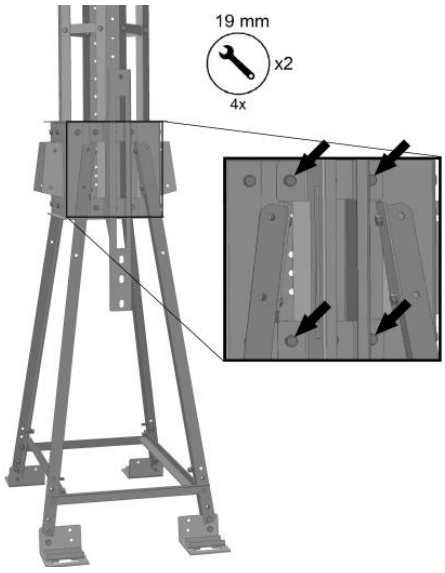
6. Connect bottom of the channels using square holder



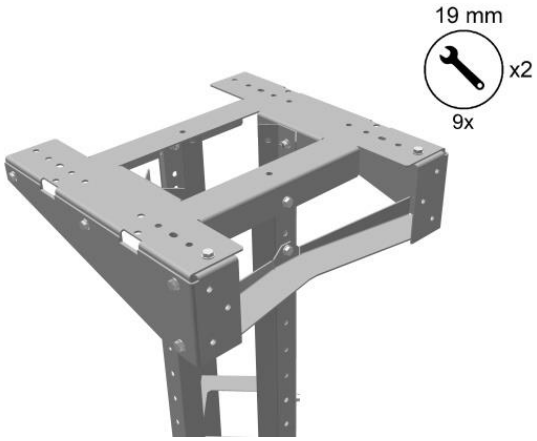
7. Connect middle of the channels using square holder



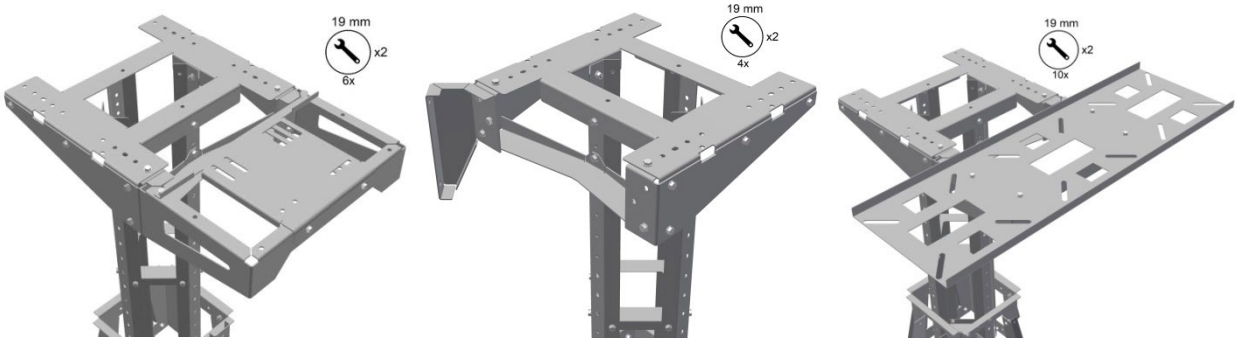
8. Fasten Outdoor Switching Module holder



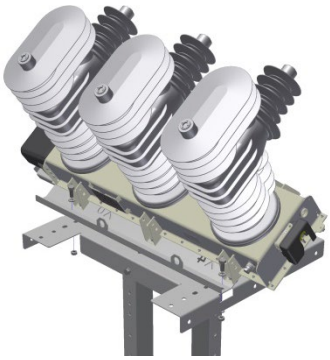
9. Fasten the Recloser Control holder



10. Fasten support for voltage transformer holder (if VT holder is applicable)



11. Fasten voltage transformer holder (if VT holder is applicable). Refer to Handling and Installation Guide for details



12. Fasten the Outdoor Switching Module on top

6 Installation

Installation operations are carried out by utility technical personnel and can be supervised by Magvatech technical representatives. This chapter describes installation procedures and required equipment. For more detailed information about the installation process contact a Magvatech technical representative.

6.1 Required Equipment

1. Set of wrenches (8-24mm);
2. Set of screw drivers (+ and -);
3. Screw driver "-" 2.5x0.4 for WAGO terminals;
4. Diagonal pliers;
5. Power line connection provision:
    - Wires (preferable insulated) (6 pcs.);
    - Support insulators 3 pcs. (if required);
    - Cable lugs applicable for chosen connection wires and M12 bolt (6 pcs.);
    - Connection clamps (waterproof if insulated connection wires are used) (6 pcs.).
6. Hydraulic cable terminal lug manual clamp up to 240mm2;
7. Alcohol for insulation cleaning;
8. Crane or other lift for the Outdoor Switching Module and RC5_4 lifting.

6.2 Installation Procedure

WARNING! The installation procedure in this manual is offered as a guide only. It should be used in conjunction with the utility's own safety procedures. Before installation begins, all necessary precautions should be carried out.

6.2.1 Outdoor Switching Module Installation

Before starting the Outdoor Switching Module installation, make sure that:

- The Outdoor Switching Module main contacts are open,
- The control cable is disconnected,
- The Outdoor Switching Module control cable socket cover is closed.

The mounting kit and surge arresters (depending on particular installation) should be installed according to procedure described in the Handling and Installation guide.

The Outdoor Switching Module installed on the mounting frame should be lifted as shown in Figure 36.

ATTENTION! The HV assembly lifting facilities should not come into contact with bushings, surge arresters or auxiliary VT bushing extensions.

ATTENTION! When installing the HV assembly, make sure that the connection to the line is performed according to the procedure described in the Handling and Installation guide.

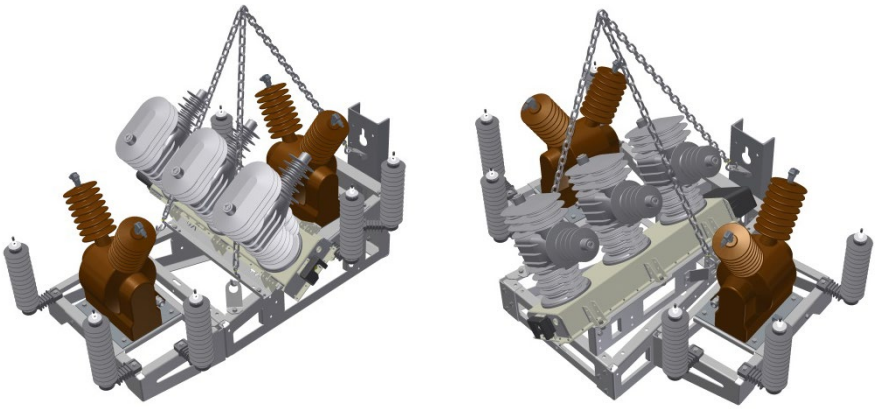


Figure 36

Outdoor Switching Module lifting method (frontal and lateral installation)

Installation example using two M20 hot-dip galvanized threated rods is shown in figure below.

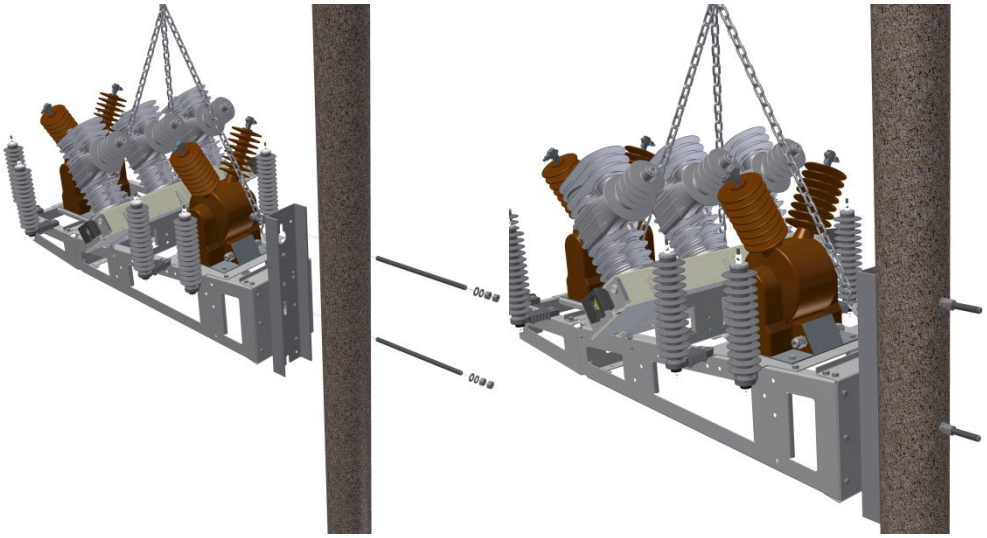


Figure 37

Outdoor Switching Module through the pole installation example

Installation example using four hot-dip galvanized U-profiles (bolted to interface bracket) and four hot-dip galvanized threated rods is shown in Figure 38.

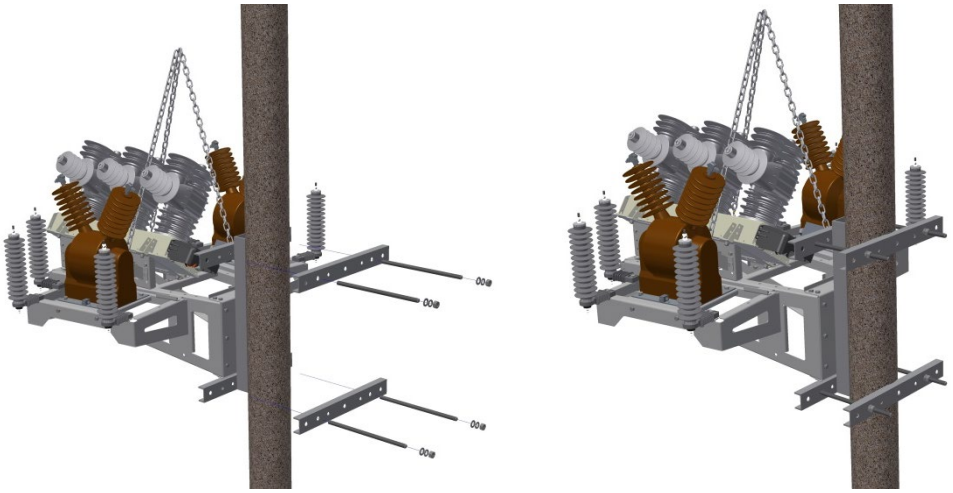


Figure 38

Outdoor Switching Module around the pole installation example

The substation mounting kit is applicable for two types of substation bay installation pinouts:

- 558…609 x 1056...1219 mm (Figure 39);
- 729…909 x 862…900 mm (Figure 40).

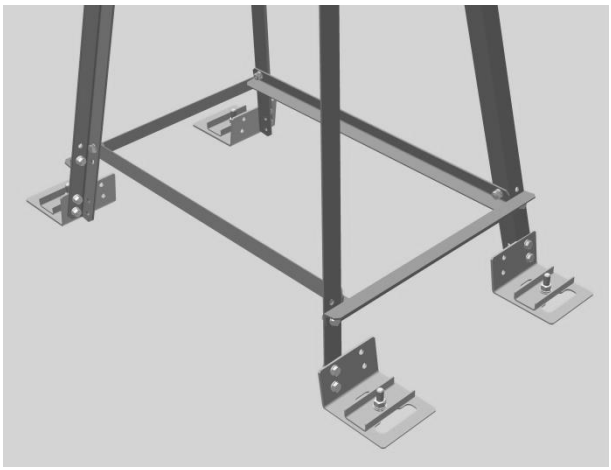


Figure 39
Substation mounting kit installation example

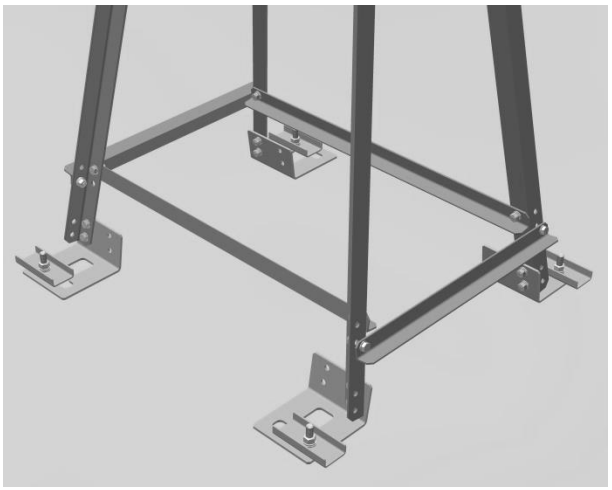


Figure 40
Substation mounting kit installation example

The available “Ground to terminals” height range:

- 2661 – 3619 mm for OSM35

Outdoor Switching Module installation example at substation mounting kit is shown in figure below.

Figure 41
Outdoor Switching Module substation installation example

6.2.2 RC5_4 installation

Before starting the Recloser Control installation, make sure that:

- The Recloser Control doors are closed,
- The control cable is disconnected,
- The Recloser Control cable socket cover is closed.

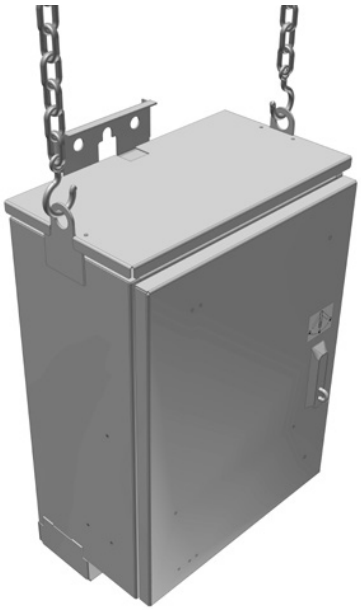


Figure 42

Recloser Control lifting method

The Recloser Control installation example using four hot-dip galvanized U-profiles and four hot-dip galvanized threated rods is shown in figure below.

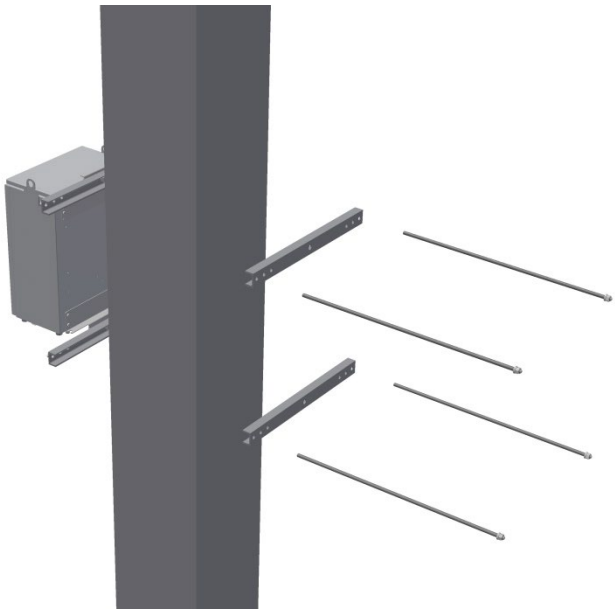


Figure 43

Recloser Control around the pole installation example

Recloser Control installation example using two hot-dip galvanized threated rods is shown in figure below.

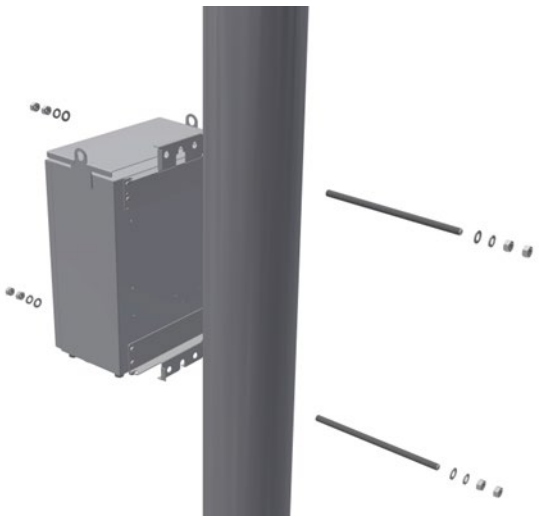


Figure 44

Recloser Control through the pole installation example

The Recloser Control installation example at substation mounting kit is shown in figure below.

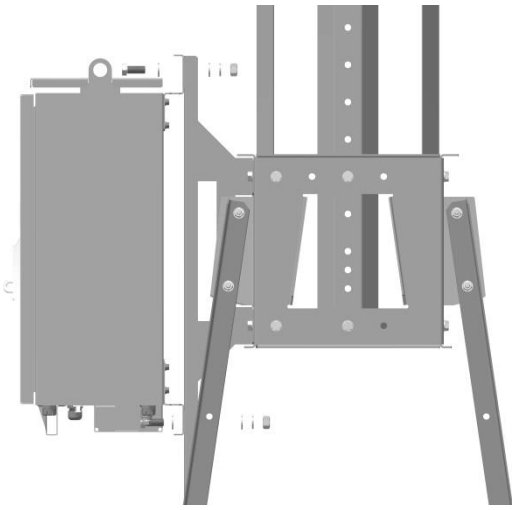


Figure 45

Recloser Control substation installation example

In case of Anti-vandal housing installation, it needs to be mounted on a pole first (Figure 46). After that the Recloser Control should be installed inside of the Anti-vandal housing using M20 studs (Figure 47).

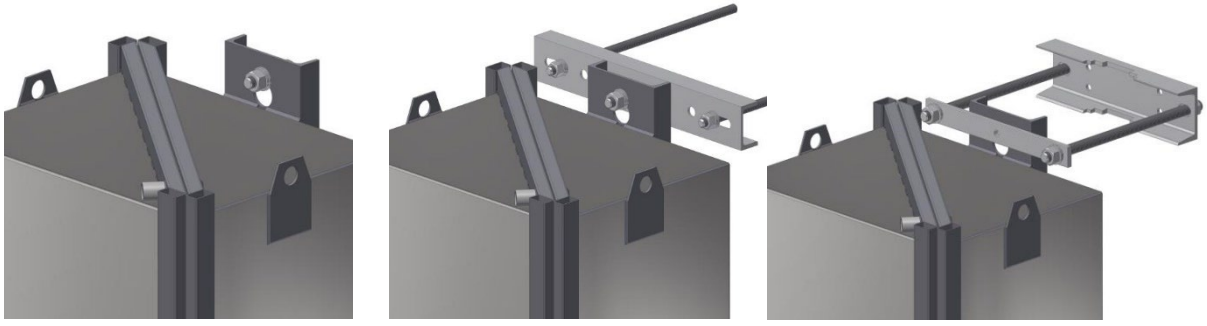


Figure 46

Anti-vandal housing installation examples

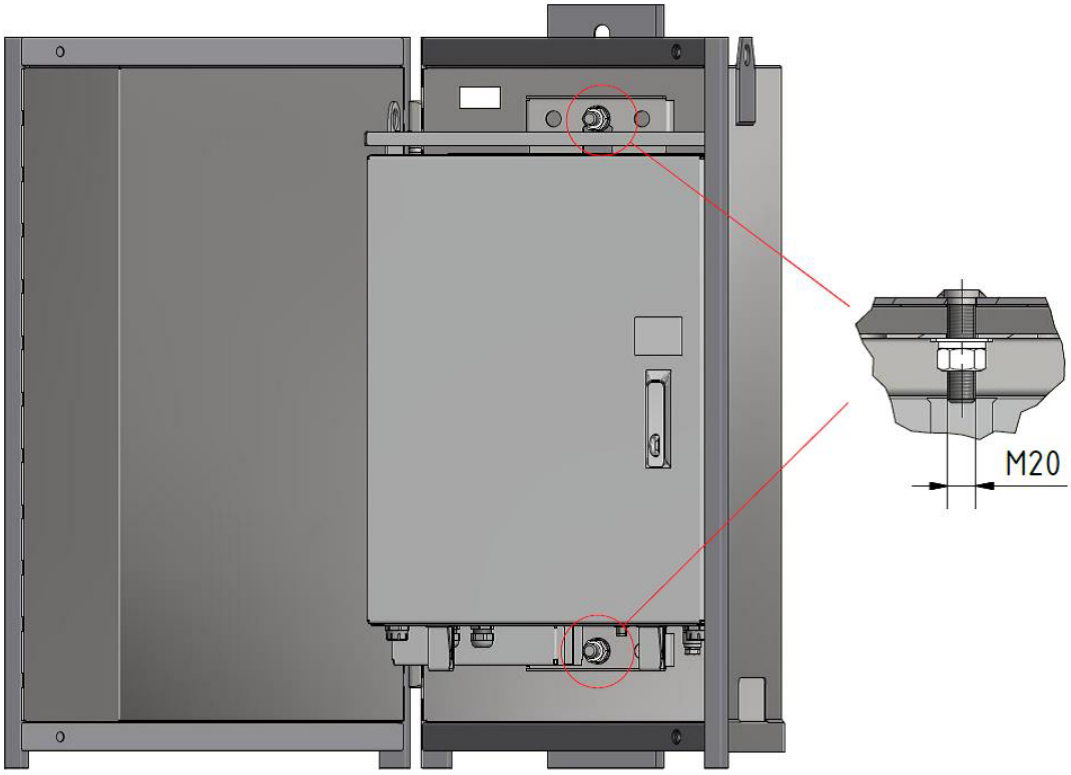


Figure 47

Recloser Control installation inside of the Anti-vandal housing

6.2.3 Auxiliary VT Installation

Auxiliary voltage transformer should be installed on a dedicated VT holder of a mounting kit.

Line connections to auxiliary voltage transformer should be performed in accordance to a VT technical manual by trained personnel who are familiar with the equipment.

6.2.4 Earthing

ATTENTION! The Outdoor Switching Module, its mounting frame and the Recloser Control should be connected to the same earthing bus using 12mm nuts and bolts tightened to 50 Nm.

Earthing points on the OSM35_Smart_5 and the RC5_4 are shown below.

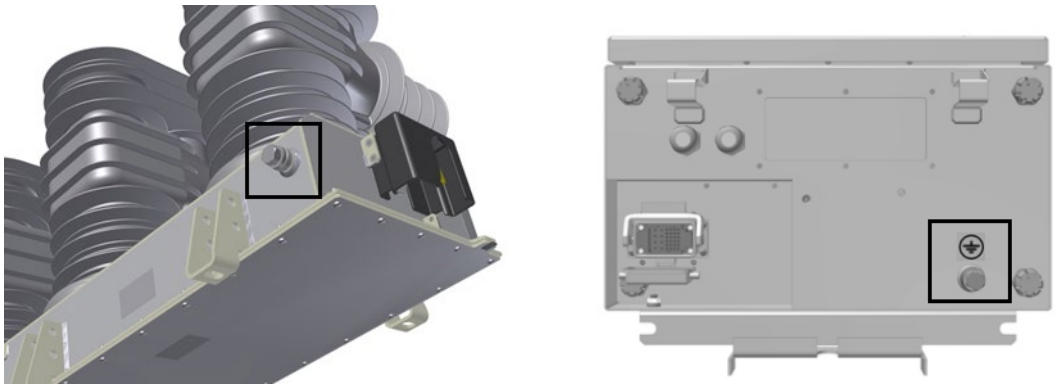


Figure 48

Earthing terminals position

ATTENTION! Make sure that the system impedance to ground is less than 5 ohms. System impedance to ground can be measured on site using special equipment or previously measured value for particular grounding bar can be provided by the utility. In case this requirement is not met it may lead to death or injury to people during operation.

It is recommended to arrange high voltage assembly earthing as it shown in Figure 49. The Outdoor Switching Module, mounting frame, auxiliary supply VTs should be earthed using separate earthing jumpers connected to the common earthing bus. Surge arresters grounding wires should be connected to special earthing provisions placed on surge arresters holders.

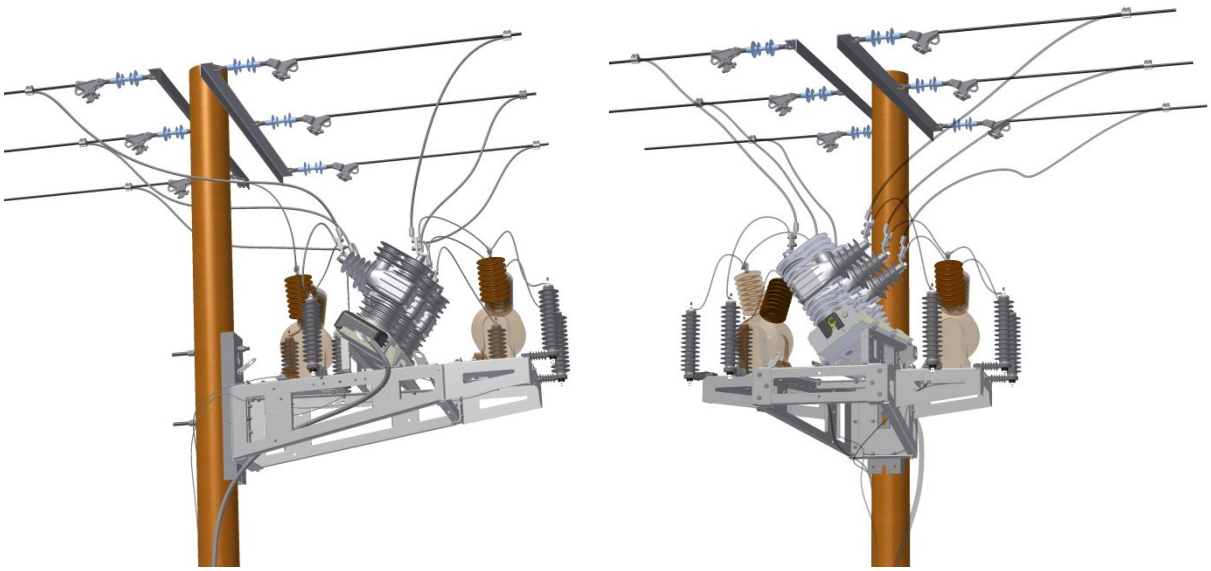


Figure 49

Complete HV assembly (frontal and lateral installation)

6.2.5 Primary Line Connection

Two-hole NEMA palm connectors (Figure 50) provide a reliable connection to power line of any type of conductors treated correspondingly.

NEMA connectors are preinstalled and tightened the Outdoor Switching Module terminals during assembly. The power line connection can be done using the M12 bolts and nuts (not supplied). It is recommended to use HDG or stainless steel M12 fasteners and tin-coated cable lugs for power line connection to prevent corrosion.

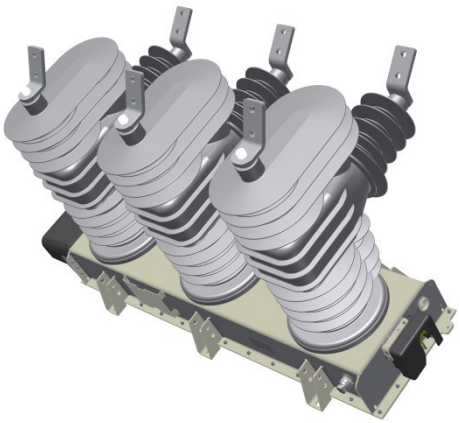


Figure 50

Two-hole NEMA palm connectors

Tightening torque for power line connection depends on M12 fasteners material used, but not less than 40 Nm.

Surge arresters and auxiliary VT HV terminals connection can be done directly to NEMA terminals.

Special two-hole NEMA protective covers can be used to protect line connections against the birds or aggressive environmental factors (Figure 51).

Figure 51

NEMA2 connector with bird protection

All technical parameters are met without the protective covers installed.

6.2.6 RC5_4 Connection to Auxiliary Supply

ATTENTION! Auxiliary supply VT connection wire should not be earthed inside the VT secondary compartment.

Before the auxiliary supply from a pole mounted VT is connected to the RC5_4, resistance measurement should be performed. Switch digital Multi-meter to the Ohm metering mode and enable beeping signal. Connect one electrode to the earthing bar (with the connected VT base earthing bar) and second electrode to both connection wires (one by one or to both of them simultaneously). Resistance should be infinite, sound signal should not appear.

Resistance measurement is not performed in case an external AC/DC supply is used.

ATTENTION! Corresponding AC1 and AC2 earthing jumpers should be removed before external AC/DC source with predefined neutral is connected to the RC5_4.

After the main line is powered, the commissioning engineer should make sure that the auxiliary supply is connected correctly. The auxiliary supply voltage should be checked by digital voltmeter.

For that purpose the RC5_4 battery switch should be set OFF, corresponding AC switch (both switches if two supply options is used) set ON.

Measured AC voltage at terminals 1-2 and 8-9 (in case two VTs are installed) should not exceed the limits of 85-265 V.

Connection terminals for the Recloser Control auxiliary power supply are shown below (Figure 52).

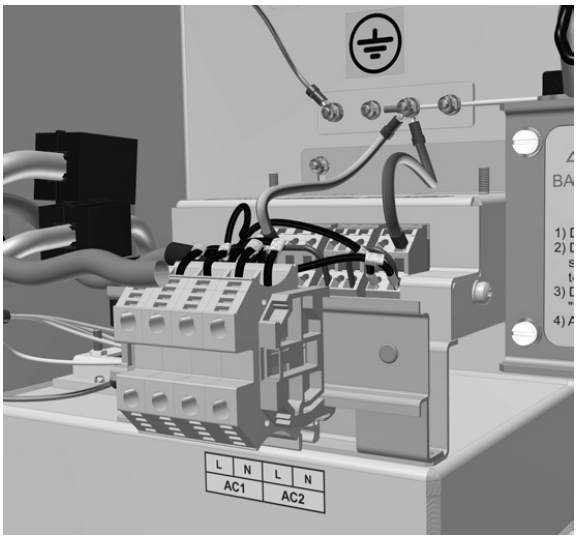


Figure 52

Auxiliary supply connections inside PSFM

Bayonet connection terminals for the Recloser Control auxiliary power supply (available on request) are shown below (Figure 53 and Figure 54).

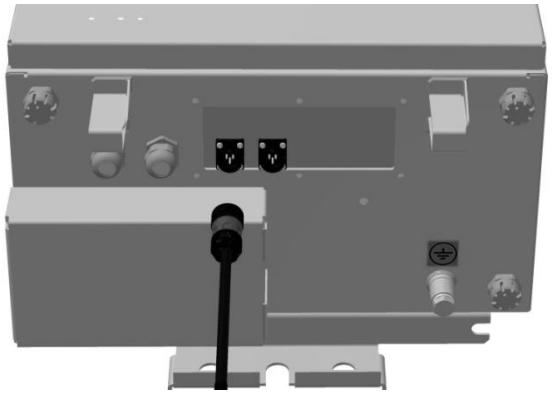


Figure 53

Auxiliary power supply connection with bayonet connectors

Figure 54

Three pin bayonet connector

6.3 Dismounting Procedure

Protection device dismounting should be performed in reverse order to the installation procedure. All safety procedures and precautions should be applied accordingly. The integrity of the line should be restored in case the protection device is removed completely.

7 Commissioning

7.1 No-load Tests

ATTENTION. Before powering the main line, the recloser should be in the OPEN position. The recloser shall be closed via the MMI only after the no-load tests are performed.

7.1.1 Powering the Protection Device

Switch on the battery switch. Make sure that local time and date are correct. If date, time or both are incorrect connect to the Recloser Control via USB, Bluetooth or TDI (see “6.5. Other RC5_4 Control Options” for details) and synchronize date and time on your computer with the RTC of the Recloser Control using TELARM. Date and time is visible at the MMI screen.

Date and time synchronization procedure:

TELARM->On-line->Synchronize date and time

Date and time setup via MMI:

CPM Main Menu -> Control Data -> Set Date and Time

After that the commissioning engineer should make sure that the MMI menu navigation is OK, indication on the MMI is OK.

7.1.2 RC5 Power Supply Check

For each of the conditions described below check that MMI displays no errors and MMI LED function (Lockout LED, Mode – Local LED, State – Open LED, On or Off LED of each protection button, Active group – 1 LED)

- Battery switch is OFF, AC supply switch is ON;
- Battery switch is ON, AC supply switch is OFF[14];
- Battery switch is ON, AC supply switch is ON.

NOTE: Up to 60 s might be required for the RC5_4 circuits energizing.

7.1.3 Checking CVCS Coefficients

Check that the CVCS coefficients in the RC5_4 settings correspond to the RTC.

CVCS coefficient indications:

MMI -> Main menu -> Settings -> System -> Measurement

To correct coefficients, connect to the Recloser Control via TELARM:

TELARM -> On-line -> Rec -> System settings -> System -> ME settings

Change “Wires to terminal connection” setting. Check that all other System settings in TELARM are correct for the particular device. How to upload settings is described in “6.6. Settings Modifications”.

7.1.4 Checking Phase Sequences

After powering the main line at the Outdoor Switching Module OPEN state, the commissioning engineer should perform the PHASE SEQUENCE check-up. The negative sequence voltage (U2) should be less than 1kV.

Negative voltage sequence indication:

MMI -> Main menu -> Indication data -> Measurement -> U2

If the negative sequence voltage is observed, it is recommended to change the software setting (changing phase sequence System-Phase sequence).

Changing phase sequence:

TELARM -> On-line -> Rec -> System settings -> System -> Configuration -> Wires to terminal connection

Change “Wires to terminal connection” setting. Check that all other System settings in TELARM are correct for this particular device. How to upload the System settings is described in the “Operation” chapter.

[14] If rechargeable battery is available.

7.2 On-load Tests

After all No-load tests are executed, the main contacts can be closed (via the MMI, USB, Bluetooth or TDI).

Check that measurements of phase currents, power factors, active and reactive power etc. are correct:

MMI -> Main menu -> Indication data -> Measurement

8 Operation

8.1 Switching

8.1.1 Mechanical Tripping

NOTE! Operation of the mechanical trip hook should be done by means of high voltage operating rod for live-line operations.

To trip the recloser mechanically, pull down the manual trip hook to the lockout position (Figure 55). In this position, the recloser is mechanically locked in the OPEN position and the actuator is electrically isolated. This prevents CLOSING (locally or remotely).

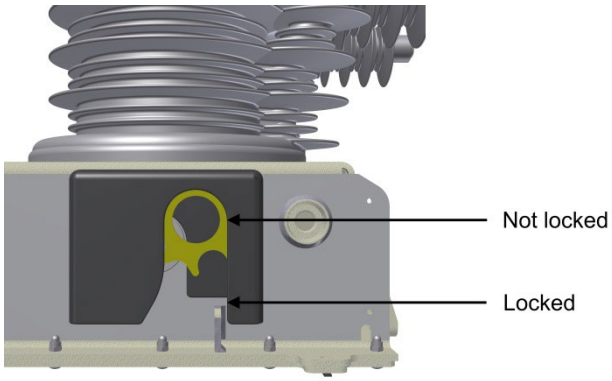


Figure 55

Mechanical trip of switching module

8.1.2 Operation via MMI

To operate the device via the MMI, change the mode of the protection device to “Local” by pressing the ”MODE” button (Figure 56).

Local device mode indication is:

“Local” LED above the “MODE” button is active.

Tripping

To trip the switching module via the MMI, push the green button «O» (Figure 56). Tripping via MMI is available both in Local and Remote modes.

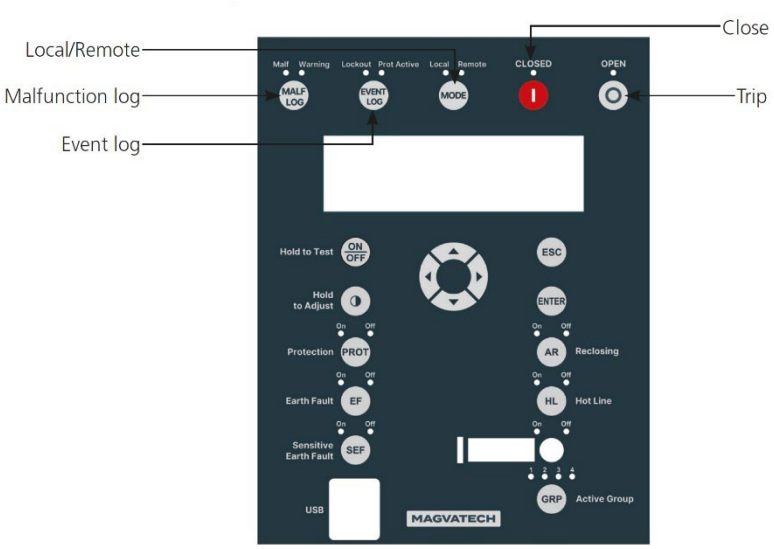


Figure 56

Switching module operation control via MMI

Closing

To close the recloser via the MMI, push the red button «I» (Figure 56).

NOTE! Make sure that the Recloser Control is in Local mode.

NOTE! Make sure that the manual trip hook is pushed back into the operating position. If it is not, change the mechanical trip hook position using the high voltage operating rod for live-line operations.

Delayed Closing

The RC5_4 functionality provides an option of delayed closing, meaning that after the close button is pushed the recloser will not be closed instantaneously, but after some delay. The corresponding setting is configurable in setup menu:

Main menu -> Settings -> System -> MMI -> Close delay

You may stop delayed closing by pressing the ESC button.

Indication

The open state of the Outdoor Switching Module main contacts is indicated via

- LED above “O” button
- Mechanical position window on the Outdoor Switching Module

The closed state of the Outdoor Switching Module main contacts is indicated via

- LED above “I” button
- position window on Outdoor Switching Module

8.2 Logging

8.2.1 Logs

From the control panel the following logs can be read:

- Event log (EL)
- Malfunction log (ML)

Other logs like Fault profile, Load profile, Communication log are available only using a PC via the PCI, TCI or TDI interfaces.

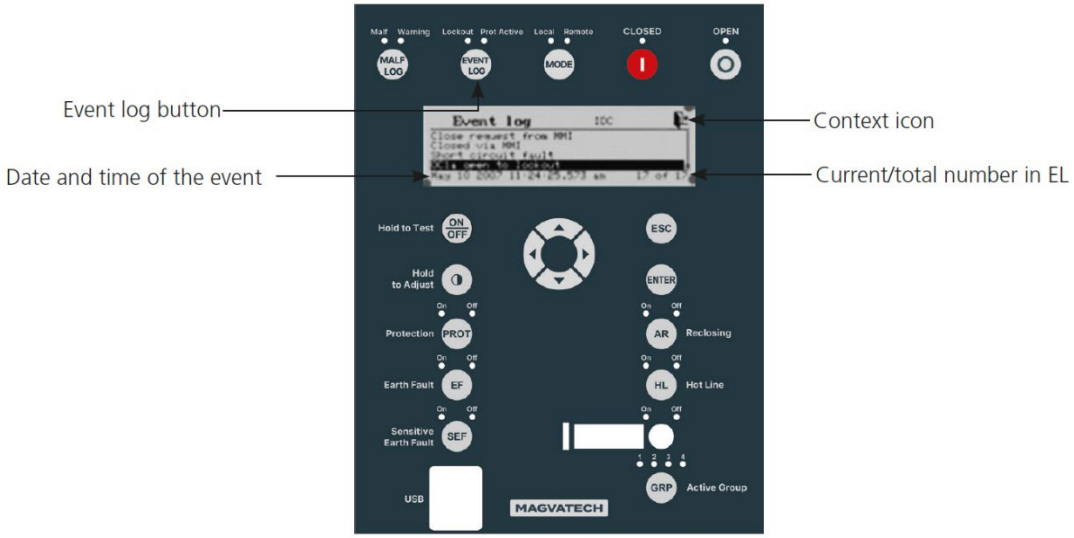


Figure 57

Event log via MMI

This screen (Figure 57) is a default one in case “Lockout” is present. Pressing the “Event Log” button provides transition to this screen from any menu.

To enter the EL via the MMI menu:

Main menu -> Indication data -> IDC -> Event log

The latest event is placed at the bottom of the list. Info about the number of the event in the list, time and date of the event is displayed on the screen.

To navigate in the EL, use arrow buttons. The “open door pictogram” marker in the top right corner of the screen means that additional info is applicable. To see this additional info, press the ENTER button, to go back to the EL menu press ESC button.

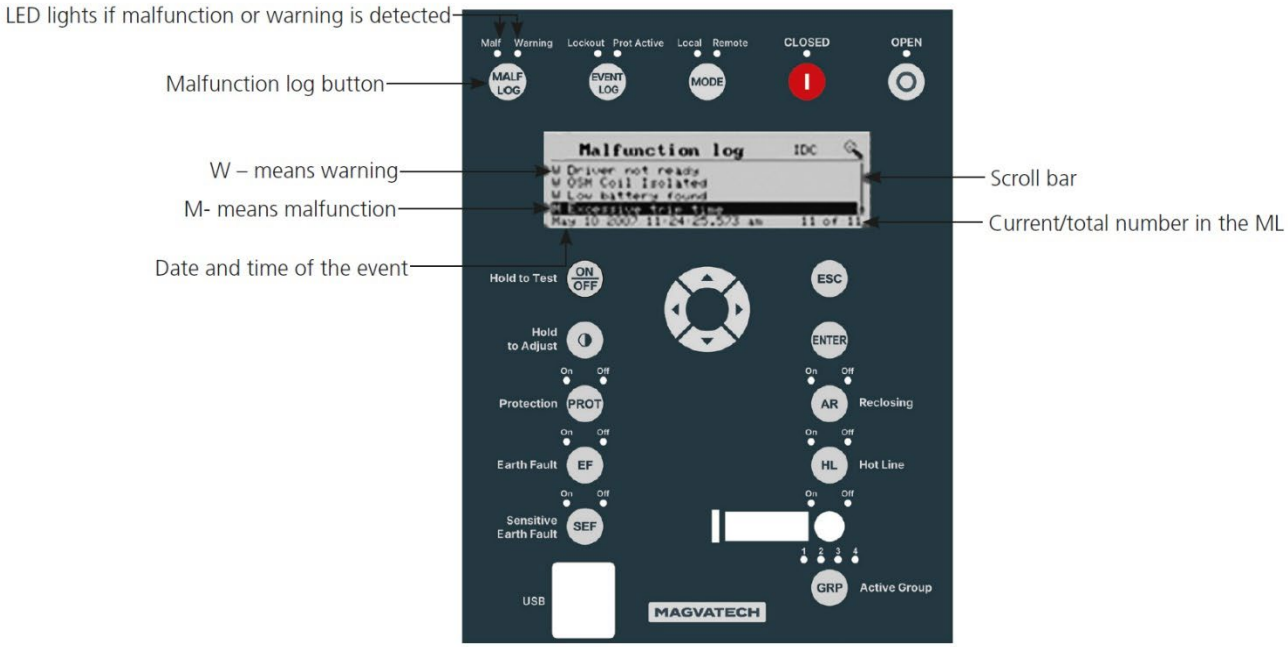


Figure 58

Malfunction log via MMI

This screen (Figure 58) is a default one in case LOCKOUT is absent and there are some unread events in the Malfunction log. Pressing the “Malfunctioning log” pushbutton provides transition to this screen from any menu.

To enter the ML via the MMI menu:

Main menu -> Indication data -> IDC -> Malfunction log

Some events have characters that classify events: “M” – malfunction or “W” - warning. A character is shown in the beginning of the event description string.

It is not possible to see the load profile via the MMI. Load profile step can be changed via the MMI.

To change Load profile step via the MMI:

Main menu -> Settings -> System -> IDC -> Load profile step

NOTE! It is only possible to erase all logs at once, single event removal is not possible.

To erase all readings in all logs, select corresponding function in the menu as shown below and confirm the action:

Main menu -> Control data -> Erase logs

8.2.2 Counters

From the control panel the following counters can be read:

- Protection counters

Main menu -> Indication data -> IDC -> Protection counters

- Lifetime counters

Main menu -> Indication data -> IDC -> Lifetime counters

- Log filling counters

Main menu -> Indication data -> IDC -> Log filling counters

8.3 Measurements

All measurement data is available via the MMI menu

Main menu -> Indication data -> ME

8.4 Date and Time Settings

Time and date readings are available in every MMI menu.

Changing time and date settings:

Main menu -> Control data -> Set date and time

Daylight saving time settings:

Main menu -> Settings -> System -> RTC

8.5 Other RC5_4 Control Options

8.5.1 PCI – Personal Computer Interface

The PCI provides Indication and control via a PC with installed TELARM Lite software and RC5 driver. The connection is established via the USB port located on the front the Control Panel Module, via RS-232 port #5, RJ45 interface of Ethernet module on the RCM or via a Bluetooth module.

The PCI provides the following control and indication functionality:

- Indication signals generated by PCI
- Data upload/download via PC
- Firmware upgrade/downgrade via PC

To operate the recloser via the USB interface it is required to have a USB 2.0 Type A Male to Type B Male cable. To operate the recloser via the Bluetooth interface it is required to have a PC with Bluetooth module. To operate the recloser via the Ethernet interface it is required to have an Ethernet or fiberglass cable.

Connection Establishment via USB

1. Connect the PC and the RC5_4 with Type A Male to Type B Male USB cable[15];
2. Select a recloser that you want to connect in TELARM Lite;
3. Set “PC interface” to USB;
4. Click “Connect” button.

[15] NOTE! The USB cable is not in the standard scope of supply, however it can be ordered separately. Please contact the MAGVATECH representative for details.

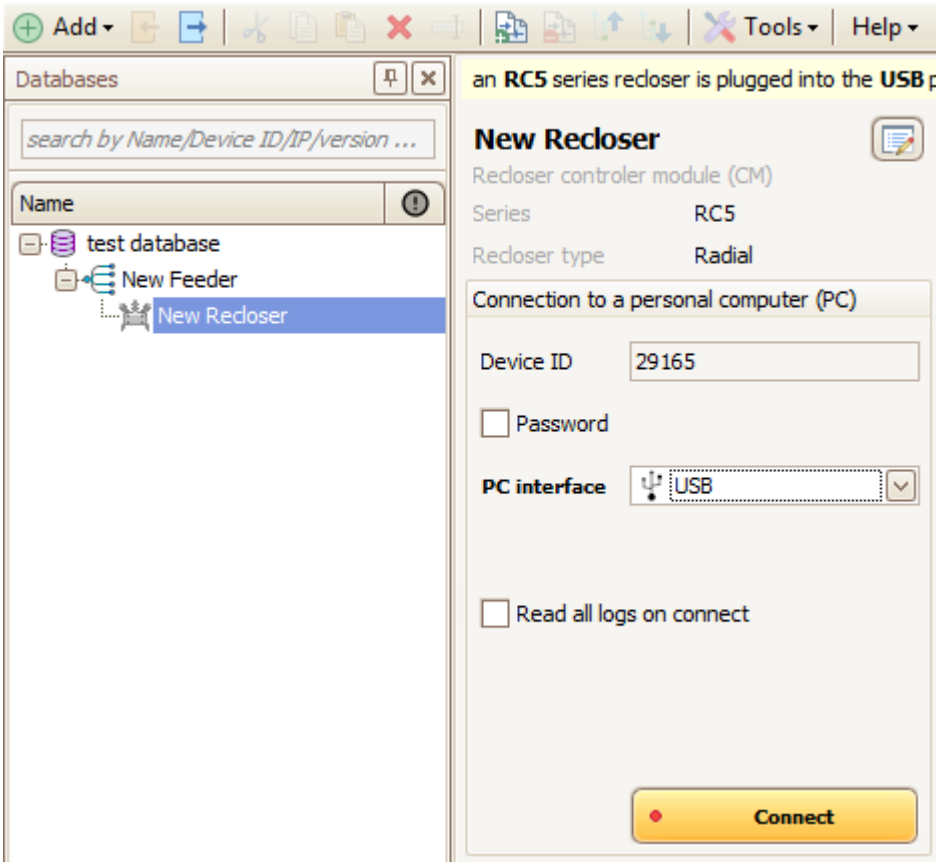


Figure 59

USB interface connection

Connection establishment via Ethernet

1. Connect the PC and the RC5_4 with twisted pair cable or optical fiber cable16;
2. Select a recloser that you want to connect in TELARM Lite;
3. Set “PC interface” to TCP/IP;
4. Enter Recloser Control IP address and port. It can be checked in MMI:

Main menu -> Settings -> Comms -> PCI -> Ethernet

5. Click “Connect” button.

[16] NOTE! The twisted pair cable and optical fiber cable are not in the standard scope of supply, however it can be ordered separately. Please contact the Magvatech representative for details.

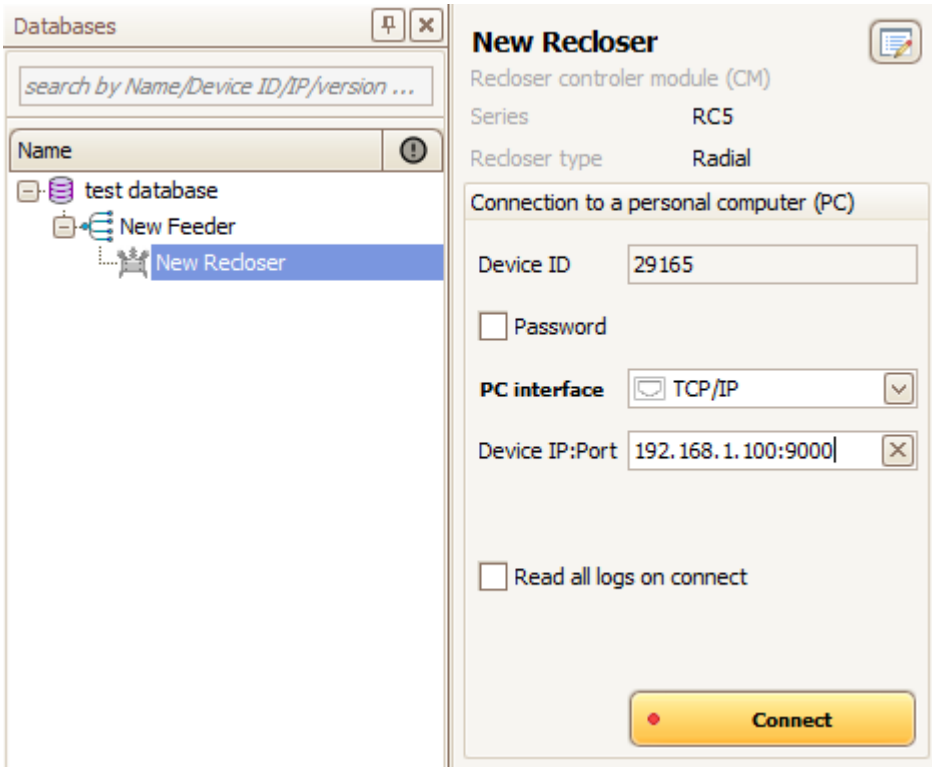


Figure 60

Ethernet interface connection

Connection establishment via Wi-Fi module

1. Enable “Access point” operating mode in Wi-Fi settings of RC5_4 using MMI:

Main menu -> Settings -> Comms -> PCI -> Wi-Fi

2. Connect your PC to the RC5_4 SSID network;

2. Select a recloser that you want to connect in TELARM Lite;

3. Set “PC interface” to TCP/IP;

4. Enter Recloser Control IP address and port. It can be checked in MMI:

Main menu -> Settings -> Comms -> PCI -> Ethernet

5. Click “Connect” button.

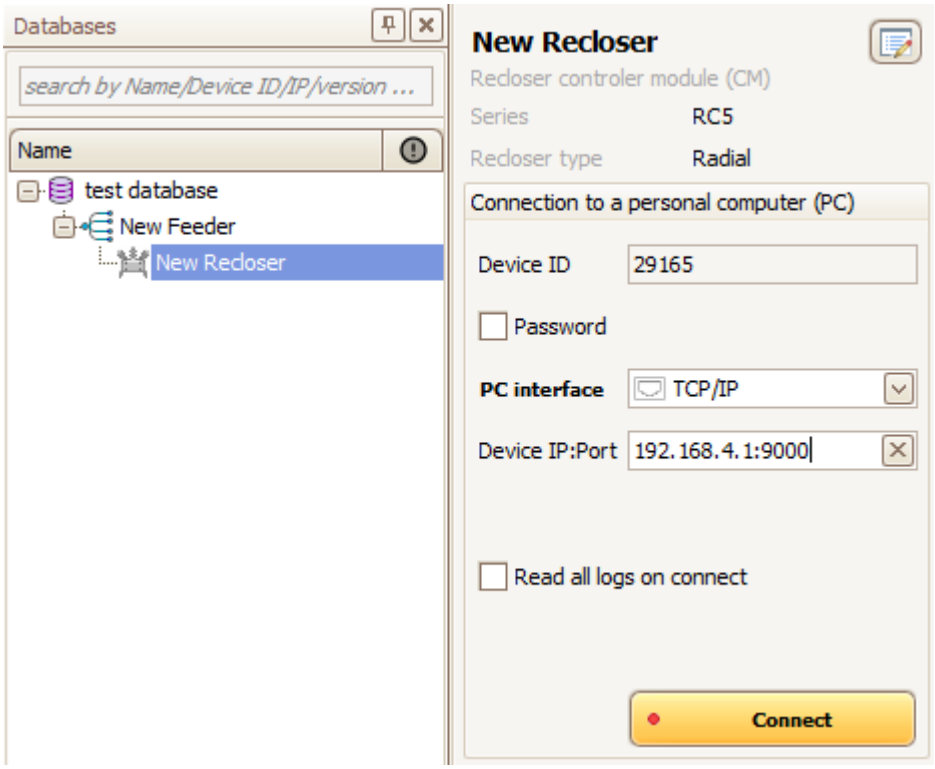


Figure 61

Wi-Fi interface connection

Operation

NOTE! Operation via PCI is possible in “Local” mode only. Current operation mode can be verified on the MMI.

NOTE! System status and logs are automatically downloaded to TELARM Lite after the RC5_4 is connected via PCI.

After PCI connection is established, the following control commands are available from TELARM Lite:

- Trip/Close commands;
- Date and time synchronization;
- Control mode selection;
- Protection groups selection;
- Switching protection state or particular element ON/OFF

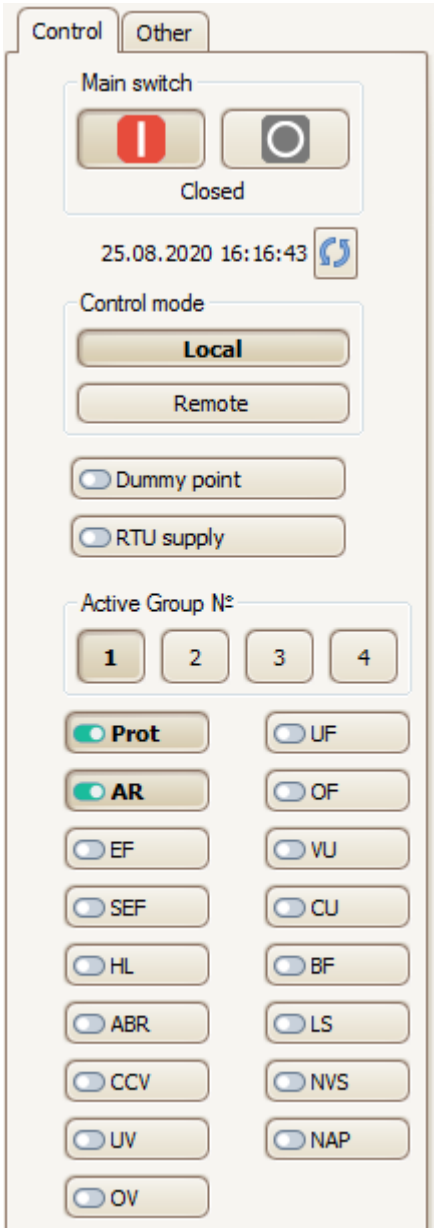


Figure 62

TELARM Lite control commands

8.6 Settings Configuration

8.6.1 Settings Downloading

To download settings:

1) Select the device on the TELARM Lite and establish the connection;

2) In the “Settings” tab, click the “Read all settings” button (Figure 63);

3) The successful downloading reading will appear in Connection log;

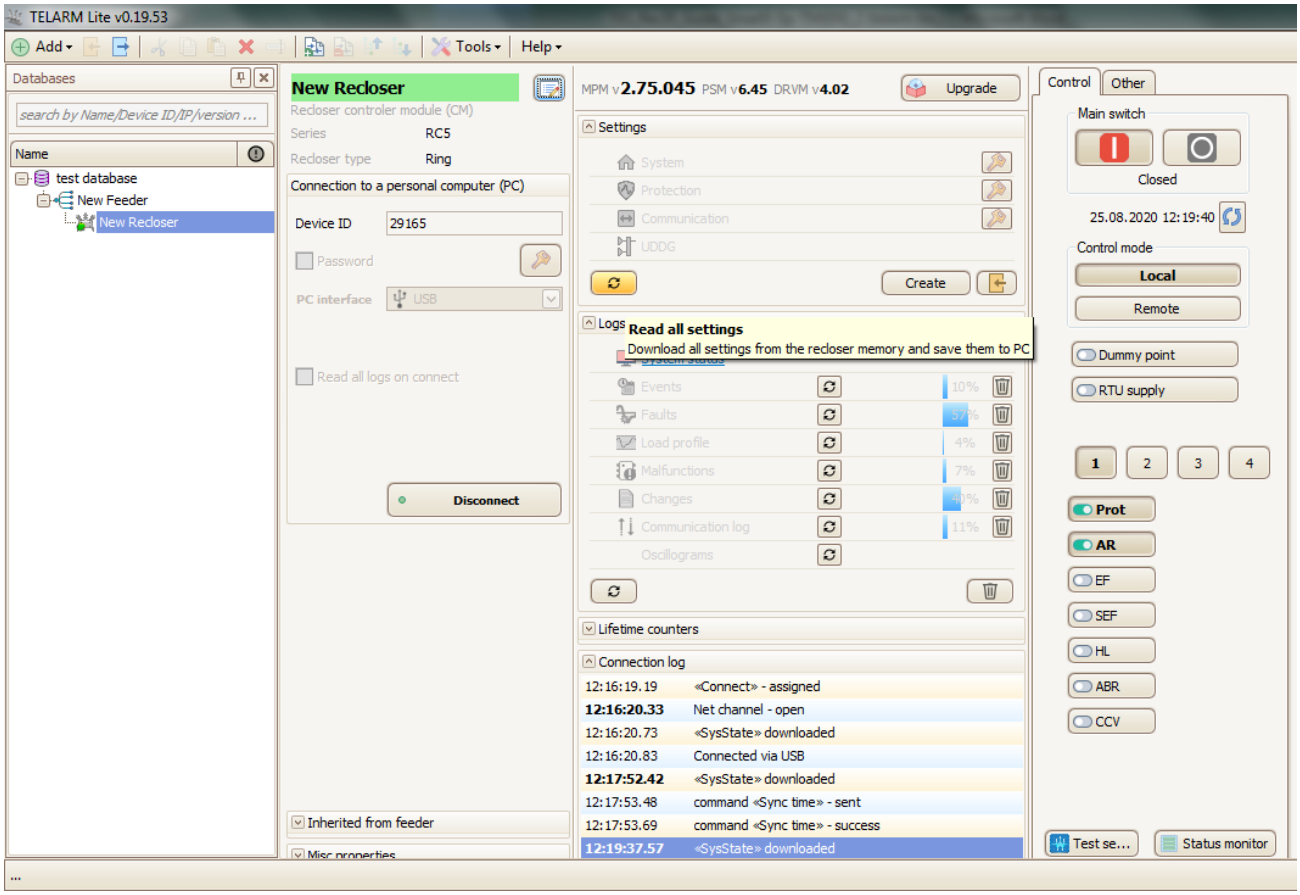


Figure 63

Settings downloading

8.6.2 System Settings Editing

System settings can be edited locally via the MMI or the PCI or remotely via the TDI interface.

System settings modifications using the MMI:

Main menu -> Settings -> System

To edit system settings locally using the PCI:

1) Select the device on the TELARM Lite and establish the connection;

2) In the “Settings” tab, click the “System” button;

3) “System settings” window will popup where it is possible to edit system settings (Figure 64).

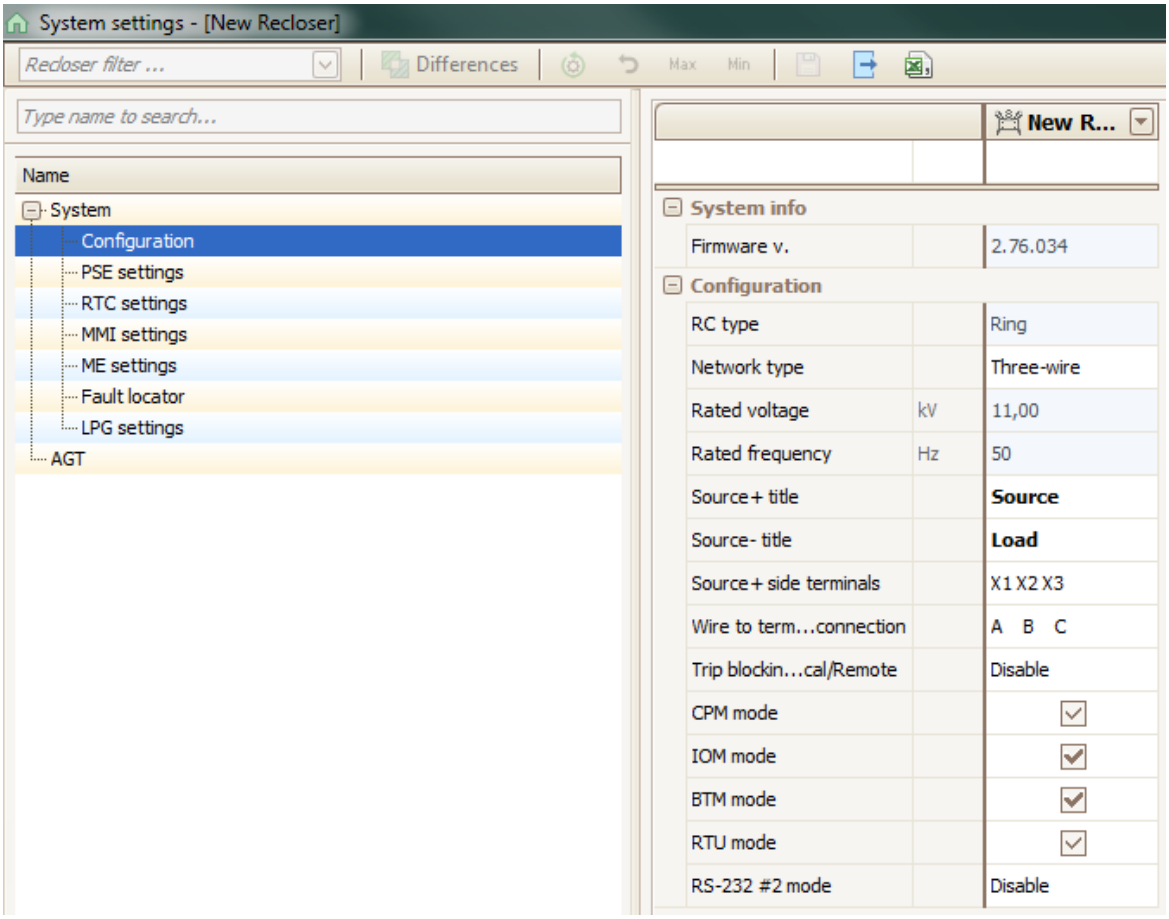


Figure 64

System settings editing

8.6.3 Protection Settings Editing

Protection settings can be edited locally via the MMI or the PCI or remotely via the TDI interface.

Protection settings modifications using the MMI:

Main menu -> Settings -> Protection -> Group #

Protection settings can be changed in each protection group independently.

NOTE! To apply updated settings it is required to upload them to the controller. Uploading settings is described in “Uploading protection settings”.

To edit protection settings locally (PCI):

1) Select the device on the TELARM Lite and establish the connection;

2) In the “Settings” tab, click the “Protection” button;

3) “Protection settings” window will popup where it is possible to edit settings, pick-up values and TCC curves (Figure 65).

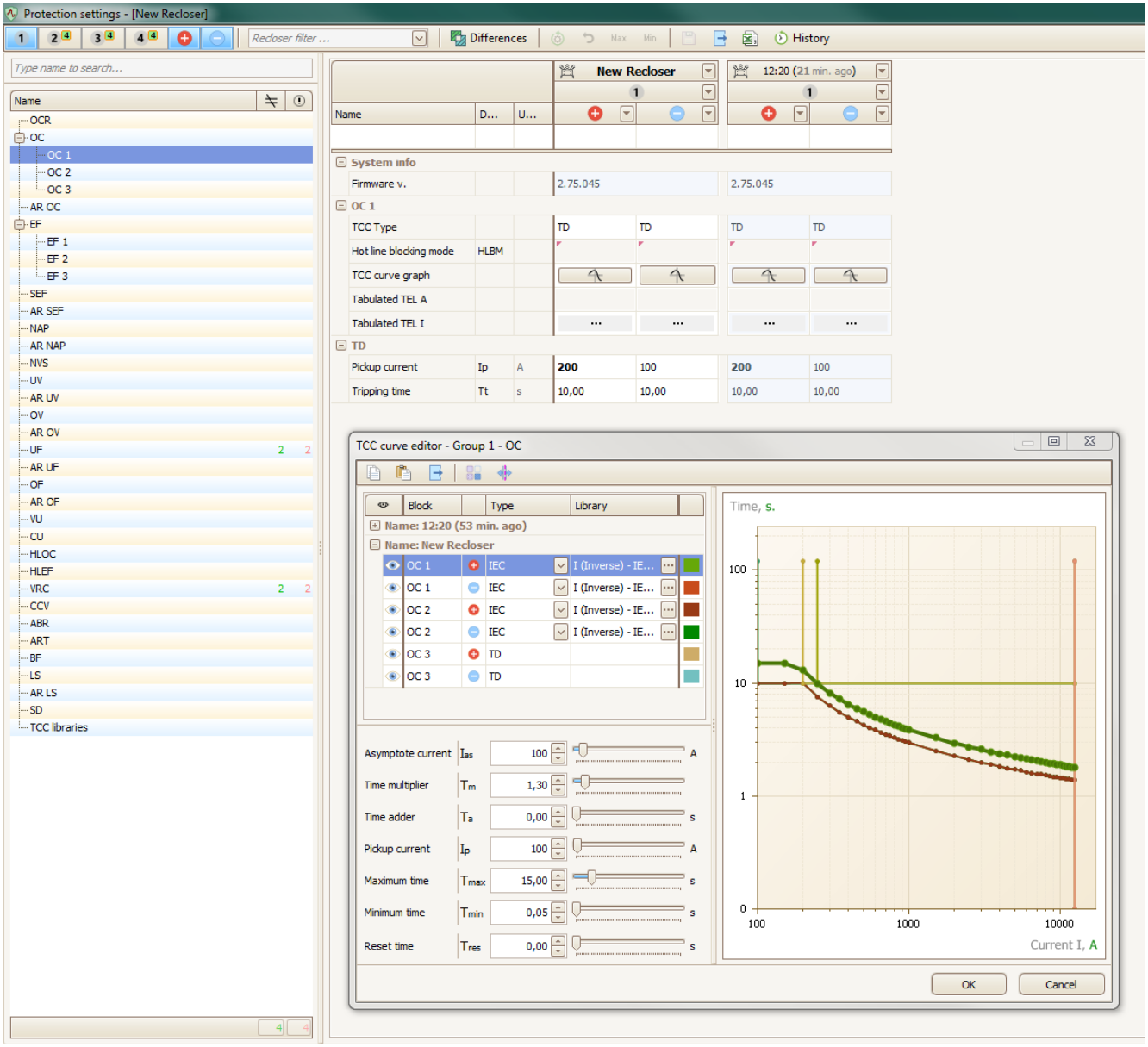


Figure 65

Protection settings editing

8.6.4 Communication Settings Editing

Communication settings can be edited locally via the MMI or the PCI or remotely via the TDI interface.

Communication settings modifications using the MMI:

Main menu -> Settings -> Comms

To edit Communication settings locally (PCI):

1) Select the device on the TELARM Lite and establish the connection;

2) In the “Settings” tab, click the “Communication” button;

3) “Communication settings” window will popup where it is possible to edit protocols and interfaces settings (Figure 66).

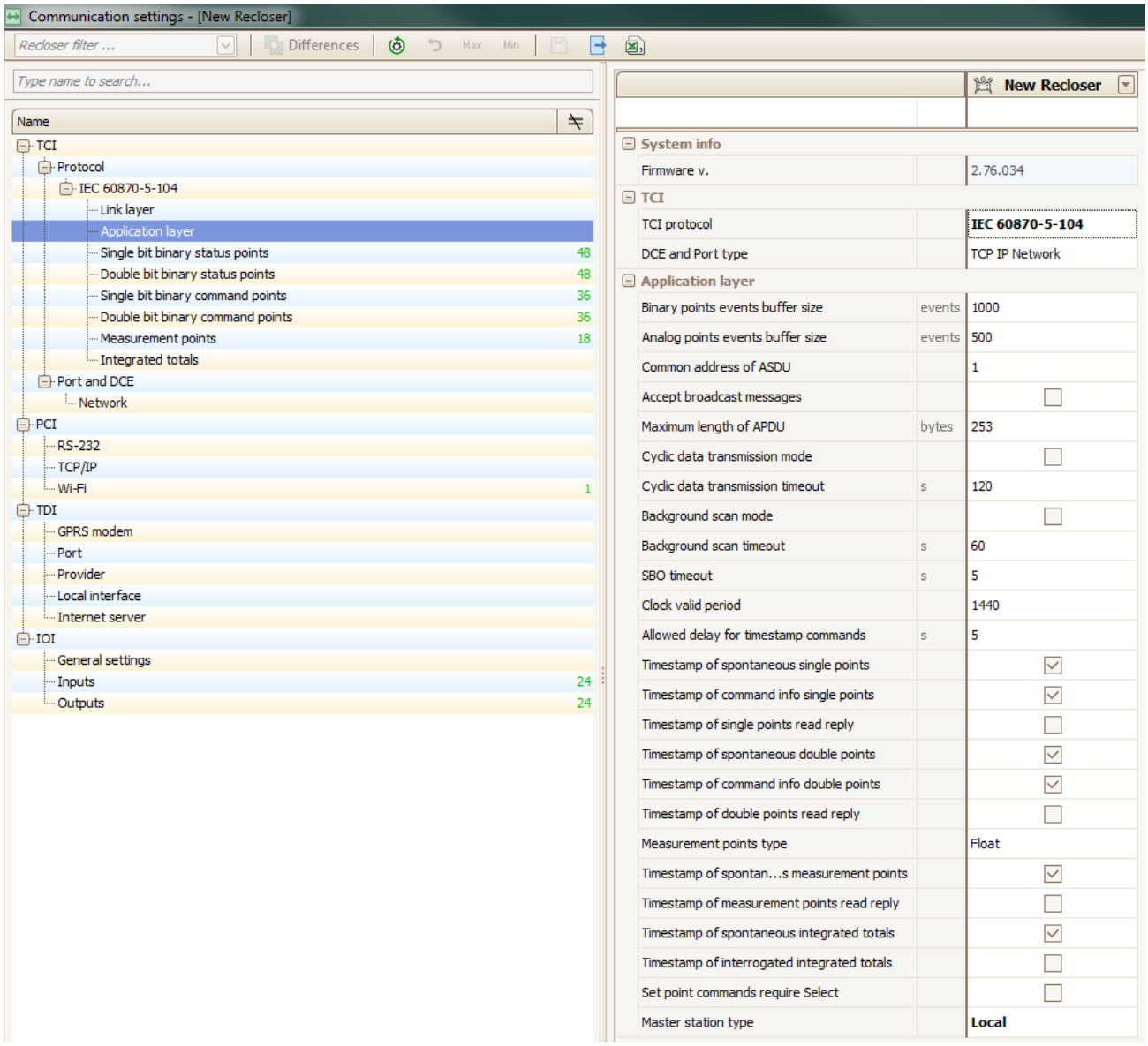


Figure 66

Communication settings editing

8.6.5 Settings Uploading

To upload settings to the device:

1) Select the device on the TELARM Lite and establish the connection;

2) In the “Settings” tab, click the “Upload” button;

3) Select the settings do you want to upload in a pop-up wizard window (Figure 67).

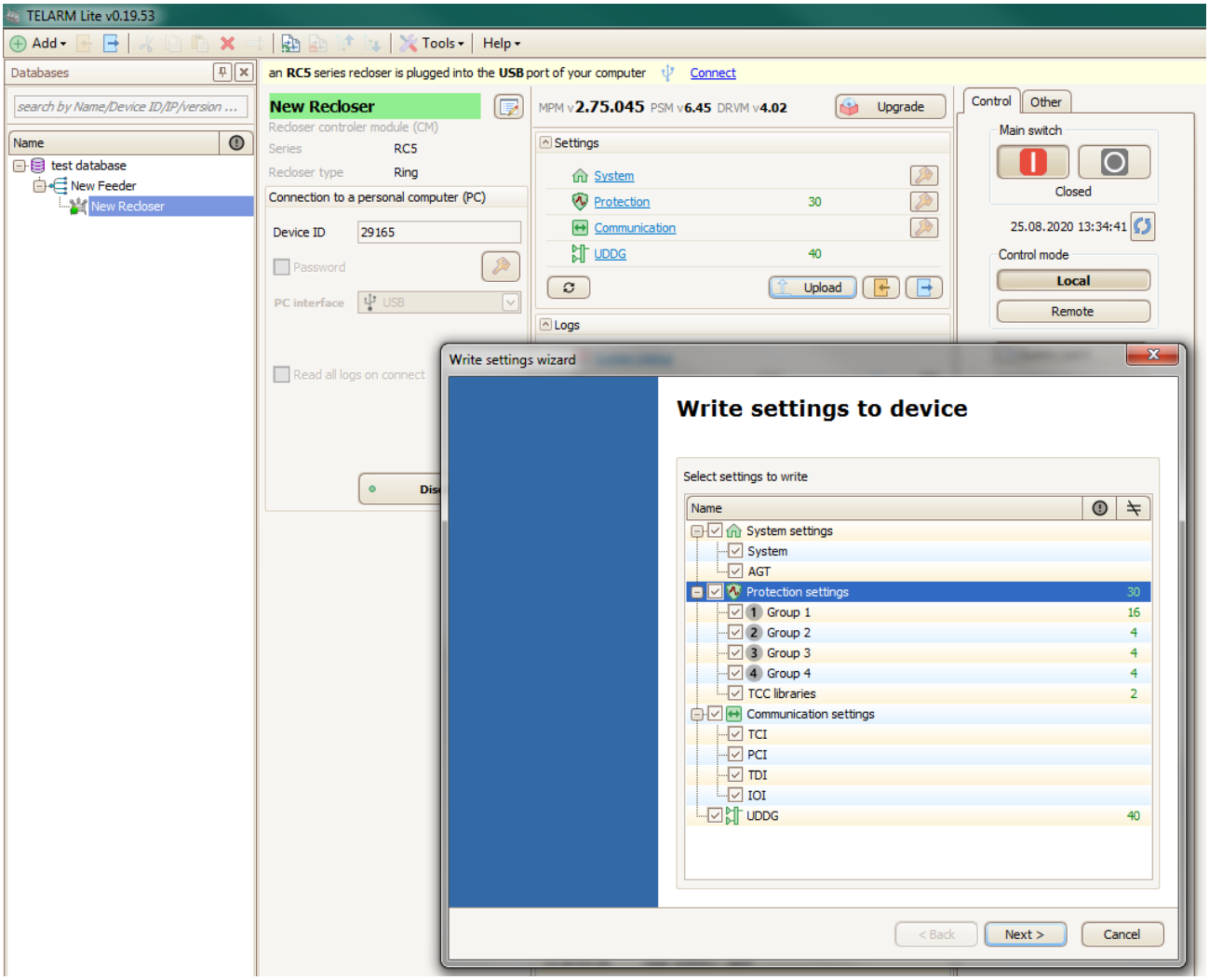


Figure 67

Settings uploading wizard

9 Maintenance and Troubleshooting

9.1 Maintenance

Magvatech recloser is a maintenance free device. No regular maintenance operations are required during the entire period of operation.

9.2 Troubleshooting

NOTE! In case the actions listed below do not help, contact your nearest Magvatech representative.

WARNING! All replacement operations of the HV assembly equipment require power line de-energizing. All necessary precautions (visible line gaps, temporary groundings etc.) should be applied.

9.2.1 PCI Connection Problems

NOTE! In case there are problems connecting to the device via the PCI interface check the following.

Possible reason	Malfunction identification procedure	Corrective action
RCM is shutdown	Check that secondary power supply switches are in ON position Check the voltage on power supply inputs of the RCM The voltage shall be in the range 85-265 V.	In case the voltage at the secondary power supply inputs of the RCM is absent, find the reasons of the malfunction similar to “Loss of auxiliary supply” described in paragraph labeled Loss of AC supply
Improper connection to RC5 via PCI	Check the connection according to chapter 6.5.1 of this guide	It is no malfunction
RCM malfunction	The most likely reason for malfunction in a control cubicle if no other reason was identified.	Replace the RCM

9.2.2 CPM Malfunction

NOTE! If it is possible to connect to the device via the PCI interface but the CPM doesn’t work properly, check the following.

Possible reason	Malfunction identification procedure	Corrective action
Low or no contrast of the screen	Check if LEDs on the CPM are lit Check if the screen lights but no readings are visible Push the button “Contrast” several times till the readings become clearly visible	It is no malfunction
The CPM mode is disabled via PCI	Download System settings from the RCM. Check in section “Configuration” the CPM mode The CPM mode is disabled if the check box is not ticked	Activate CPM mode via PCI
Improper connection of plugs connecting the CPM and the RCM	Check the connection of the plug “1” and plug “19”	Provide reliable connection of the plugs “1” and “19”
RCM malfunction	Connect new CPM via new wiring to the RCM If the new CPM with new wiring doesn’t work properly it is most likely a malfunction of the RCM	Replace the RCM
Malfunction of wiring connecting the RCM and the CPM	If the new CPM with new wiring works properly, replace the new wiring with the old one If the new CPM doesn’t work properly with the old wiring it is a wiring malfunction	Replace wiring
CPM malfunction	If the new CPM works properly with the old wiring it is CPM malfunction	Replace the CPM

9.2.3 Active Malfunction

Replacing procedure for components is described in paragraph “9.3 Components Replacement Procedure”

RCM Fault

Possible reason	Malfunction identification procedure	Corrective action
Internal fault of the RCM.	None	Replace the RCM

Driver Fault

Possible reason	Malfunction identification procedure	Corrective action
Internal fault of the driver module.	None	Replace the RCM

IOM Fault

Possible reason	Malfunction identification procedure	Corrective action
Internal fault of the Input/Output module.	None	Replace the IOM. If the new IOM does not work as well, replace the RCM together with the IOM

RTU Short Circuit

Possible reason	Malfunction identification procedure	Corrective action
Internal RTU short circuit	Disconnect the RTU from the power supply Turn the RTU supply on via the MMI If signal disappears short circuit is inside the RTU	Replace RTU
Short circuit in the wires connecting RTU and RCM	If the signal does not disappear disconnect Plug “10” If the signal disappears the short circuit is in the wiring between the RTU and the RCM	Replace the wiring
RCM malfunction	If the signal does not disappear the problem is in the RCM	Replace the RCM

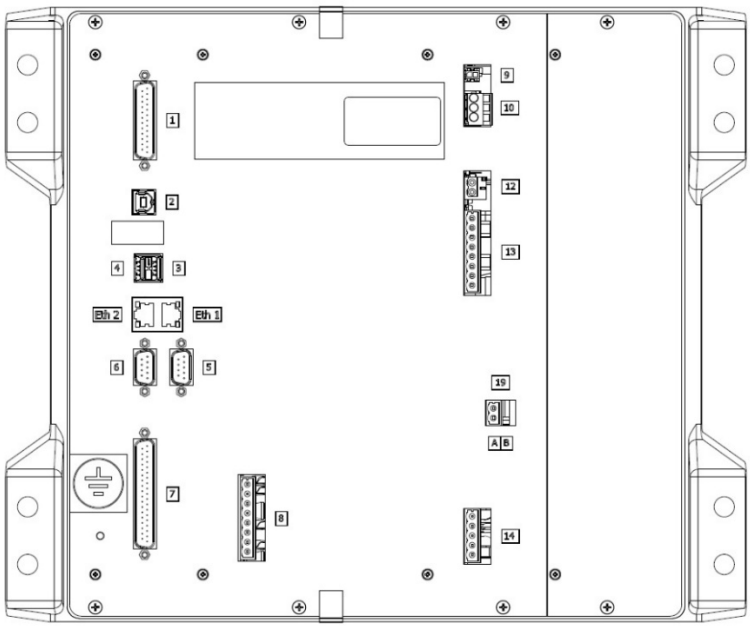


Figure 68

RTU power supply plug at RCM

NOTE! Wire numbers shall comply with the numbers of the socket.

Loss of AC Supply

Possible reason	Malfunction identification procedure	Corrective action
Auxiliary voltage transformer malfunction	Check the voltage at the power supply input terminals (Figure 69) If the voltage is less than 85 V it is a malfunction of the auxiliary voltage transformer	Check the auxiliary voltage transformer and its wiring, fix the malfunctioning component
PSFM malfunction	If the voltage is between 85-265 V, check the voltage at the RCM input (Figure 70) If the voltage is less than 85 V, the malfunction is in the PSFM	Replace PSFM
RCM malfunction	In case the voltage at the RCM inputs is between 85-265 V it is an RCM malfunction	Replace the RCM

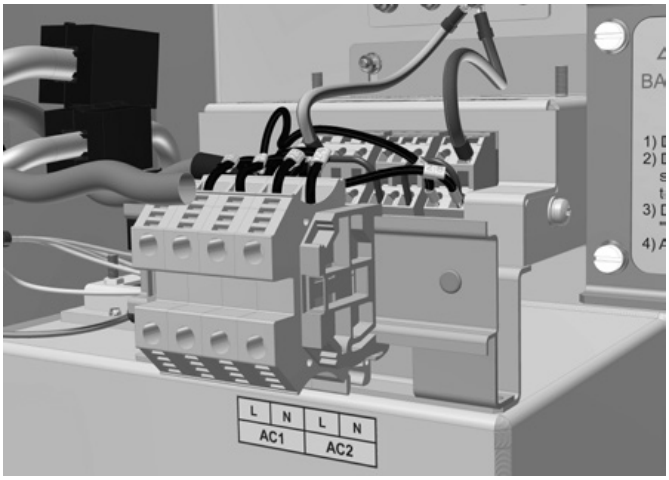


Figure 69

Auxiliary supply connections inside PSFM

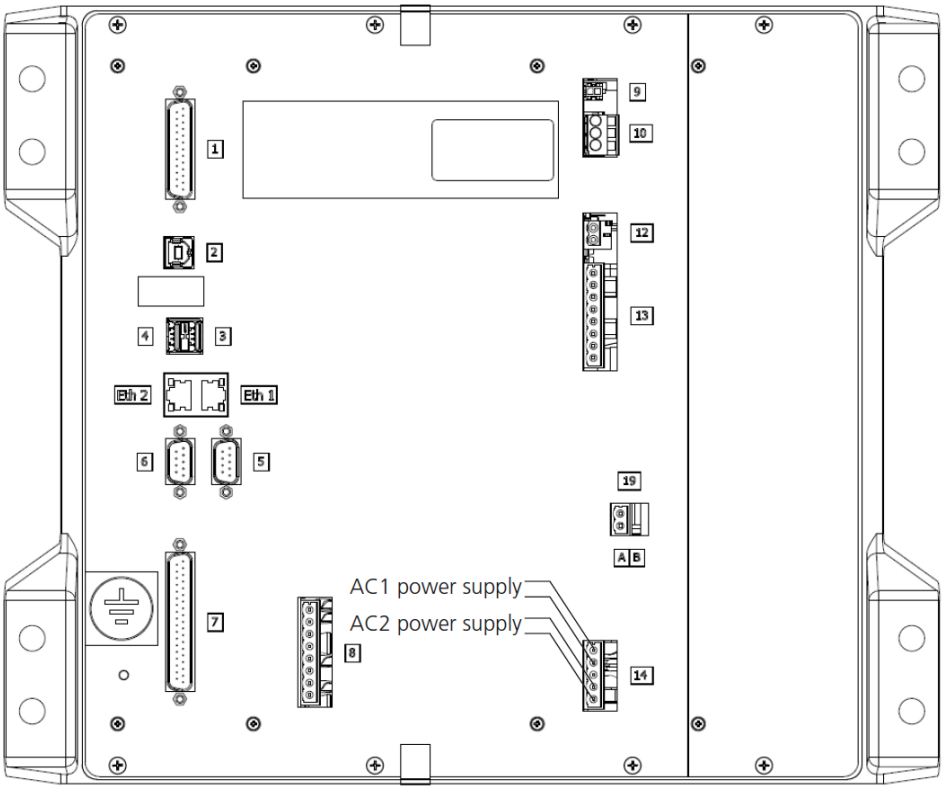


Figure 70

Auxiliary supply connections at RCM

Battery Fault

Possible reason	Malfunction identification procedure	Corrective action
The battery is disconnected by the battery switch	Check if the battery switch is in the ON position Check that the battery is properly connected to the RCM. Plug “13” wires 1(+) and 2(-) Check the wiring connection to the battery terminals. “+” terminal = wire with “+” mark “-” terminal = battery sensor In case signal disappears you have located the problem	Turn the battery switch to ON position. Provide reliable connection of wiring

Possible reason	Malfunction identification procedure	Corrective action
Wiring malfunction	Disconnect the wiring from the RCM. Plug “13” wires 1(+) and 2(-) Disconnect the wiring from the battery Wires marked “+” and “-” Check that switch and wiring is not short circuited or broken. NOTE! Reconnect the wiring properly after the tests are done	Replace the wiring assembly
Internal fault of the battery	If none of the above described reasons were confirmed it is likely to be an internal battery fault	Replace the battery

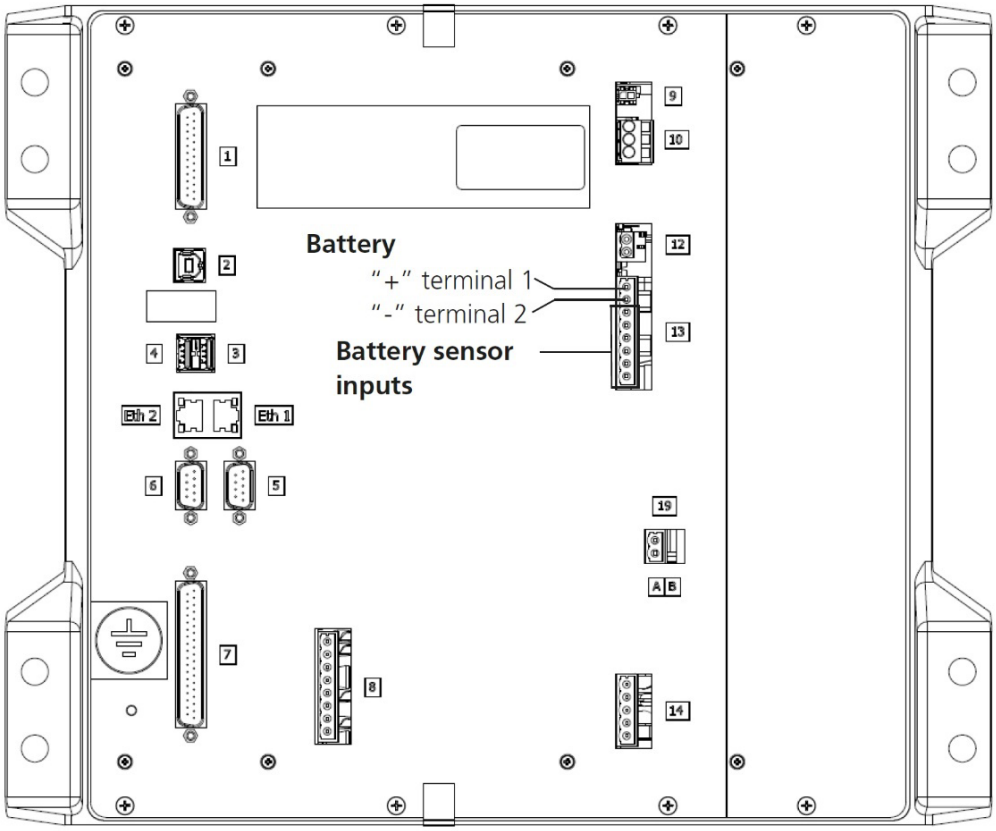


Figure 71

Battery and battery sensor inputs Plug “13” at RCM

NOTE! Wire numbers comply with the numbers of inputs in the plug.

Excessive Trip Time

Possible reason	Malfunction identification procedure	Corrective action
Outdoor Switching Module actuator coil short circuit	Check if the reading in the malfunction log “OSM coil short circuit” is present	Refer to paragraph “Outdoor Switching Module Actuator Coil Short Circuit”
Outdoor Switching Module actuator coil isolated	Check if the reading in malfunction log “OSM coil isolated” is present	Refer to paragraph “Outdoor Switching Module Actuator Coil Isolated”
Driver is not ready	Check if the malfunction “Driver is not ready” is present Wait for 1 min and open the recloser	The “Excessive trip time malfunction” will disappear
RCM malfunction	Switch off the RC5_4 and battery Disconnect plug “8“ from the RCM Disconnect wire 7 and 8 from plug “8” Short circuit inputs 7 and 8 of plug “8” by a short piece of insulated wire. See Figure 72 Connect plug “8” to the RCM Switch on RC5_4 and battery The indication of the main contact position should change to “Open” If the indication doesn’t change to “Open” the malfunction is in the RCM	Replace the RCM

Possible reason	Malfunction identification procedure	Corrective action
Open circuit in Control Cable	If RCM replacement doesn't help: Switch off the RC5_4 and the battery Disconnect "8" plug from the RCM Disconnect the control cable from the RC5_4. Disconnect the control cable from the Outdoor Switching Module Short circuit pins 22 and 29 of the heavy duty connector of the control cable (Outdoor Switching Module side) as it is shown in Figure 73 Connect the control cable to the RC5_4 Connect plug "8" to the RCM Switch on the RC5_4 and battery The indication of the main contacts position should change to "Open" If the indication doesn't change to "Open" the malfunction is in the control cable	Replace the control cable
Outdoor Switching Module malfunction	If none of the above described actions helped it is an Outdoor Switching Module malfunction	Replace the Outdoor Switching Module

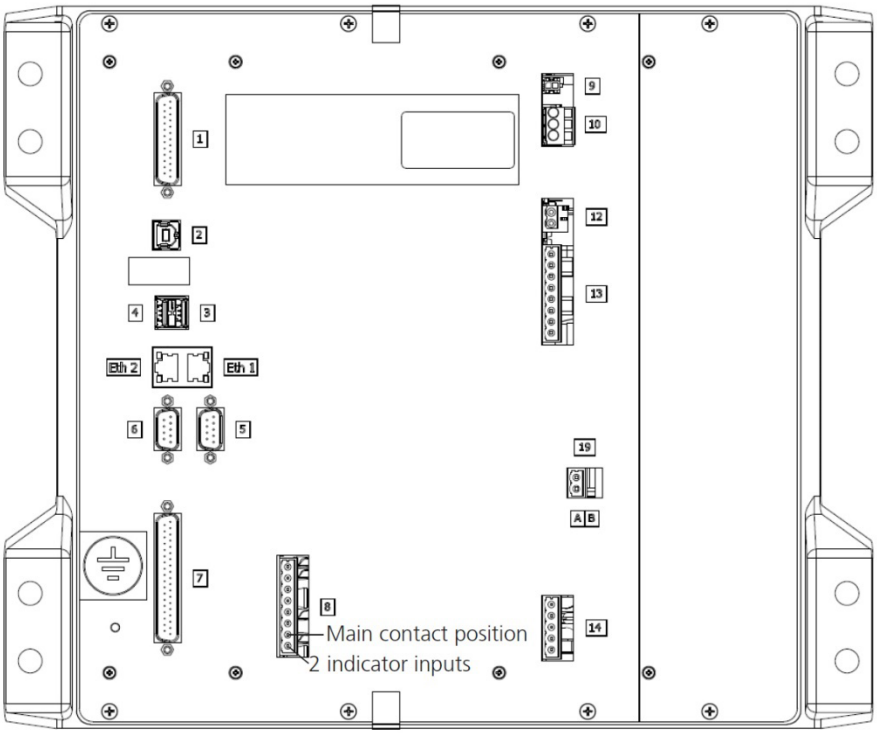


Figure 72

Main contact position indicator inputs at RCM

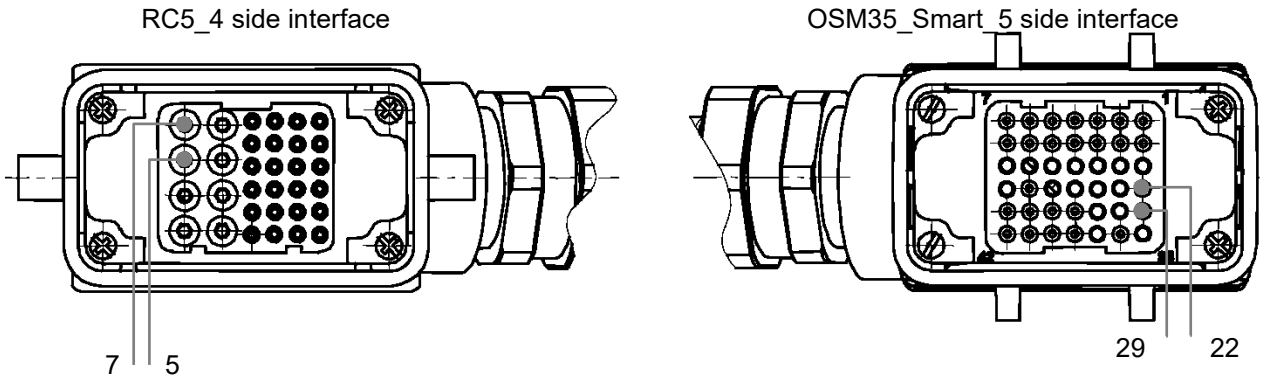


Figure 73

Main contact position indicator inputs of heavy duty connector of the RC5_4 (left picture) and umbilical heavy duty connector from the Outdoor Switching Module side (right picture)

NOTE! To short circuit the two pins of the connectors use two miniature crocodile clips and a wire.

Excessive Close Time

Possible reason	Malfunction identification procedure	Corrective action
Outdoor Switching Module coil short/open circuit	Check if the reading in the malfunction log “OSM coil short circuit” is present	Fix the “Outdoor Switching Module coil short circuit” or “Outdoor Switching Module coil isolated” malfunctions first
Driver is not ready	Check that the malfunction “Driver is not ready” is present Wait for 1 min and open the Outdoor Switching Module	The “Excessive close time malfunction” will disappear
RCM malfunction	Switch off the RC5_4 and battery Disconnect plug „8“ from the RCM The indication of main contact position should change to “Close” If the indication doesn’t change to “Close” the malfunction is in the RCM	Replace the RCM
Short circuit in the wiring connecting the RCM with control cable	Switch off the RC5_4 and the battery Disconnect the control cable from the RC5_4. Switch on the RC5_4 and battery The indication of main contact position should change to “Close” If the indication doesn’t change to “Close” the malfunction is in the wiring connecting the RCM with control cable	Replace the RC5_4
Open circuit in Control Cable	Switch off the RC5_4 and the battery Connect the control cable to the RC5_4. Disconnect the control cable from the Outdoor Switching Module Switch on the RC5_4 and the battery The indication of the main contact position should change to “Close” If the indication doesn’t change to “Close” the malfunction is in the control cable	Replace the control cable
Outdoor Switching Module malfunction	If none of the above described actions helped it is an Outdoor Switching Module malfunction	Replace the Outdoor Switching Module

Outdoor Switching Module Coil Isolated

Possible reason	Malfunction identification procedure	Corrective action
The Outdoor Switching Module is switched off manually	Check if the Outdoor Switching Module is switched off manually.	Return the Outdoor Switching Module to “operated” position.
Wiring connecting drivers of the RCM and control cable are not properly connected	Check that wiring connecting the drivers of the RCM and control cable are properly connected	Connect wiring properly

Possible reason	Malfunction identification procedure	Corrective action
The RCM malfunction	Switch off the RC5_4 and the battery and wait for 2 minutes Short circuit inputs 1 and 2 of plug “8” of the RCM (Figure 74) Switch on the RC5_4 and the battery The malfunction readings should change to “OSM coil short circuit” In case the reading doesn’t change the malfunction is in the RCM NOTE! Remove the short circuiting wiring after the test. Connect the wiring to the drivers properly.	Replace the RCM
Wiring assembly in the RC5_4 is open circuited	Switch off the RC5_4 and the battery and wait for 2 minutes Short circuit pins 1 and 3 of the RC5_4 heavy duty connector as it is shown in Figure 75 Switch on the RC5_4 and the battery The malfunction readings should change to “OSM coil short circuited” If the reading doesn’t change the malfunction is in wiring assembly between the RCM and control cable NOTE! Remove the short circuiting wiring after the test.	Replace the RC5_4
Control Cable is not connected properly	Check that the heavy duty plugs of the control cable, Outdoor Switching Module and RC5_4 are visually not damaged Check that the control cable is connected properly	Connect control cable properly
Control Cable malfunction	Switch off the RC5_4 and the battery and wait for 2 minutes Short circuit pins 37 and 39 of the heavy duty connector of the control cable (Outdoor Switching Module side) as it is shown in Figure 75 Switch on the RC5_4 and the battery The malfunction readings should change to “OSM coil short circuited” If the reading doesn’t change the malfunction is in the control cable NOTE! Remove the short circuiting wiring after the test.	Replace the control cable
Outdoor Switching Module malfunction	If none of the above described actions helped it is an Outdoor Switching Module malfunction	Replace the Outdoor Switching Module

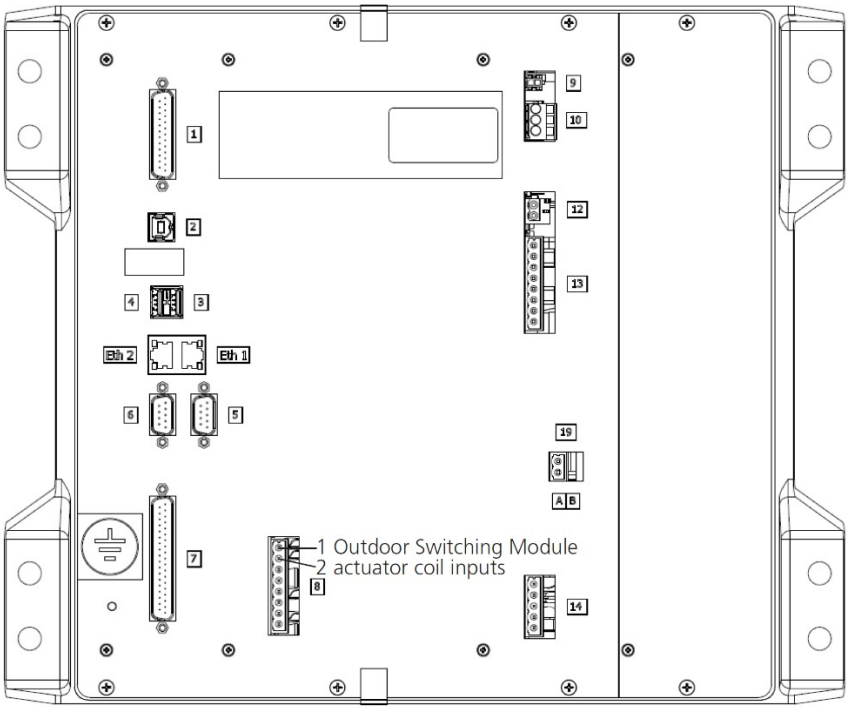


Figure 74

Outdoor Switching Module actuator coil inputs at RCM

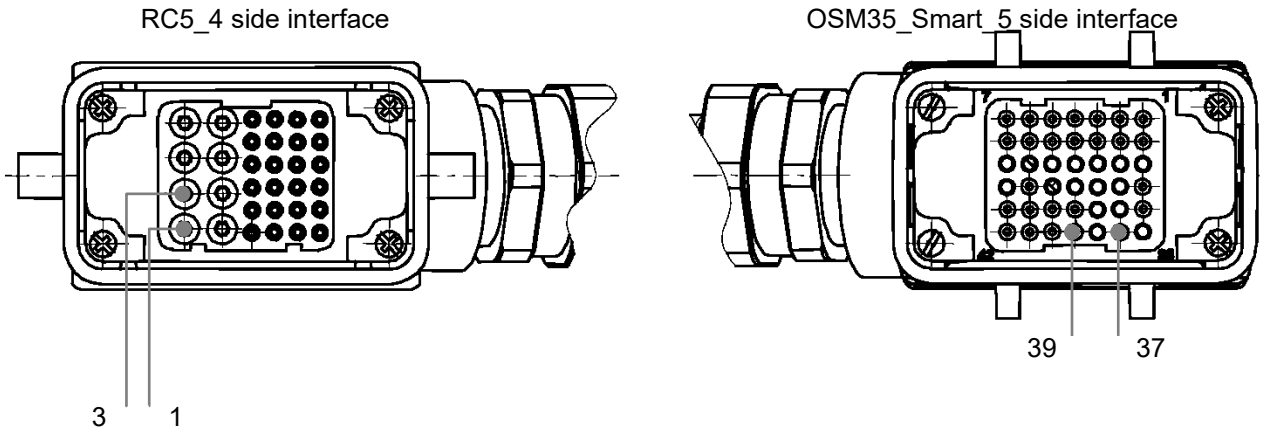


Figure 75

Outdoor Switching Module actuator coil inputs of heavy duty connector of RC5_4 (left picture) and umbilical heavy duty connector from Outdoor Switching Module side (right picture)

NOTE! To short circuit the two pins of the connectors use two miniature “crocodile” clips and a wire.

Outdoor Switching Module Actuator Coil Short Circuit

Possible reason	Malfunction identification procedure	Corrective action
Wiring connecting drivers of the RCM and control cable are not properly connected	Check that wiring connecting the drivers of the RCM and control cable are properly connected	Connect wiring properly
The RCM malfunction	Switch off the RC5_4 and the battery and wait for 2 minutes Disconnect the plug „8“ from the RCM. Switch on the RC5_4 and the battery. The malfunction readings should change to “OSM coil isolated” In case the reading doesn’t change the malfunction is in the RCM NOTE! After this test remember to connect the wiring to the drivers properly.	Replace the RCM
Wiring assembly in the RC5_4 is open circuited	Switch off the RC5_4 and the battery and wait for 2 minutes Disconnect control cable from the RC5_4. Switch on the RC5_4 and the battery. The malfunction readings should change to “OSM coil isolated”. If the reading doesn’t change the malfunction is in wiring assembly between the RCM and control cable NOTE! After this test remember to connect the control cable to RC5_4.	Replace the RC5_4
Control Cable is not connected properly	Check that the heavy duty plugs of the control cable, Outdoor Switching Module and RC5_4 are visually not damaged Check that the control cable is connected properly	Connect control cable properly
Control Cable malfunction	Switch off the RC5_4 and the battery and wait for 2 minutes. Disconnect the control cable from the Outdoor Switching Module. Switch on the RC5_4 and the battery. The malfunction readings should change to “OSM coil isolated”. If the reading doesn’t change the malfunction is in the control cable.	Replace the control cable
Outdoor Switching Module malfunction	If none of the above described actions helped it is an Outdoor Switching Module malfunction	Replace the Outdoor Switching Module

Driver Not Ready

Possible reason	Malfunction identification procedure	Corrective action
Switching capacitors are still charging	Wait for 60 s. If the signal disappears this warning is not associated with any malfunction.	Not required
Outdoor Switching Module actuator coil short circuit or Outdoor Switching Module actuator coil isolated	In case this message has not disappeared and messages “OSM coil short circuit” or “OSM coil isolated” appear it is necessary to remove the reason of these malfunctions.	Fix the “Outdoor Switching Module coil short circuit” and “Outdoor Switching Module coil isolated” malfunctions first
RCM malfunction	If none of the above described actions helped it is an RCM malfunction	Replace the RCM

9.3 Components Replacement Procedure

9.3.1 RCM Replacement

Dismounting

1) Disconnect all wiring assemblies and the earthing wire connected to the RCM;

2) Unscrew four nuts fixing the RCM and remove the washers (Figure 76);

3) Pull the RCM from the fixing studs and take it out of the housing.

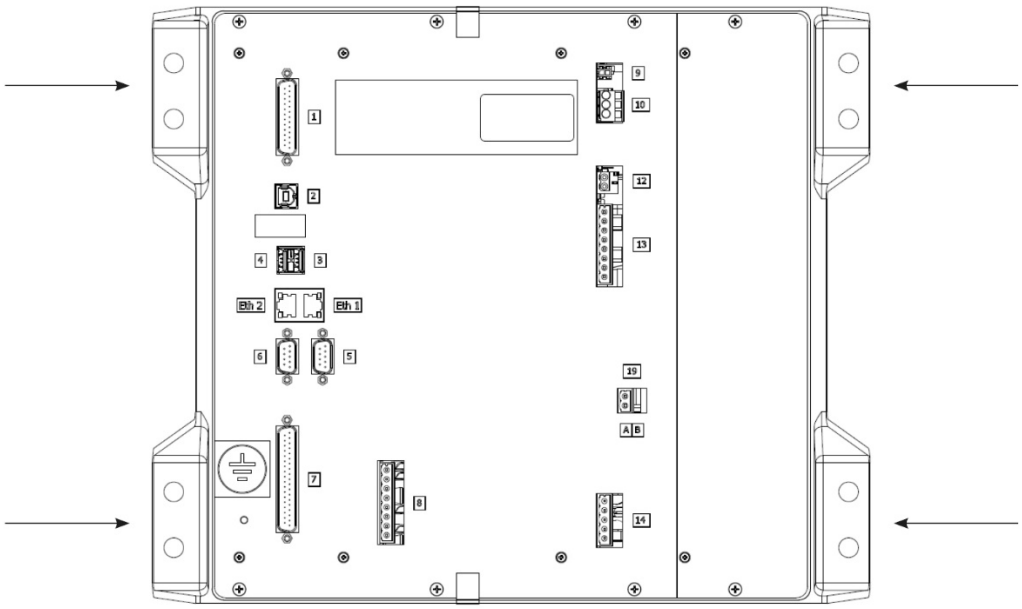


Figure 76

RCM with fixing nuts and washers (marked by arrows)

Installation

1) Take a spare RCM with appropriate protective, system and communication settings and put it on the fixing studs and install washers;

2) Tighten four nuts fixing RCM;

3) Connect the wiring to the RCM according to the wiring assembly diagram (Figure 77).

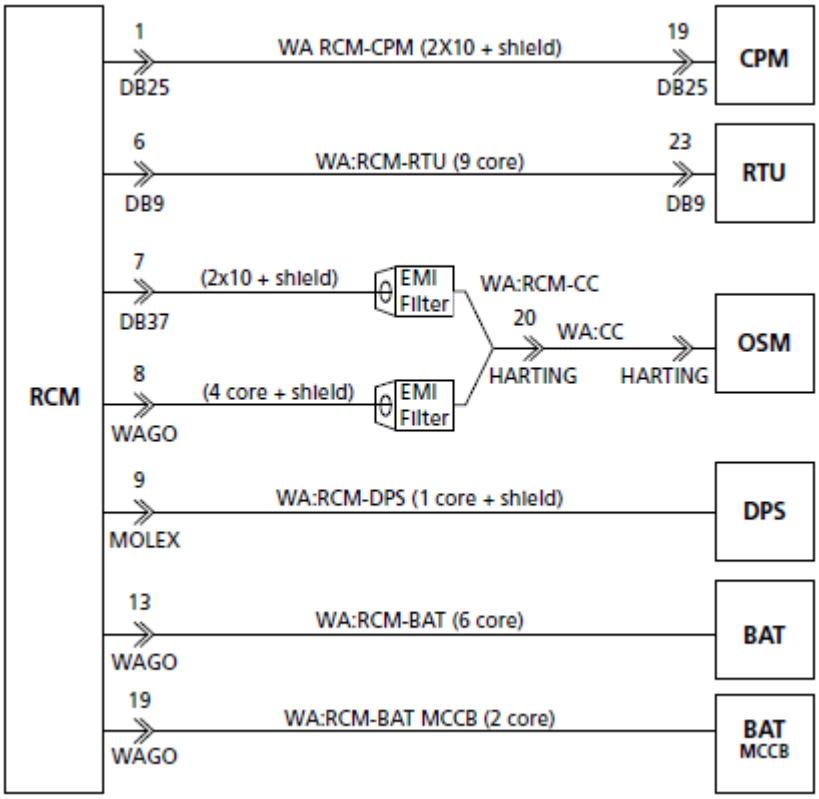


Figure 77

RCM Wiring diagram

Plug numbering correspond to socket numbering.

9.3.2 CPM Replacement

Dismounting

1) Disconnect plug “19” from the CPM;

2) Unscrew six nuts fixing the CPM and remove the washers (Figure 78);

3) Pull the CPM from the fixing studs and take it out of the housing.

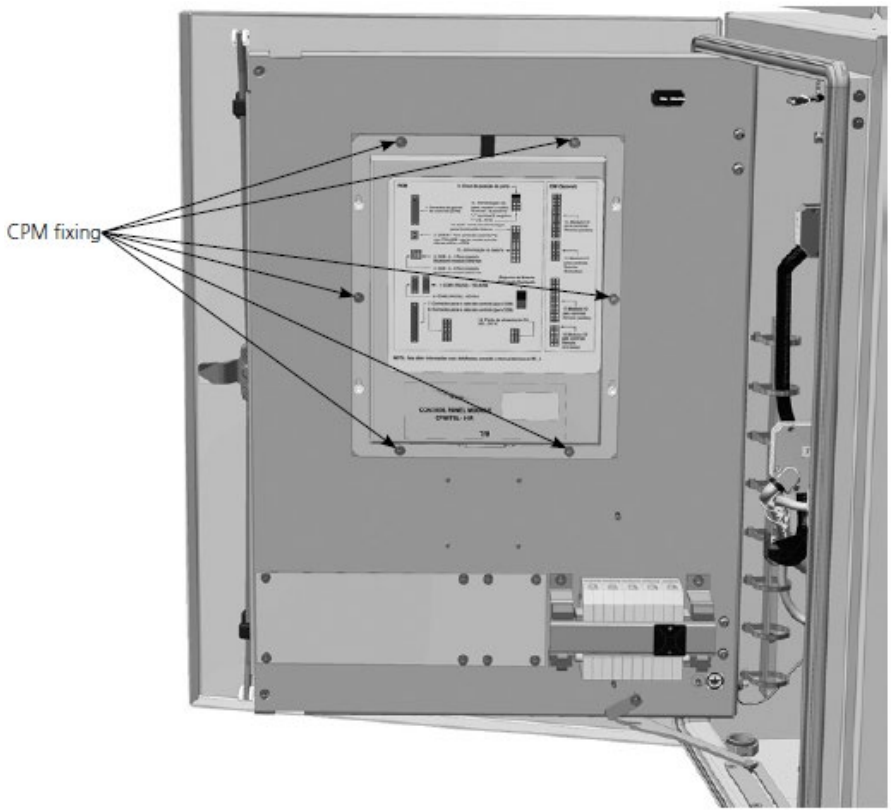


Figure 78

Nuts holding CPM on RC5_4 internal door

Installation

1) Install the CPM on the fixing studs;
2) Tighten six nuts fixing the CPM;
3) Connect plug “19” to the CPM.

9.3.3 PSFM Replacement

Dismounting

1) Make sure that there is no voltage on any inputs of the PSFM;
2) Disconnect all auxiliary supply wiring from the PSFM;
3) Disconnect plug “14” from the RCM;
4) Disconnect earthing wires;
5) Remove cable ties fixing cable “14”;
6) Unscrew four nuts fixing the PSFM and remove the washers;
7) Take the PSFM out of the housing.

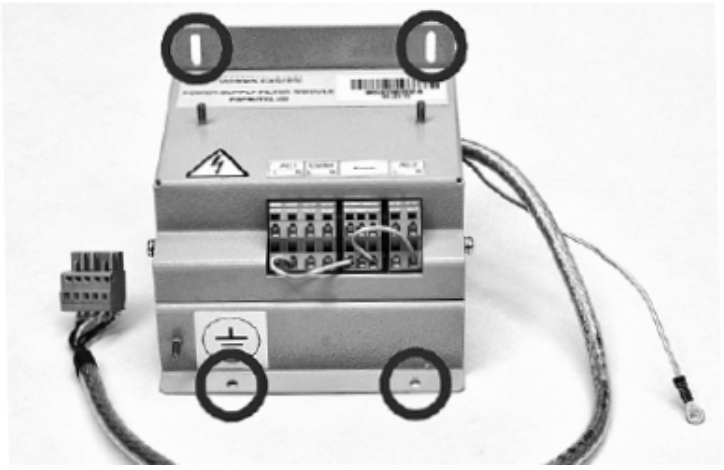


Figure 79
PSFM fixing provisions

Installation

1) Install the new PSFM on the fixing studs inside the RC5_4;

2) Tighten four nuts with washers fixing the PSFM;

3) Connect plug “14” to RCM;

4) Connect one earthing wire from the control cubicle to the stud on the PSFM marked with the grounding sign. Earthing wire from the PSFM connection to the stud on the control cubicle located above the PSFM;

5) In case you have a PSFM without a plug, use the old one. Numbers on the wires correspond to numbers on plug “14”;

6) Connect the auxiliary supply wiring to the inputs of the PSFM.

9.3.4 Battery Replacement

Dismounting

1) Switch off the battery circuit breaker;

2) Disconnect the plug “13” from the RCM;

3) Disconnect the wires from the battery terminals - the minus terminal should be disconnected first;

4) Unscrew four bolts from the battery fixing plate (Figure 80);

5) Remove the Battery.

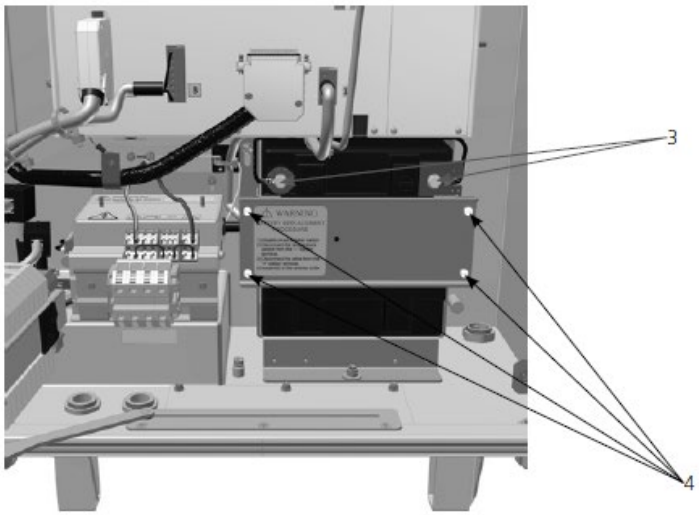


Figure 80

Battery fixing provisions

Installation

1) Switch off the battery circuit breaker;

2) Switch off auxiliary AC power supply circuit breaker;

3) Disconnect plug “13” from the RCM;

4) Mount the battery to the appropriate place;

5) Install battery fixing plate and fix it with four bolts (Figure 80);

6) Install plus terminal to the battery;

7) Connect plug “13” to the appropriate RCM socket;

8) Switch on auxiliary AC power supply circuit breaker;

9) Switch on the battery circuit breaker.

9.3.5 RC5_4 Replacement

RC5_4 dismounting and installation should be performed according to the Installation section of this document.

NOTE! To upload protection and communication settings to a newly installed Recloser Control, refer to chapter 6.6.1.3 and 6.6.2.3 correspondingly.

9.3.6 Outdoor Switching Module Replacement

The Outdoor Switching Module dismounting and installation should be performed according to the Installation section of this document.

NOTE! Each Outdoor Switching Module is supplied with current and voltage sensor (CVCS) coefficients. If the Outdoor Switching Module has been replaced, it is recommended to upload the correct CVCS coefficients into the Recloser Control. To upload sensor coefficients refer to chapter 5.1.3 of this guide.

10 Product Coding

10.1 Recloser Coding

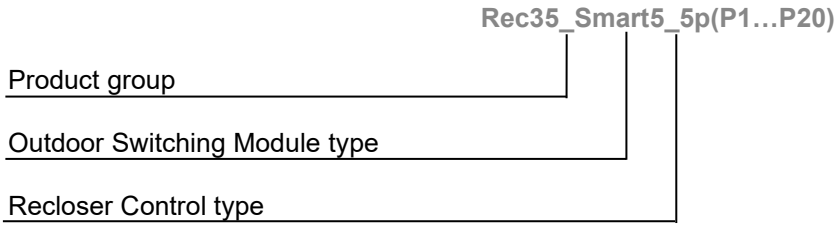


Table 105 – Recloser coding description

Parameter	Parameter description	Applicable options	Code
P1	Customization	No customization	1
		Other – Contact Magvatech representative	…
P2	OSM type	Three-phase 35kV module with voltage sensor of 70 mV/kV, Rogowski coils and 220V actuator coil, version 1	1
		Three-phase 35kV 1250A module with voltage sensor of 30 mV/kV, Rogowski coil 2 V/kA, Zero sequence current sensor 2 V/kA based on three Rogowski coils and 220V actuator coil, version 1	2
P3	Language	English RC stickers	1
		Portuguese RC stickers	2
		Spanish RC stickers	3
		English RC stickers, OSM/RC nameplates	4
		Portuguese RC stickers, OSM/RC nameplates	5
		Spanish RC stickers, OSM/RC nameplates	6
		According to Customization parameter value	7
		Without language properties	8
P4	Controller type	Basic RC5 with DRVM-04 + PSM-02A(1) and MPM-04M(3) based RCM. Aluminum housing	1
		Basic RC5 with DRVM-04 + PSM-02A(1) and MPM-04E(1) based RCM. Aluminum housing	2
P5	Firmware version	Factory-default firmware version	1
P6	OSM mounting kit	Clamp-ready mounting kit for universal installation	6
		Around-pole mounting kit with 500mm U-profiles for universal installation	7
		Around-pole mounting kit with 700mm U-profiles for universal installation	8
		Through-pole mounting kit with M16 studs for universal installation	9
		Through-pole mounting kit with M20 studs for universal installation	A
		Substation mounting kit	B
P7	AT mounting kit	No auxiliary transformer mounting kits	1
		1x cast resin transformer holder for universal installation	4
		2x cast resin transformer holders for universal installation	5
		Kit for CRVT installation on substation mounting kit	6
P8	Control cable	Umbilical 5m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) with protective conduit	1
		Umbilical 7m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) with protective conduit	2
		Umbilical 12m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) with protective conduit	3
		Umbilical 20m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) with protective conduit	4
		No control cable provided	5
		Umbilical 5m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) without protective conduit	6
		Umbilical 7m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) without protective conduit	7
		Umbilical 12m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) without protective conduit	8
		Umbilical 20m for OSM15/25_AI1 (42-pin) and RC5_4 (32-pin) without protective conduit	9
P9	Primary connector type	No additional connectors	1
		NEMA2 bended (125/145 degrees) bus aluminium connectors	2
		NEMA2 bended (125/145 degrees) bus aluminium connectors with bird protection	3
P10	Earthing accessories	No earthing accessories	1
		According to Customization parameter value	2
		2x cross-pressure terminals: 25-70 mm^2 earthing wire, 13 mm hole diameter	3
P11	Power cable	No power cable	1

Parameter	Parameter description	Applicable options	Code
		According to customization parameter value - Contact Magvatech representative	2
		5m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	3
		7m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	4
		12m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	5
		20m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	6
		2 cables: 5m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	7
		2 cables: 7m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	8
		2 cables: 12m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	9
		2 cables: 20m 2core 1.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	A
		5m 3core 2.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	D
		7m 3core 2.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	E
		12m 3core 2.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	F
		20m 3core 2.5mm^2 cable, 6mm ring lug at VT side, crimp sleeve lug at RC side	G
		5m 3core 2.5mm^2 cable, 6mm ring lug at VT side, CNLinko YM20 connector at RC side	H
		7m 3core 2.5mm^2 cable, 6mm ring lug at VT side, CNLinko YM20 connector at RC side	J
		12m 3core 2.5mm^2 cable, 6mm ring lug at VT side, CNLinko YM20 connector at RC side	K
		20m 3core 2.5mm^2 cable, 6mm ring lug at VT side, CNLinko YM20 connector at RC side	L
P12	Recloser Control mounting kit	No RC mounting kit	1
		According to Customization parameter value	2
		M20 studs for through-hole RC mounting	3
		500mm U-profiles for around-pole RC mounting	4
		800mm U-profiles for around-pole RC mounting	5
		Universal RC MK for substation mounting kit	6
		M16 studs for through-hole RC mounting	7
P13	Battery type	No battery	1
		Battery wiring	2
		Opearing temperature above -15C	3
		Opearing temperature above -25C	4
		Opearing temperature above -40C	5
P14	Input-output module	No input-output module	1
		60V input-output module	2
		220V input-output module	3
P15	Ethernet	No optional ethernet interface	1
		Wired optional ethernet interface	2
		Optical ethernet interface	3
P16	Local wireless access	No local wireless access	1
		Wi-Fi module and associated wiring	2
P17	Power outlet	Socket wiring (included to RC5.4)	1
		According to Customization parameter value	2
		Socket wiring + blank socket plate	3
		NBR socket plate, wiring	4
		Without power outlet properties	5
		EU socket, associated plate, wiring	6
P18	Cabinet light	No cabinet light	1
		LED strip	2
P19	Internal door additional equipment	No additional equipment, door cutout	1
		According to Customization parameter value	2
		Blank plate for IDAE door cutout	3
		Kit of class C LVSA with In=10 kA for AC1 power input	4
		Kit of class C LVSA with In=10 kA for AC1 power input for LATAM	5
P20	Bottom interface plate	No bottom interface plate	1
		According to Customization parameter value	2
		Blank plate for bottom cutout	3
		Bottom plate with 2 glands for d = 4.5-10mm	4

Parameter	Parameter description	Applicable options	Code
		Bottom plate with 2 glands for d = 4.5-10mm, Wi-Fi/BT provision	5
		Bottom plate with 2 CNLinko YM20 3-pin male receptacles for auxiliary power supply	6
		Bottom plate with 2 CNLinko YM20 3-pin male receptacles for auxiliary power supply, Wi-Fi/BT provision	7
		Bottom plate with 1 CNLinko YM20 2pin male receptacles for auxiliary power supply	8

10.2 Recloser Components Coding

Recloser Control Coding

RC5_4M(P1…P12)

Table 106 – Recloser Control coding description

Parameter	Parameter description	Applicable options	Code
P1	Customization	No customization	1
		Other – Contact Magvatech representative	…
P2	Language	According to Customization parameter value – contact Magvatech representative	1
		English RC stickers	2
		Spanish RC stickers	3
		Portuguese RC stickers	4
		English RC stickers, RC nameplate	5
		Spanish RC stickers, RC nameplate	6
		Portuguese RC stickers, RC nameplate	7
P3	Controller type	Basic RC5 with DRVM-04 + PSM-02A(1) and MPM-04M(3) based RCM. Aluminum housing	1
		Basic RC5 with DRVM-04 + PSM-02A(1) and MPM-04E(1) based RCM. Aluminum housing	2
P4	Firmware version	Factory default firmware	1
P5	Battery type	No battery	1
		Battery-ready kit	2
		Operating temperature above -15C	3
		Operating temperature above -25C	4
		Operating temperature above -40C	5
		Operating temperature above -0C	6
P6	Input-output module	No input-output module	1
		60 V input-output module	2
		220 V input-output module	3
P7	Ethernet	No optional ethernet interface	1
		Wired optional ethernet module	2
		Optical ethernet module	3
P8	Local wireless access	No local wireless access	1
		Wi-Fi module and associated wiring	2
P9	Power outlet	Socket wiring (included to RC5.4)	1
		According to Customization parameter value	2
		Socket wiring + blank socket plate	3
		EU socket + socket wiring + associated plate	4
		2 NBR socket + socket wiring + associated plate	5
P10	Cabinet light	No cabinet light	1
		5 V LED strip	2
P11	Internal door additional equipment	No internal door additional equipment	1
		According to Customizaton parameter value – contact Magvatech representative	2
		Plate without cutouts	3
		Kit of class C LVSA with In=10kA for AC1 power input	4
		Kit of class C LVSA with In=10kA for AC1 power input	5

P12	Bottom interface plate	No bottom interface plate	1
		According to Customization parameter value	2
		Blank plate	3
		Bottom plate with 2 glands for d = 4.5-10 mm	4
		Bottom plate with 2 glands for d = 4.5-10 mm and WiFi provision	5
		Bottom plate with 2 CNLinko YM20 3pin male receptacles for auxiliary power supply	6
		Bottom plate with 2 CNLinko YM20 3pin male receptacles for auxiliary power supply and WiFi provision	7

Each Recloser Control has adhesive serial number plate and riveted stainless steel nameplate on the internal door. The nameplates contain information about the Recloser Control type, serial number, ratings and manufacturing date.

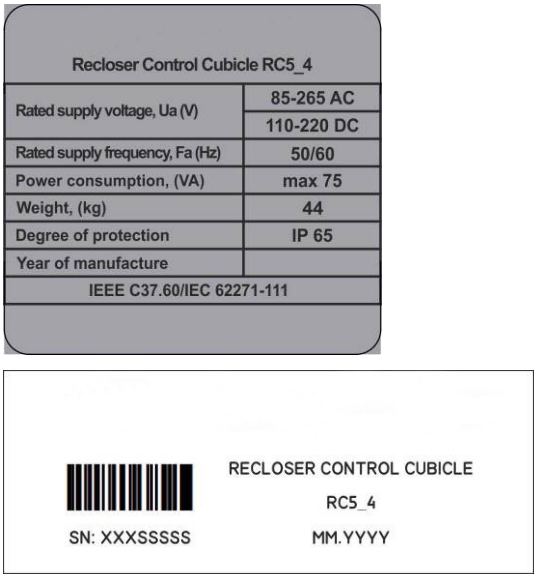


Figure 81

Nameplate and serial number plate of Recloser Control

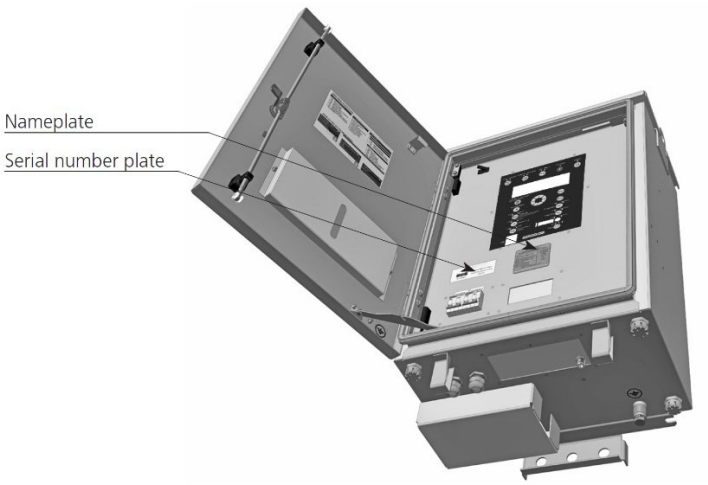


Figure 82

Recloser Control nameplate placement

11 Appendices

Appendix 1. Spare Parts and Accessories

Spare parts and accessories can be ordered separately in case of theft or damage. Contact your local sales representative to choose the option suitable for you.

Dimensions and mass shown are approximate and for reference purposes only.

Part name	Description	Package type	Dimensions, mm	Mass, kg
OSM35_Smart_5E	Outdoor switching module	Wooden crate	1144x767x940	138
RecUnit_Umbilical_4	Control cable	Cardboard box	550x400x200	up to 19
RecUnit_RC5_4M	Recloser control cubicle	Cardboard box	935x580x445	45
CM_RCM_1P	Control module suitable for RC5 recloser control cubicle	Cardboard box	400x330x210	10
RecUnit_IOM_04E	Input/Output module 24/60 VDC suitable for RC5 recloser control cubicle	Cardboard box	316x196x56	0.5
RecUnit_IOM_03E	Input/Output module 100/220 VDC suitable for RC5 recloser control cubicle	Cardboard box	316x196x56	0.5
RecUnit_Filter_PSFM-2E	Power supply filter module suitable for RC5_4 recloser control cubicle	Cardboard box	202x180x87	1.5
RecUnit_MMI_CPM-1	Control panel suitable for RC5 recloser control cubicle	Cardboard box	300x250x35	2
Rechargeable Battery	Battery for recloser uninterruptable power supply	Cardboard box	–	–
RecParamKit_LWAKit_LWA.WF	Kit for organizing wireless access with RC5	Plastic bag	–	0.1
RecKit_AntiVandalHousing_2	Anti-vandal housing for RC5	Galvanized steel box	1395x1145x800	–

Appendix 2. Outdoor Switching Module Drawings

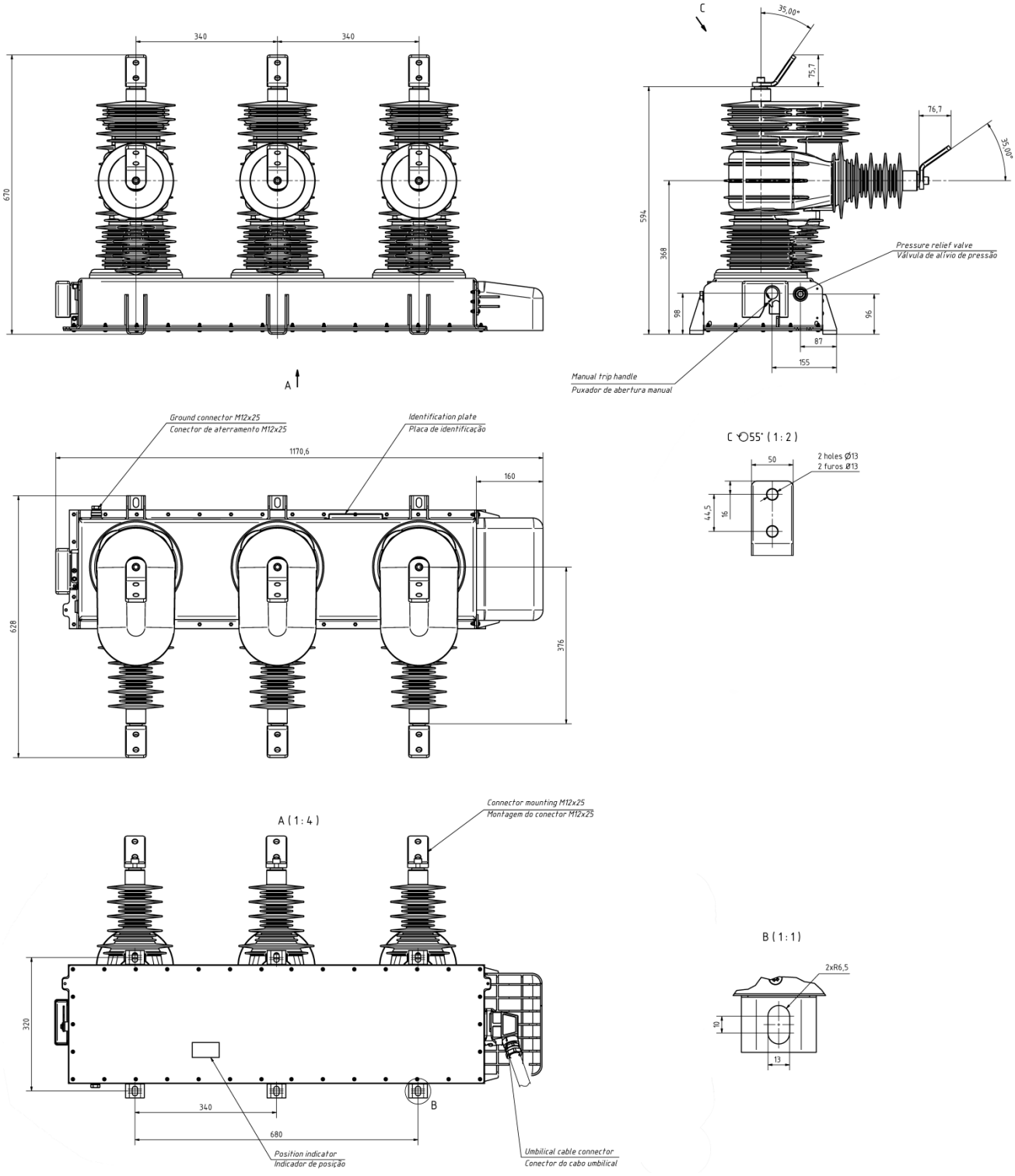


Figure 83

Dimensions of OSM35_Smart_5

Table 107 – OSM35_Smart_5 dimensions

Rated voltage, kV	Dimensions, mm		Weights, kg
	Creepage distance	Minimum taut string distance	
38	1180	402	95

Appendix 3. Recloser Control Drawings

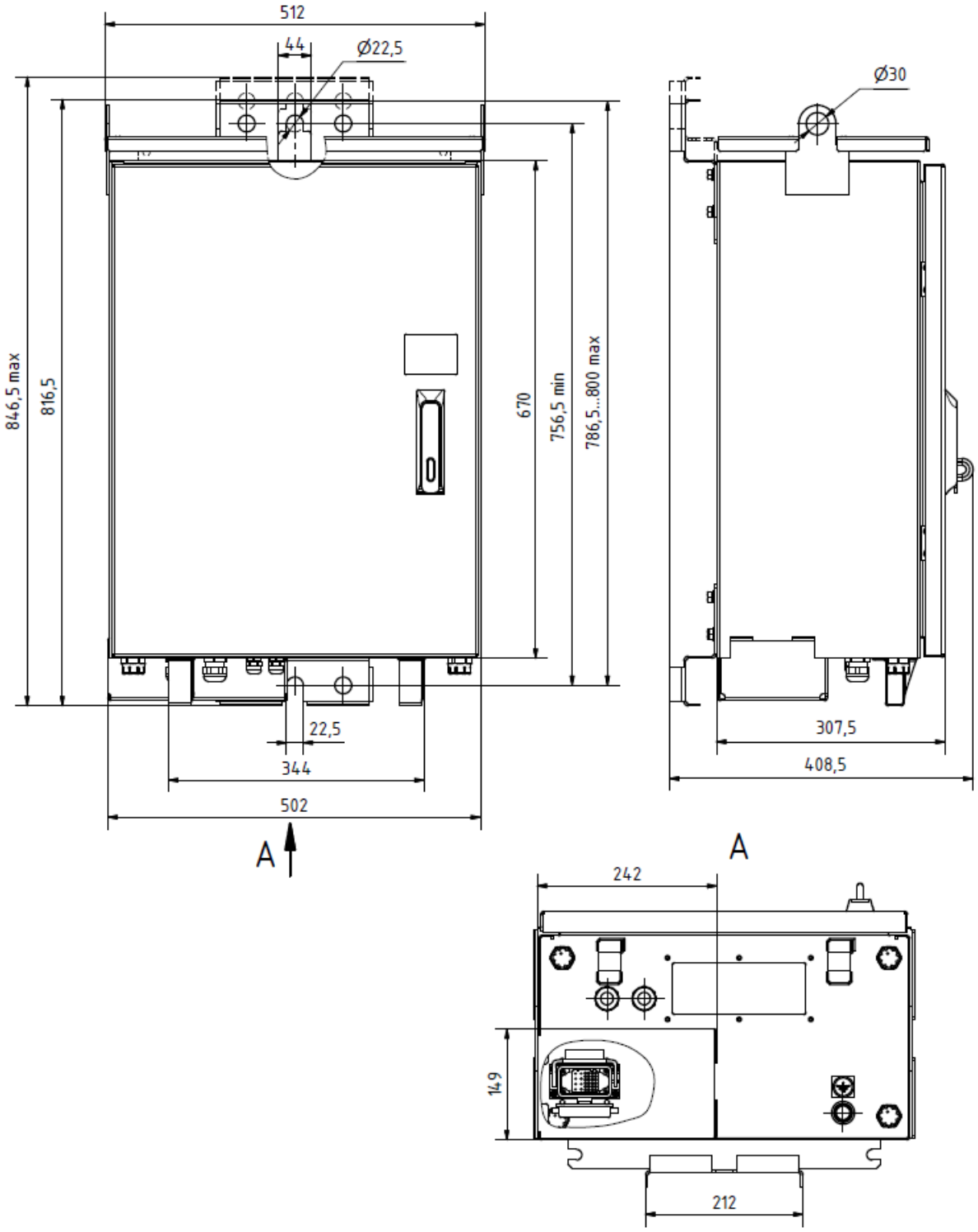


Figure 84

Dimensions of RC5_4

Appendix 4. Control Cable Drawings

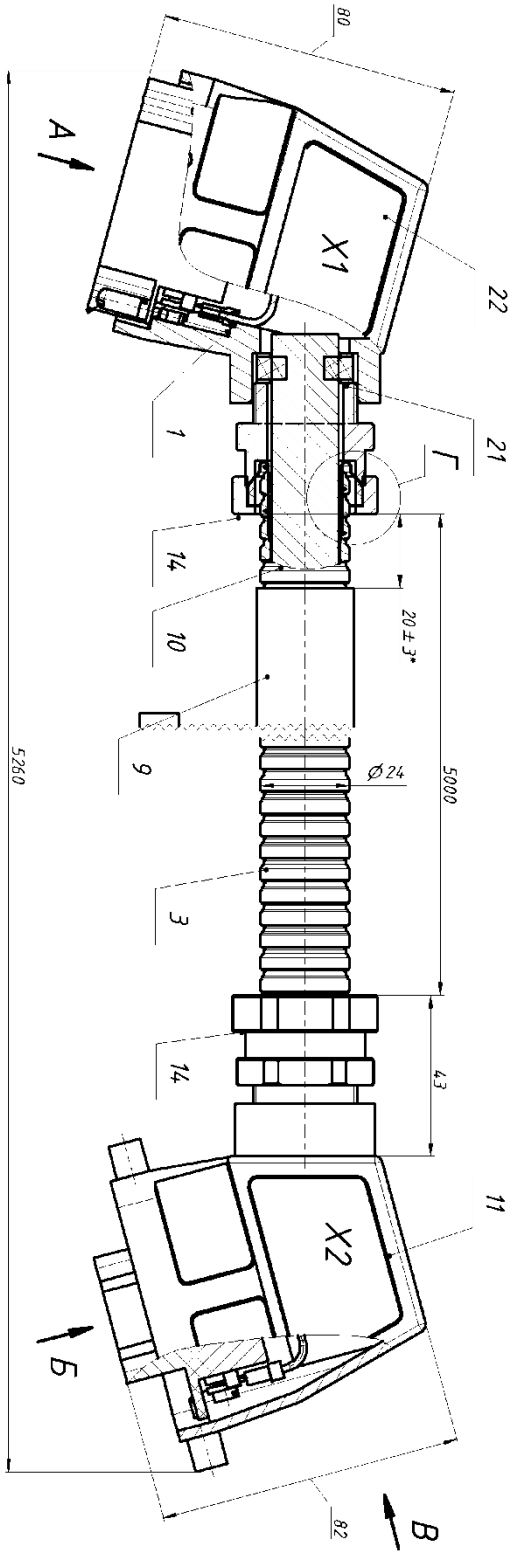


Figure 85

Dimensions of control cable

Table 108 – Control cable characteristics

Part number	L, m	Mass, kg
Umbilical_4(5)	5	5
Umbilical_4(7)	7	6.5
Umbilical_4(12)	12	11.2
Umbilical_4(20)	20	18.6

Appendix 5. Package Drawings

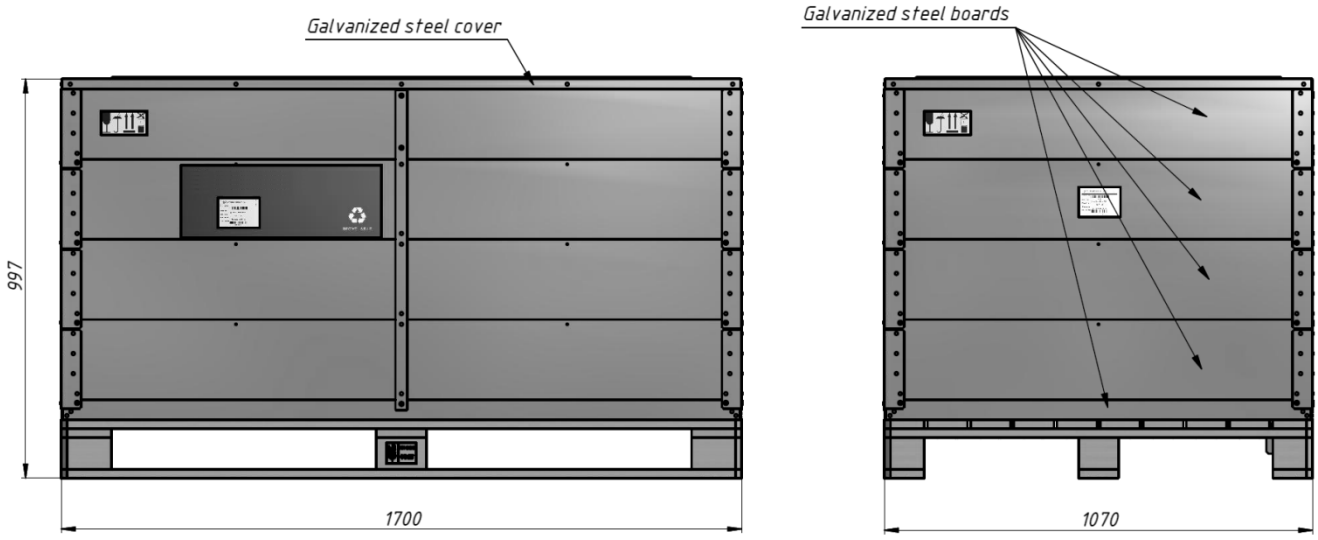


Figure 86

Dimensions of Rec35_Smart5_5p package

Appendix 6. Mounting Kits Drawings

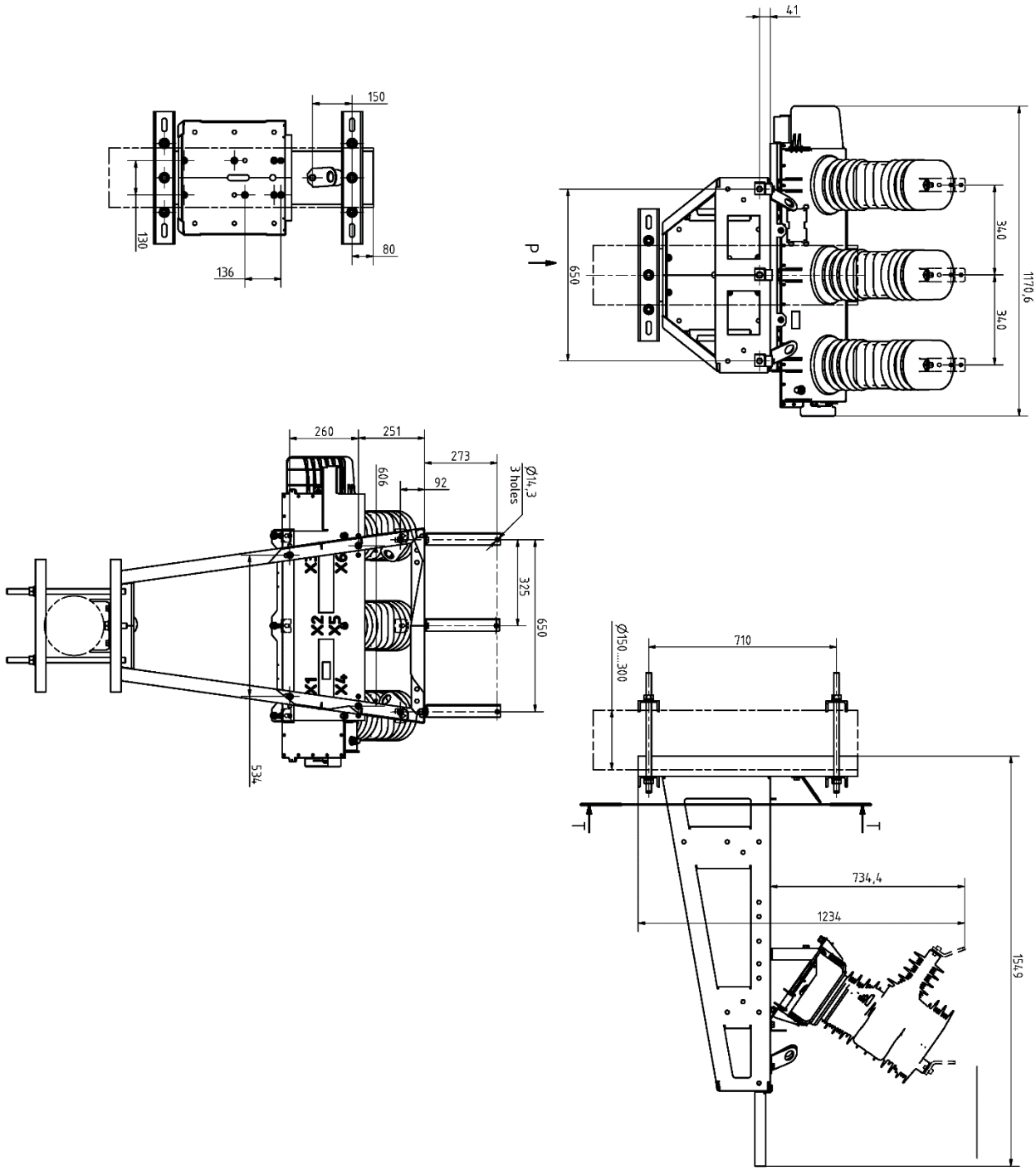


Figure 87

Dimensions of Around-pole mounting kit with 500mm U-profiles (Frontal installation)

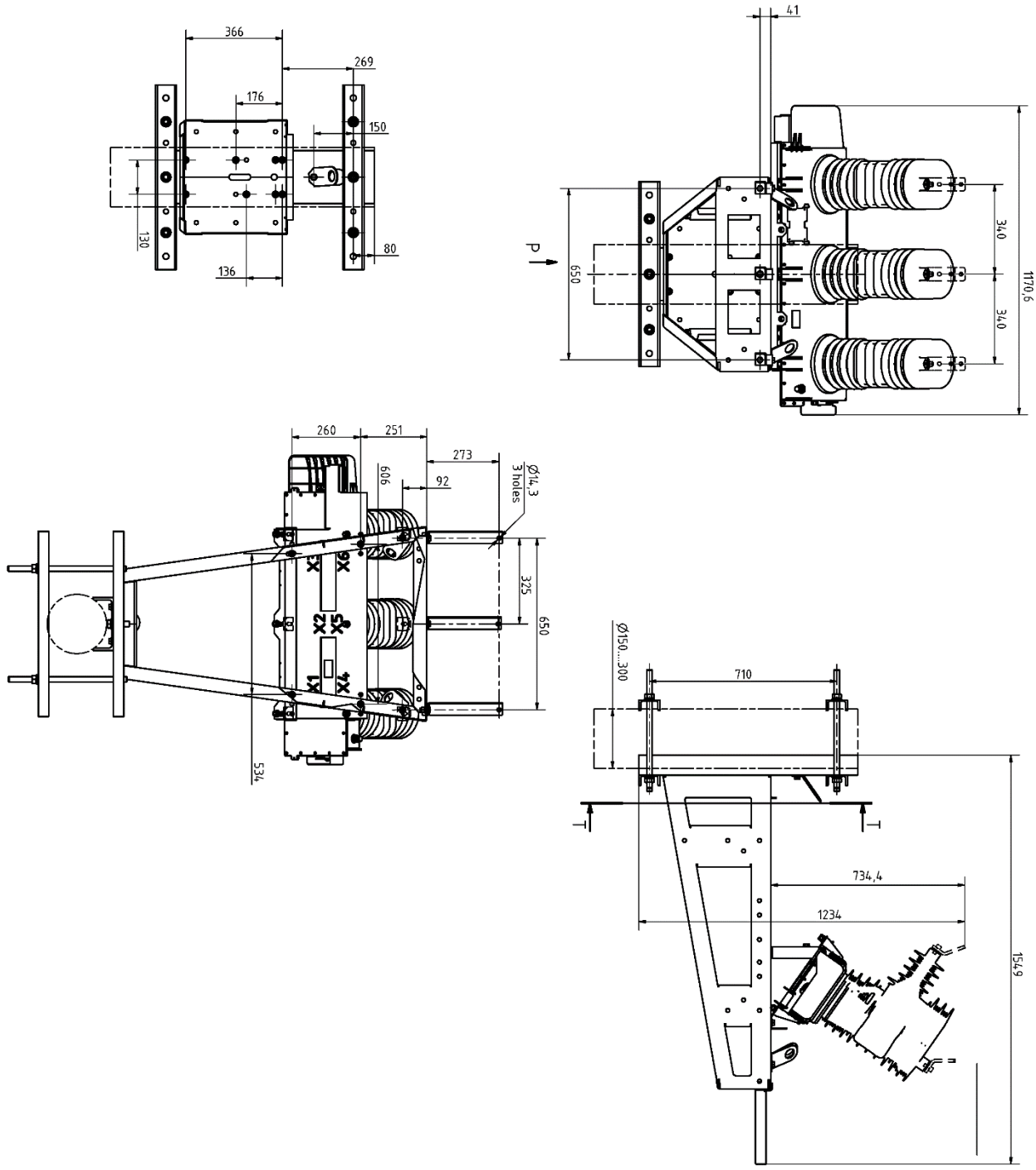


Figure 88

Dimensions of Around-pole mounting kit with 700mm U-profiles (Frontal installation)

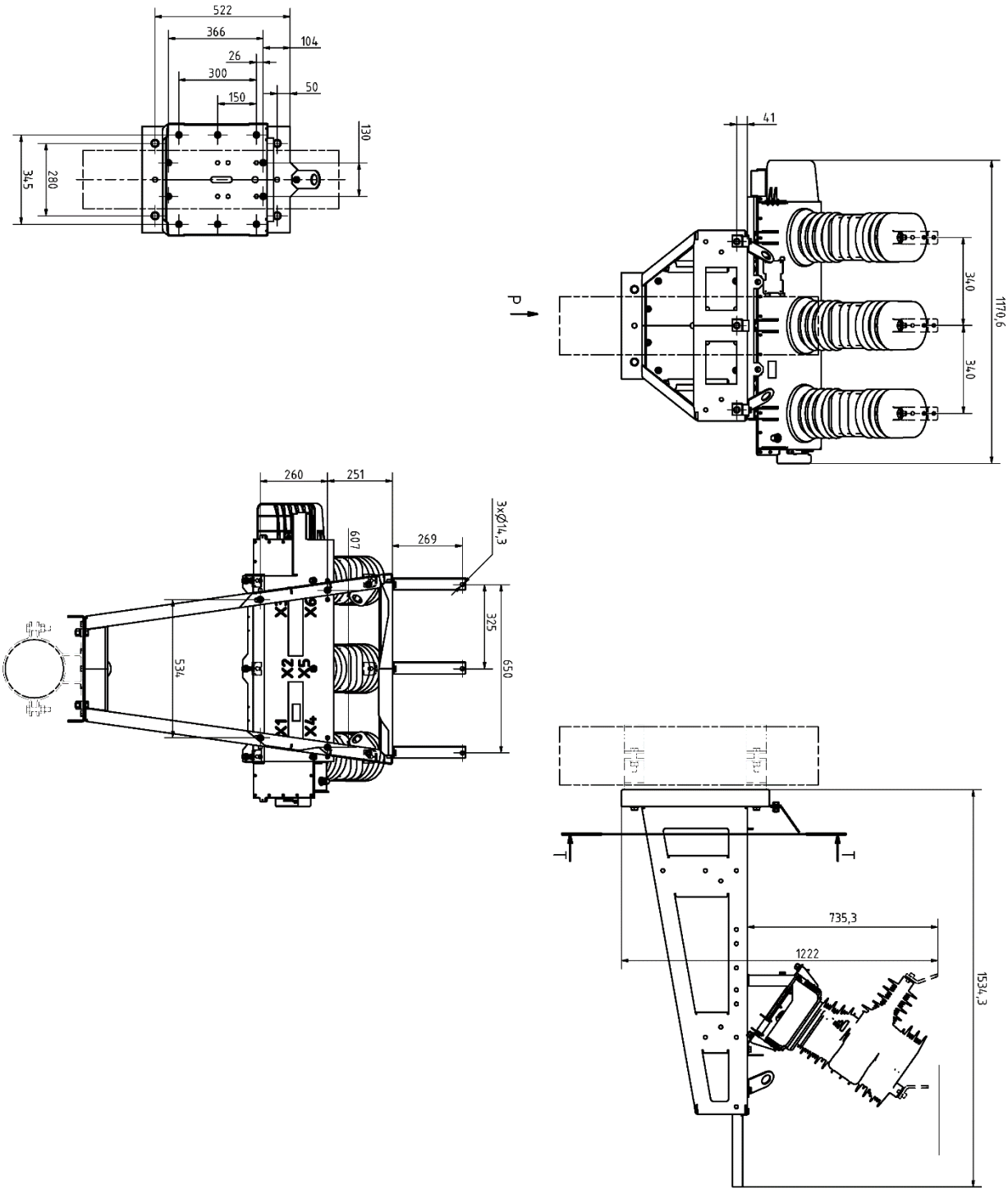


Figure 89

Dimensions of Clamp-ready mounting kit (Frontal installation)

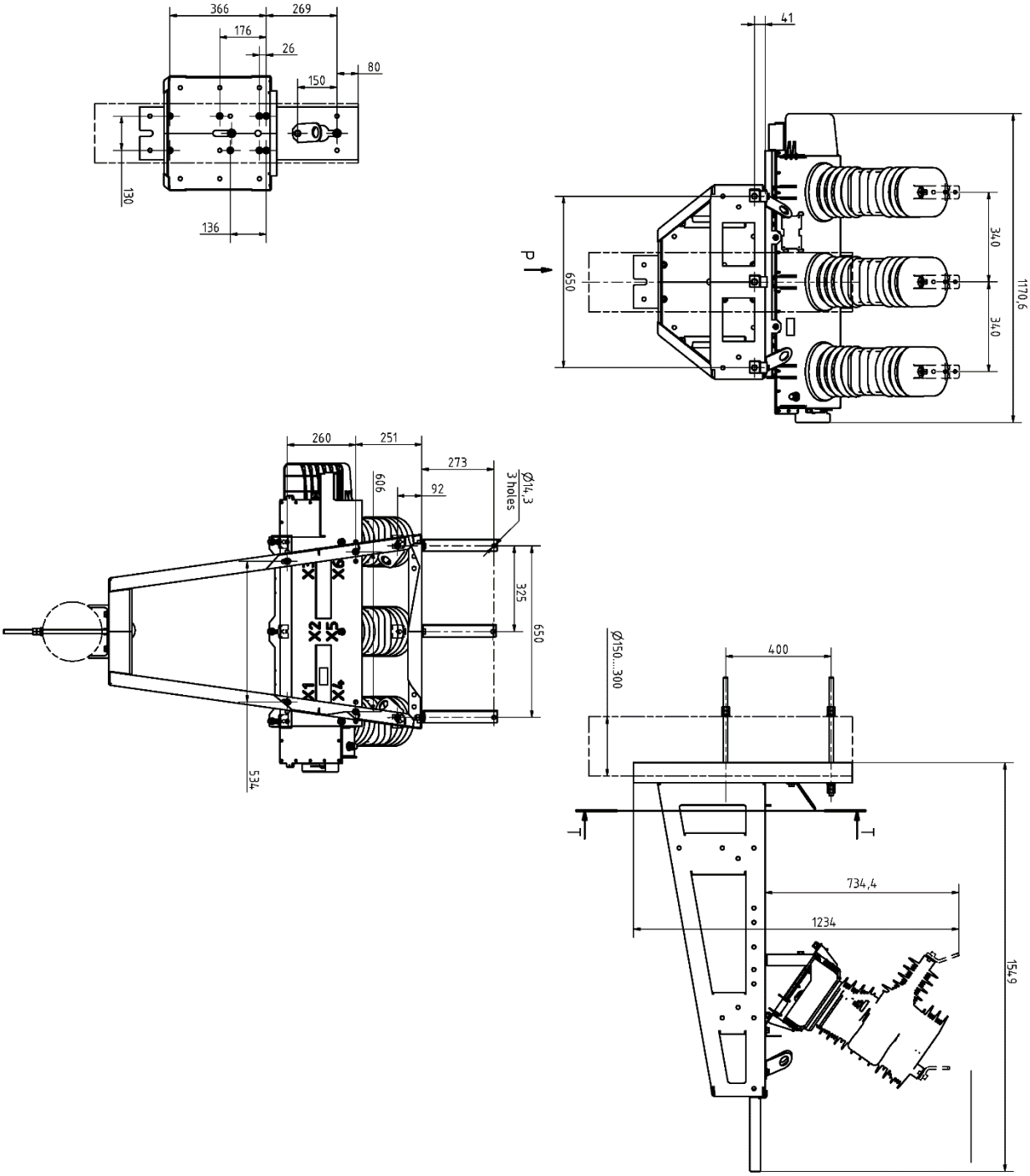


Figure 90

Dimensions of Through-pole mounting kit with M16 studs (Frontal installation)

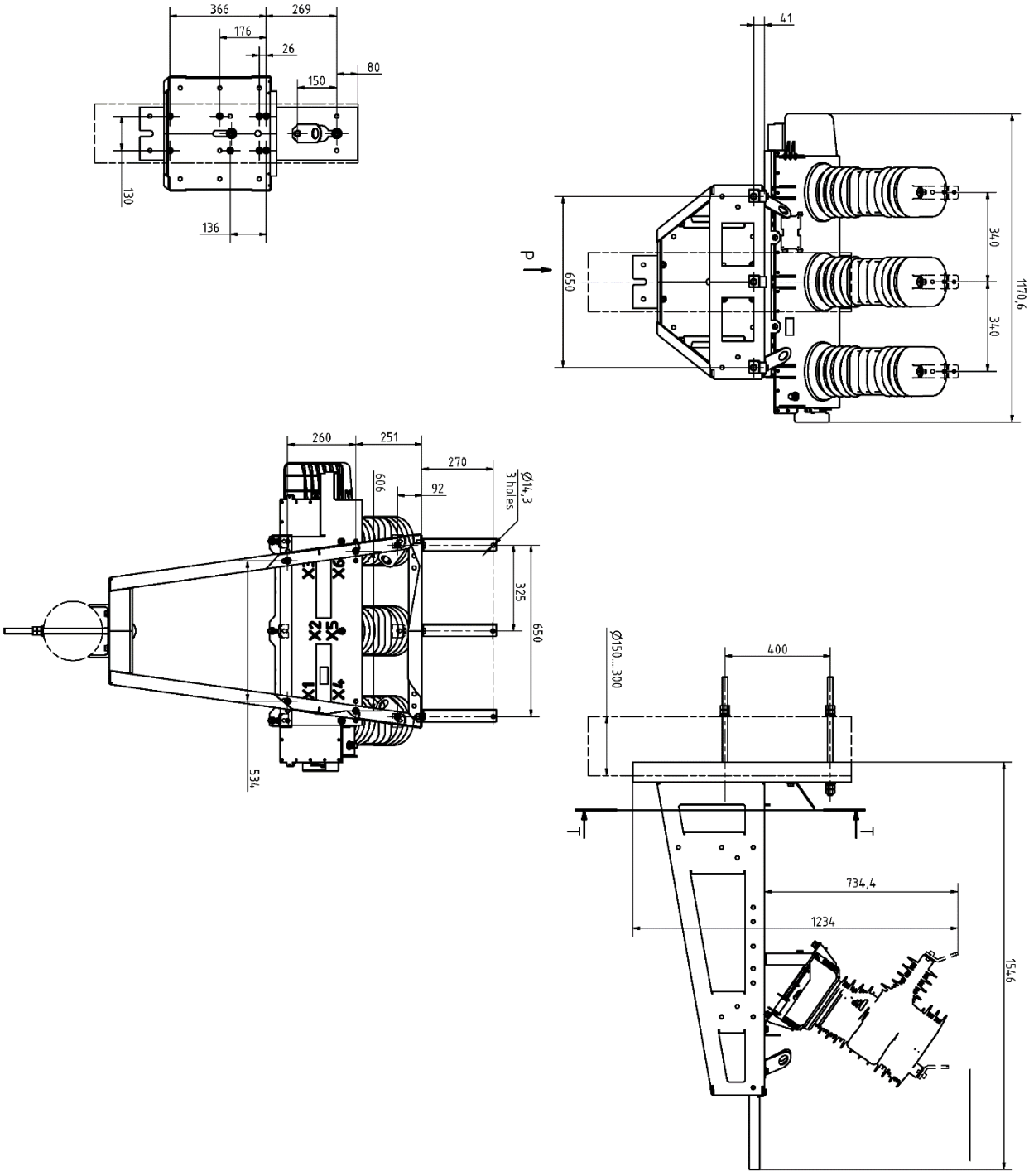


Figure 91

Dimensions of Through-pole mounting kit with M20 studs (Frontal installation)

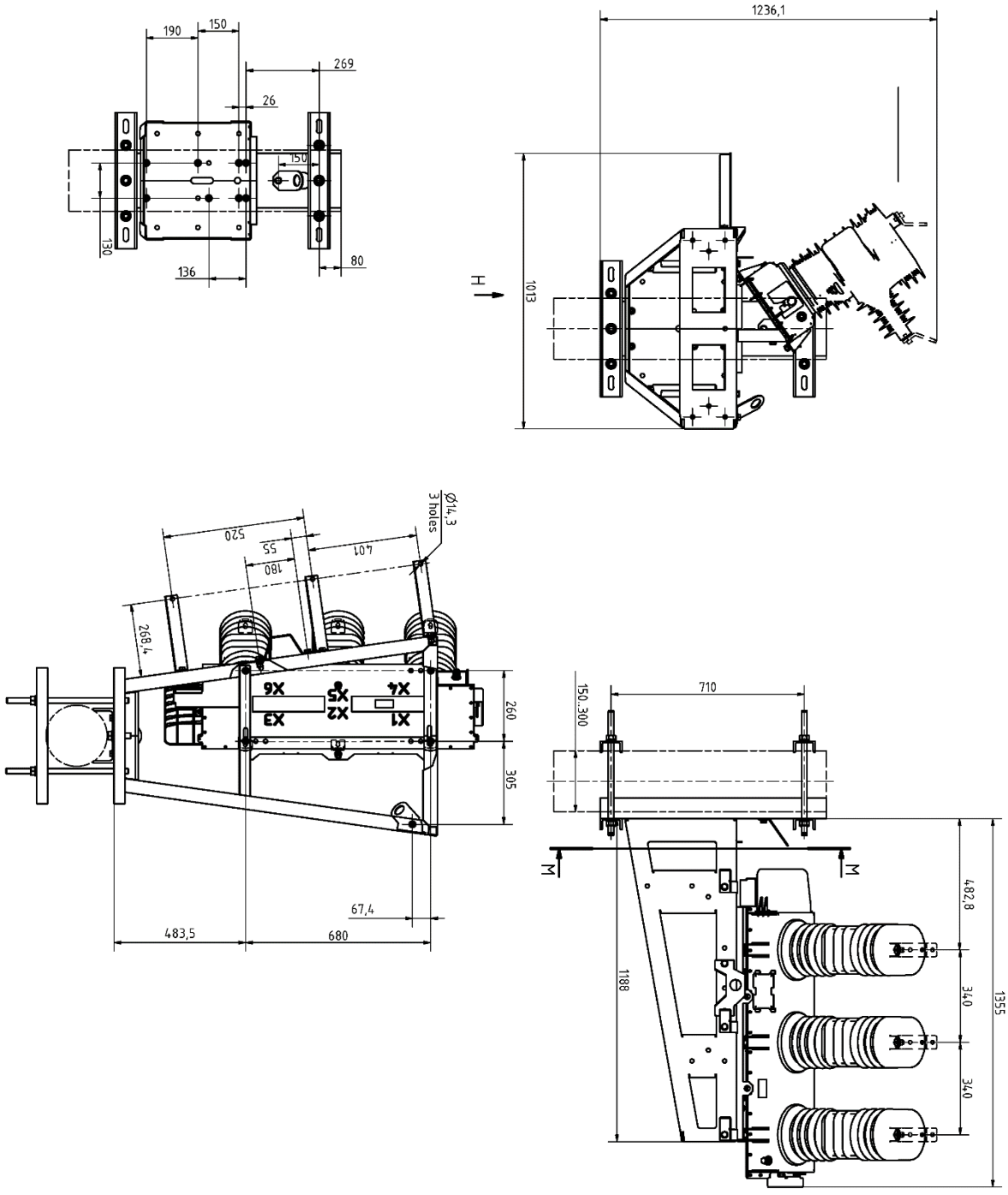


Figure 92

Dimensions of Around-pole mounting kit with 500mm U-profiles (Lateral installation)

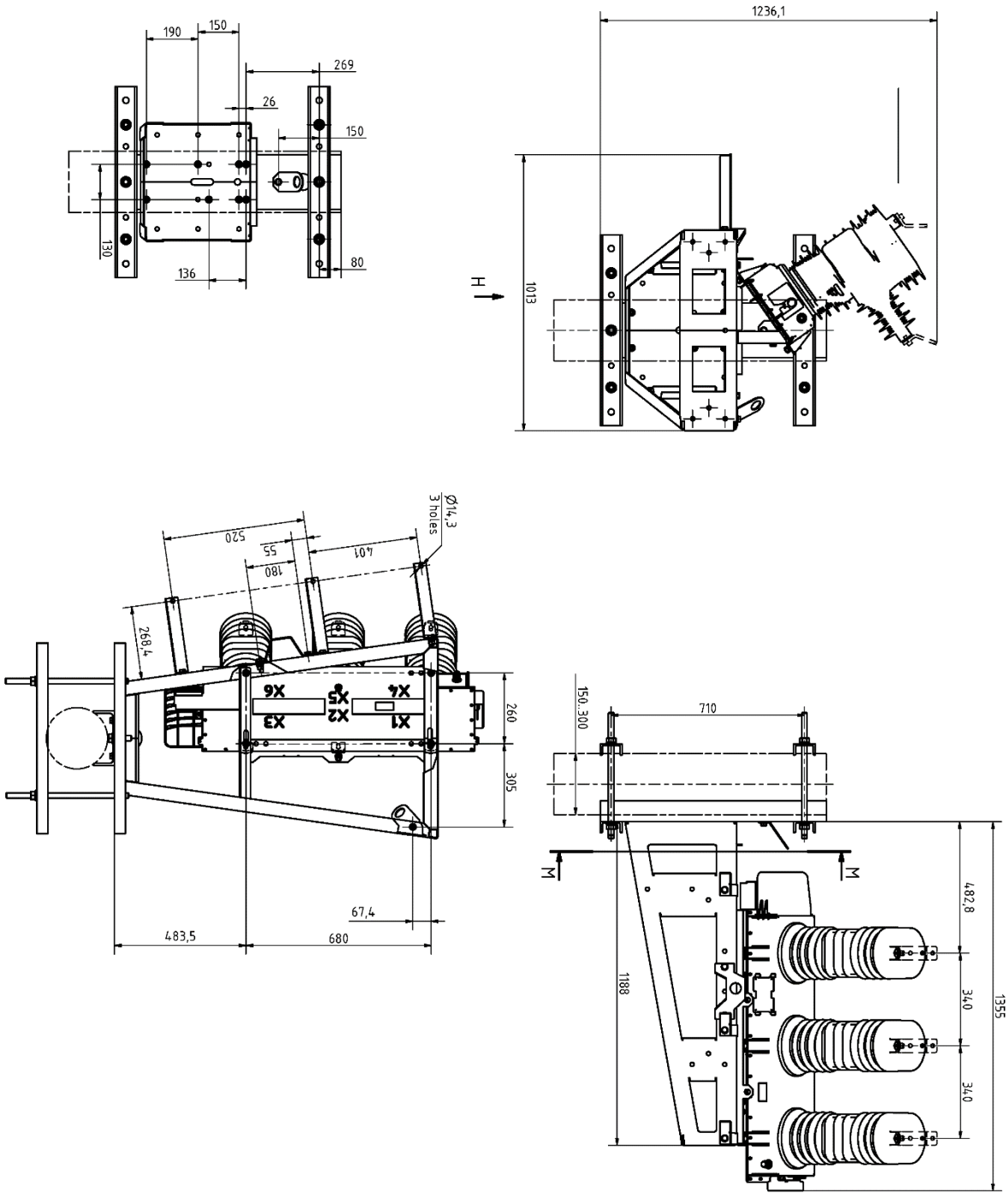


Figure 93

Dimensions of Around-pole mounting kit with 700mm U-profiles (Lateral installation)

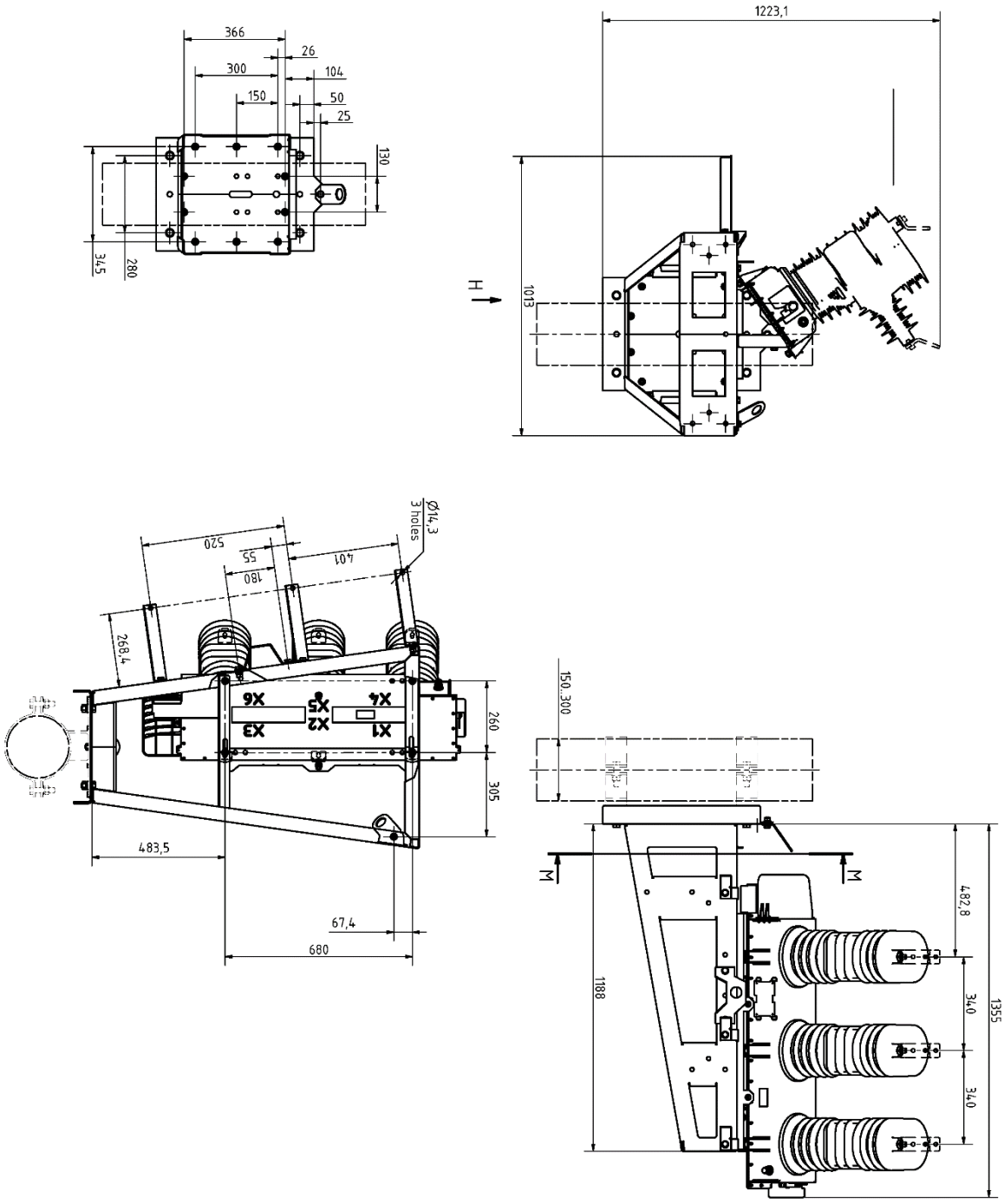


Figure 94

Dimensions of Clamp-ready mounting kit (Lateral installation)

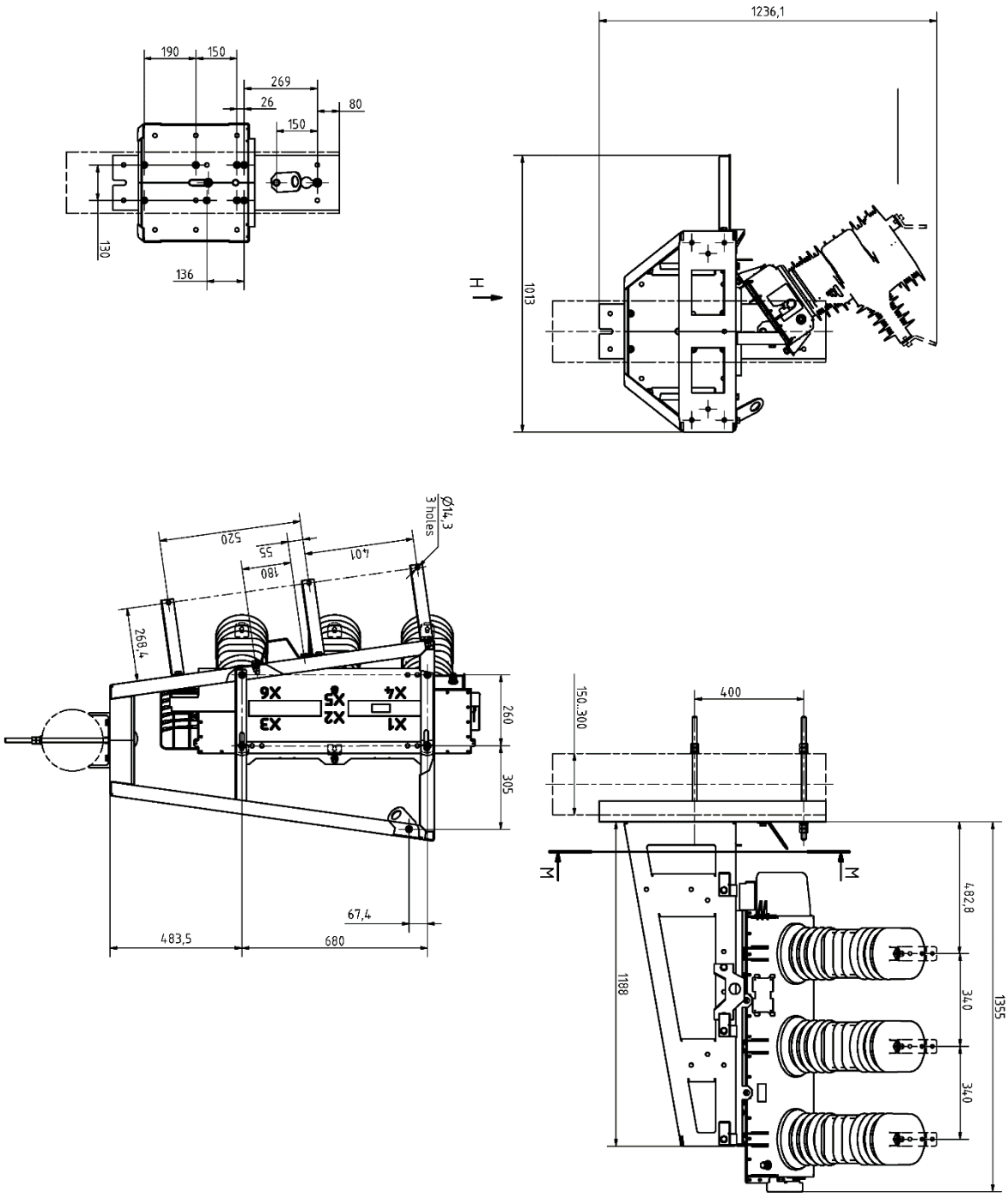


Figure 95

Dimensions of Through-pole mounting kit with M16 studs (Lateral installation)

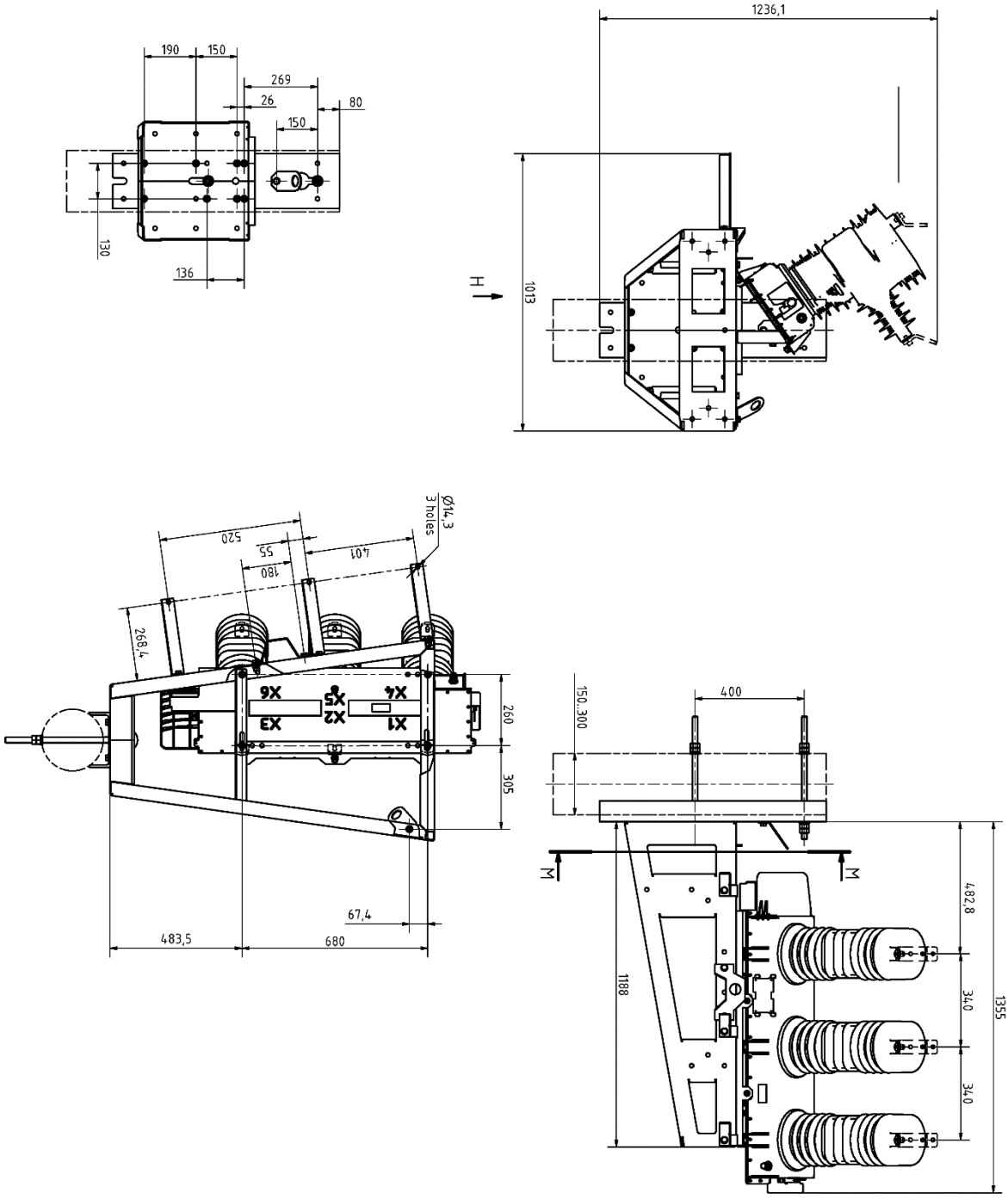


Figure 96

Dimensions of Through-pole mounting kit with M20 studs (Lateral installation)

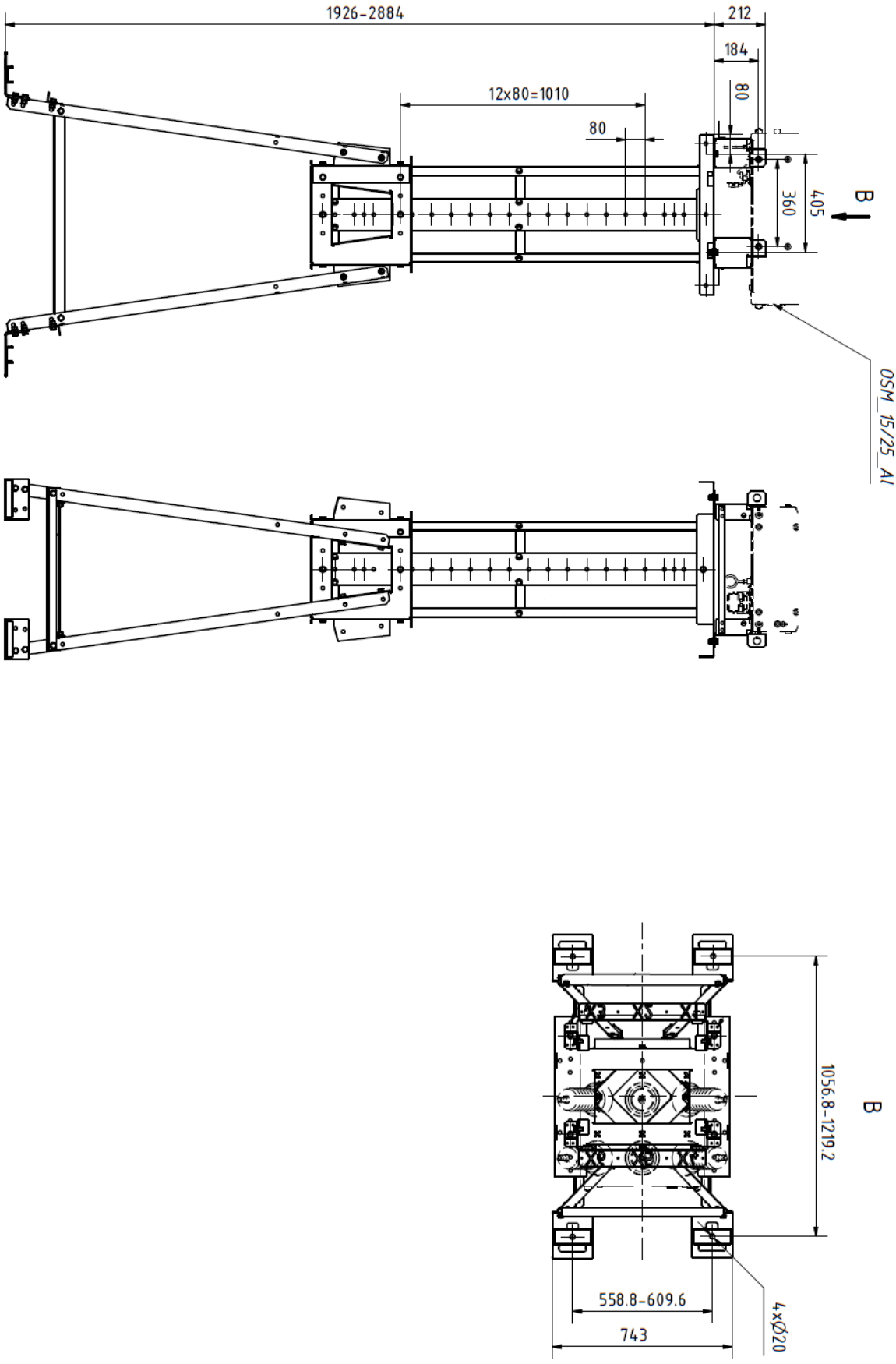


Figure 97

Dimensions of Outdoor Switching Module substation mounting kit

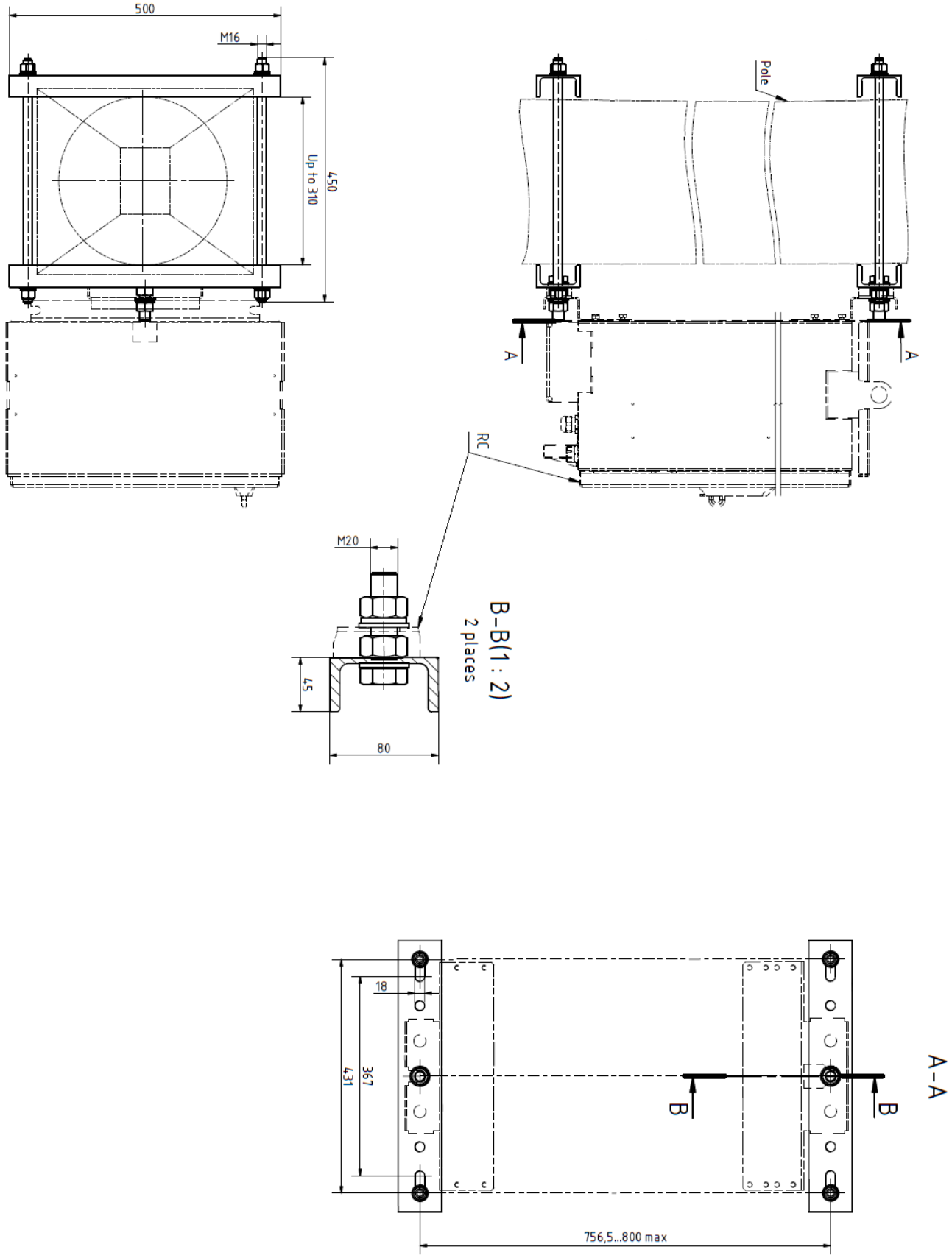


Figure 98

Dimensions of RC mounting kit for around the pole installation: 500 mm U-profiles, 450 mm M16 threaded rods

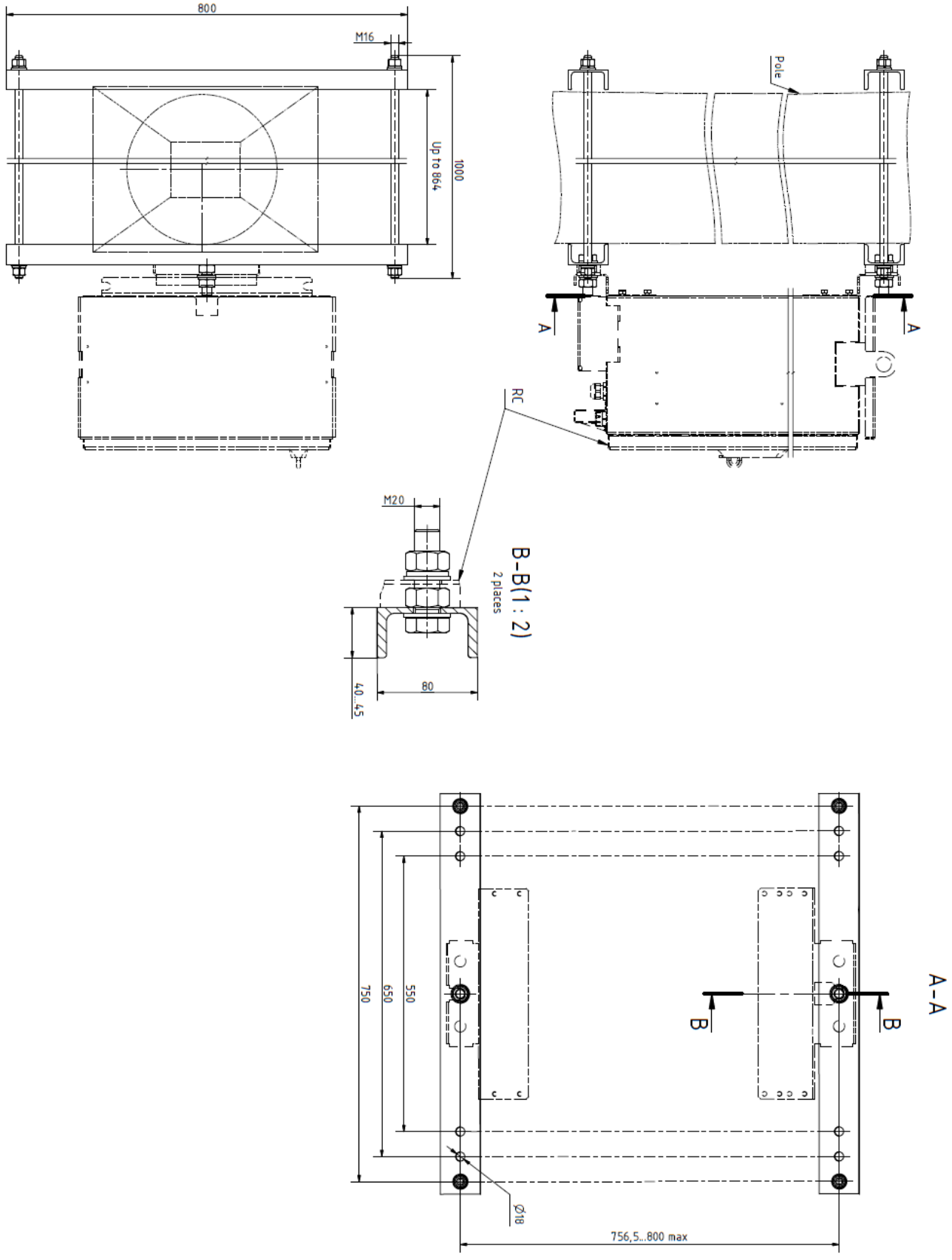


Figure 99

Dimensions of RC mounting kit for around the pole installation:
800 mm U-profiles, 1000 mm M16 threaded rods

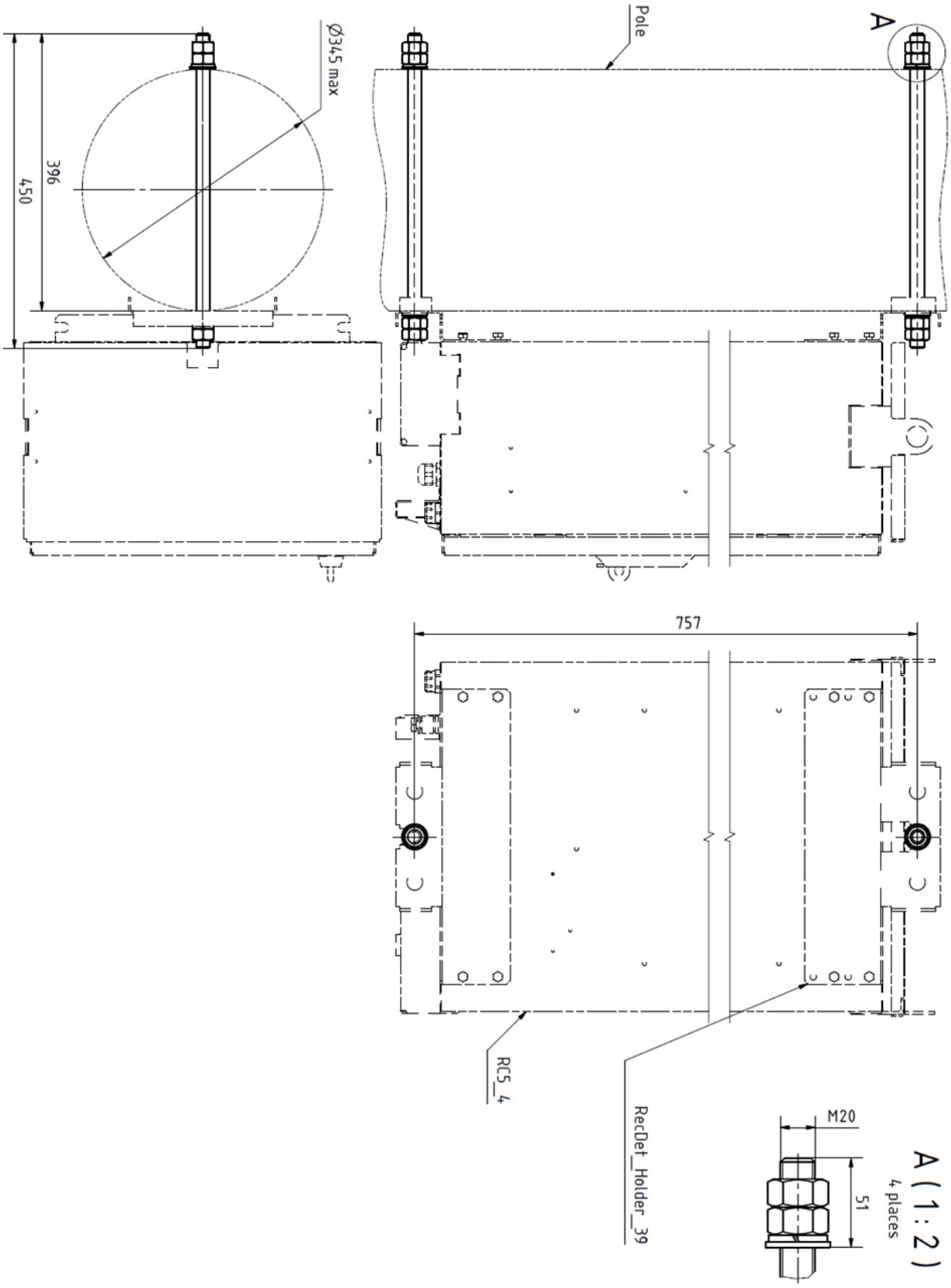


Figure 100

Dimensions of RC mounting kit for through the pole installation

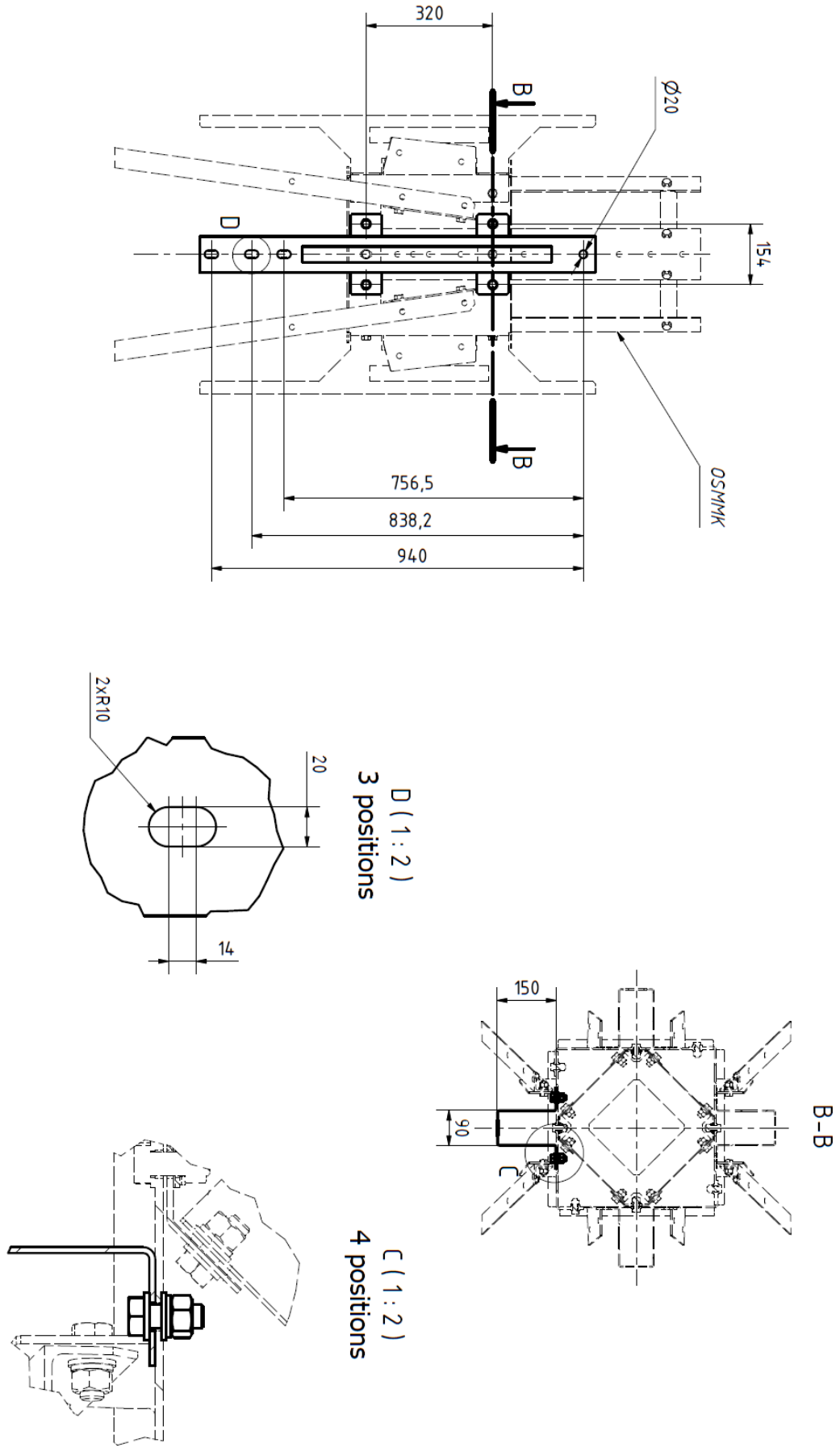


Figure 101

Dimensions of RC substation mounting kit

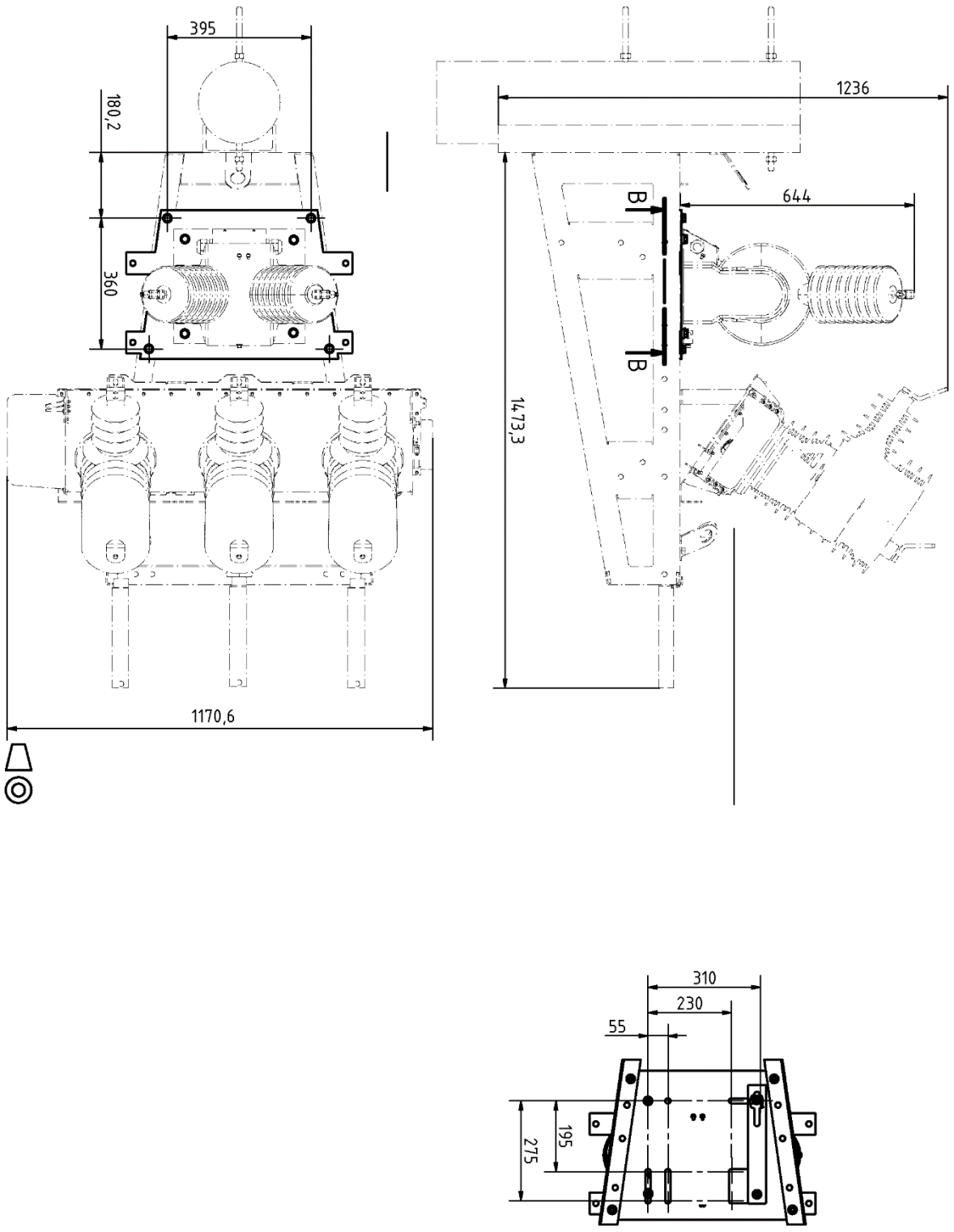


Figure 102

Dimensions of VT mounting kit for 1xVT (Frontal installation)

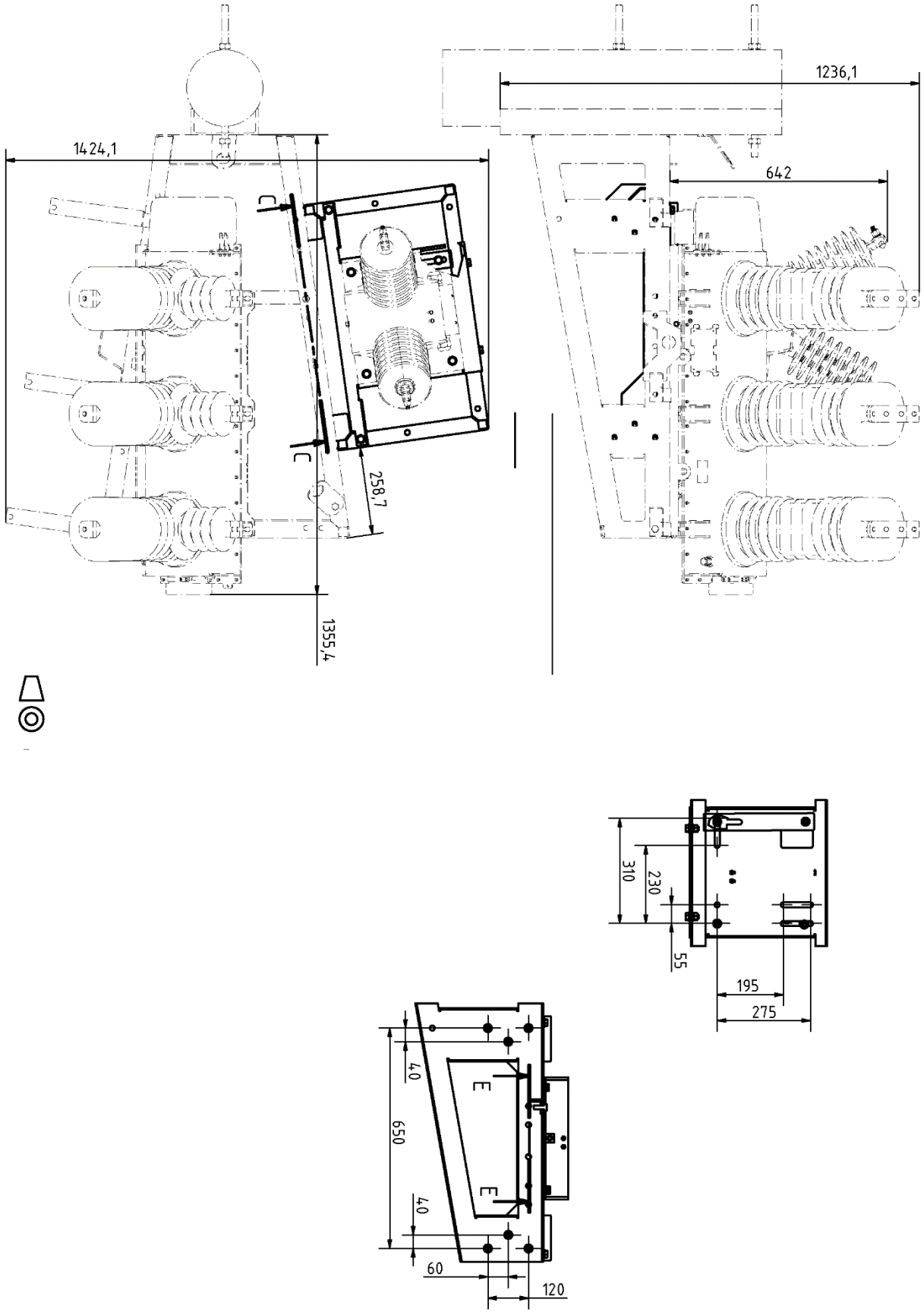


Figure 103

Dimensions of VT mounting kit for 1xVT (Lateral installation)

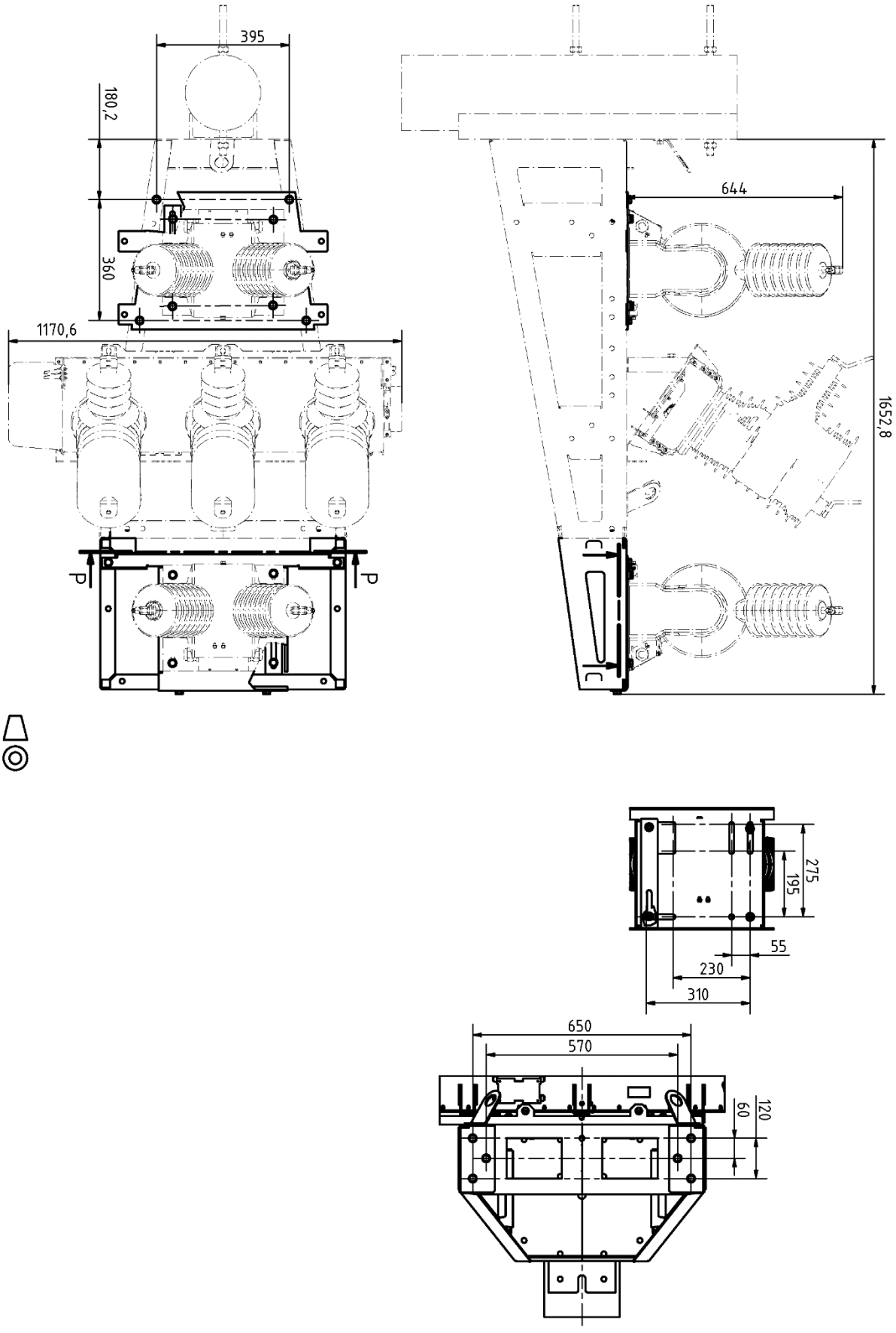


Figure 104

Dimensions of VT mounting kit for 2xVTs (Frontal installation)

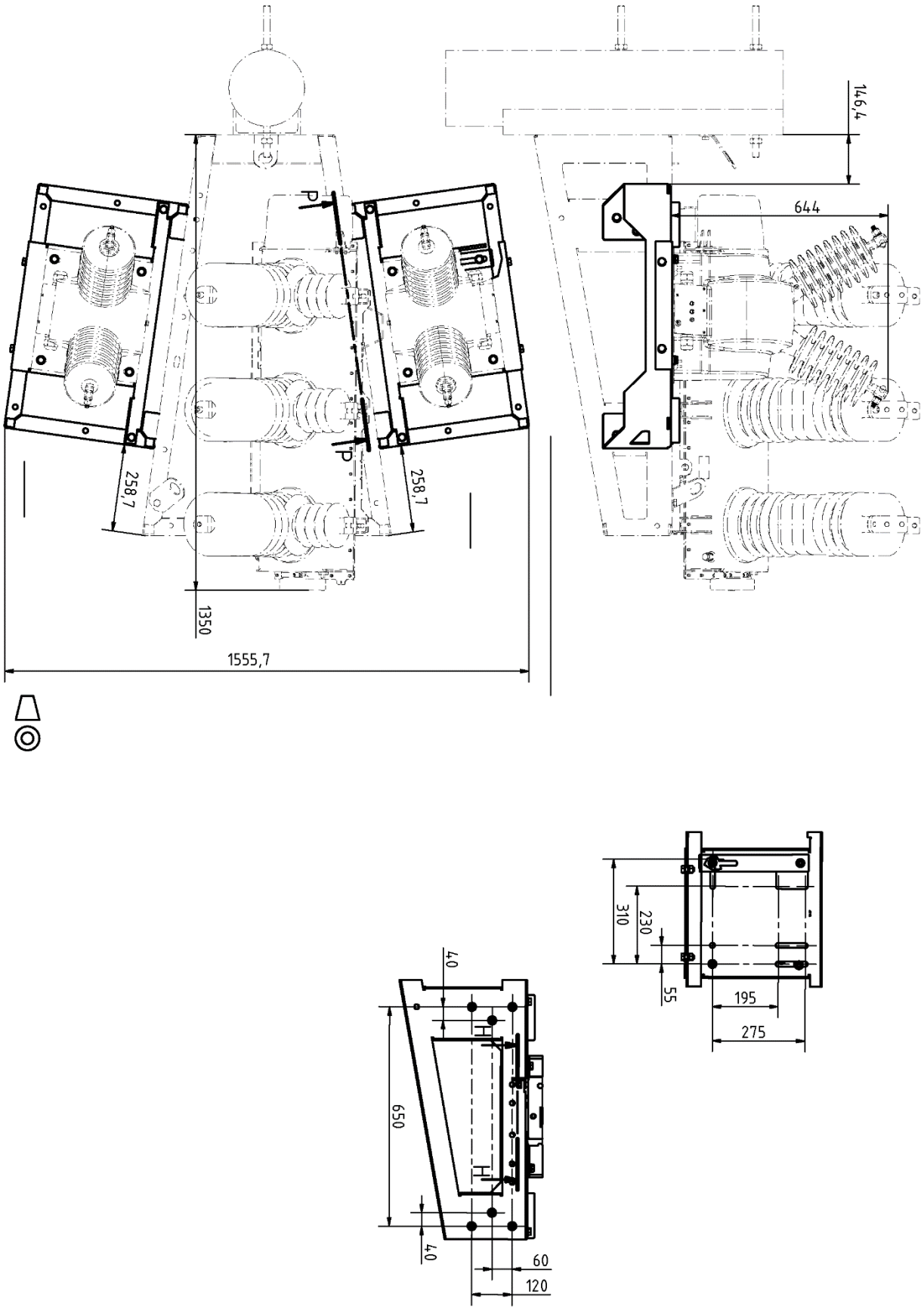


Figure 105

Dimensions of VT mounting kit for 2xVTs (Lateral installation)

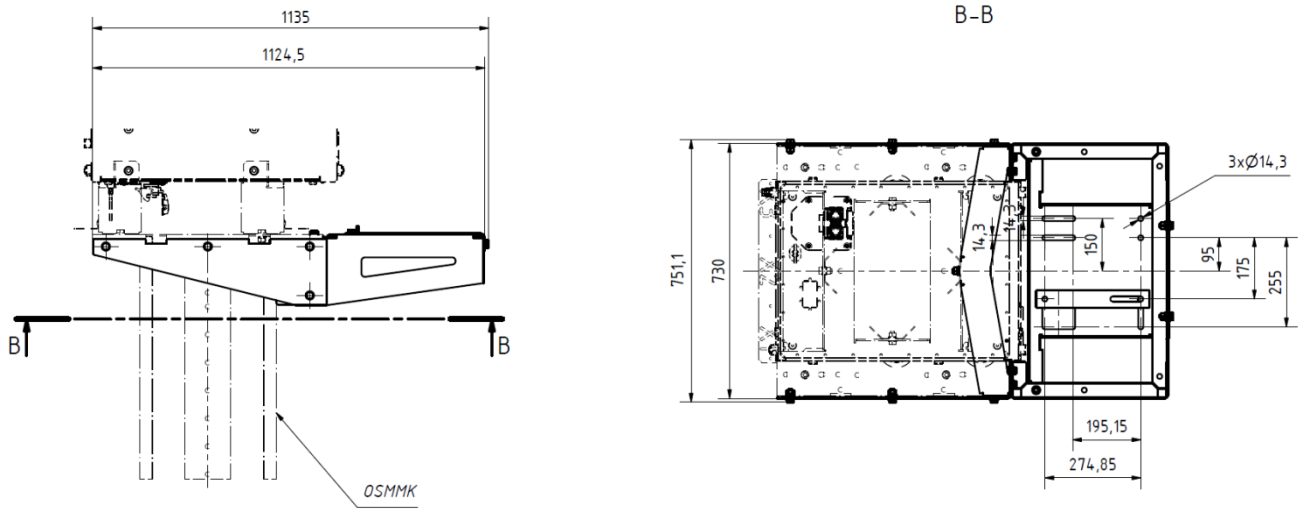


Figure 106

Dimensions of VT for Cast resin VT (Substation installation)

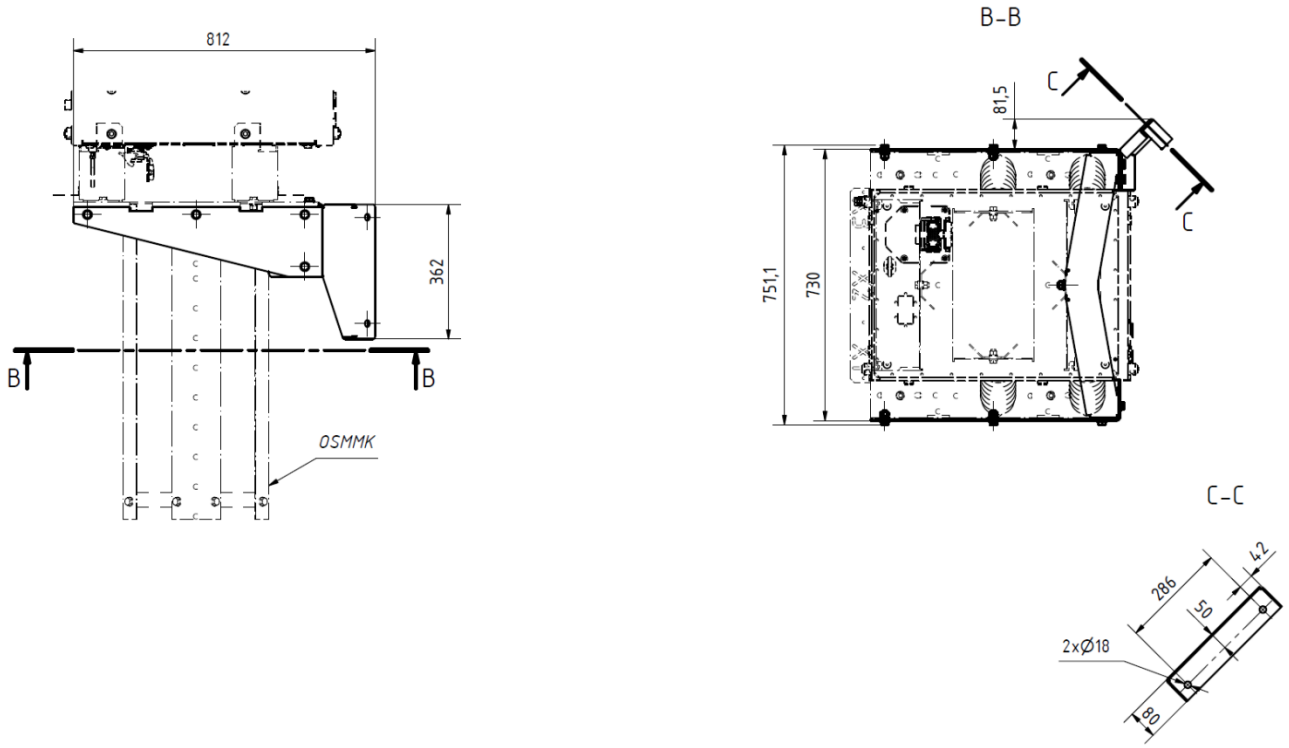


Figure 107

Dimensions of VT for Oil VT (Substation installation)

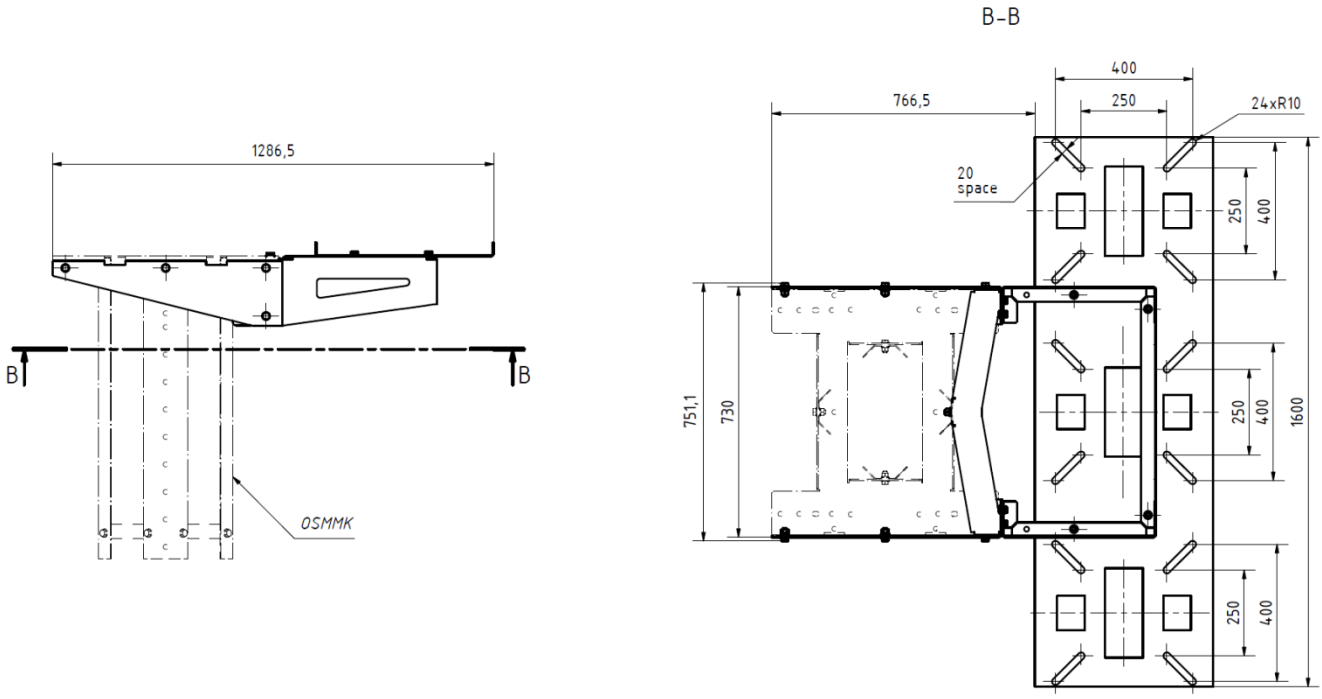


Figure 108

Dimensions of CT mounting kit (Substation installation)

Appendix 7. Recloser Control Wiring Diagram

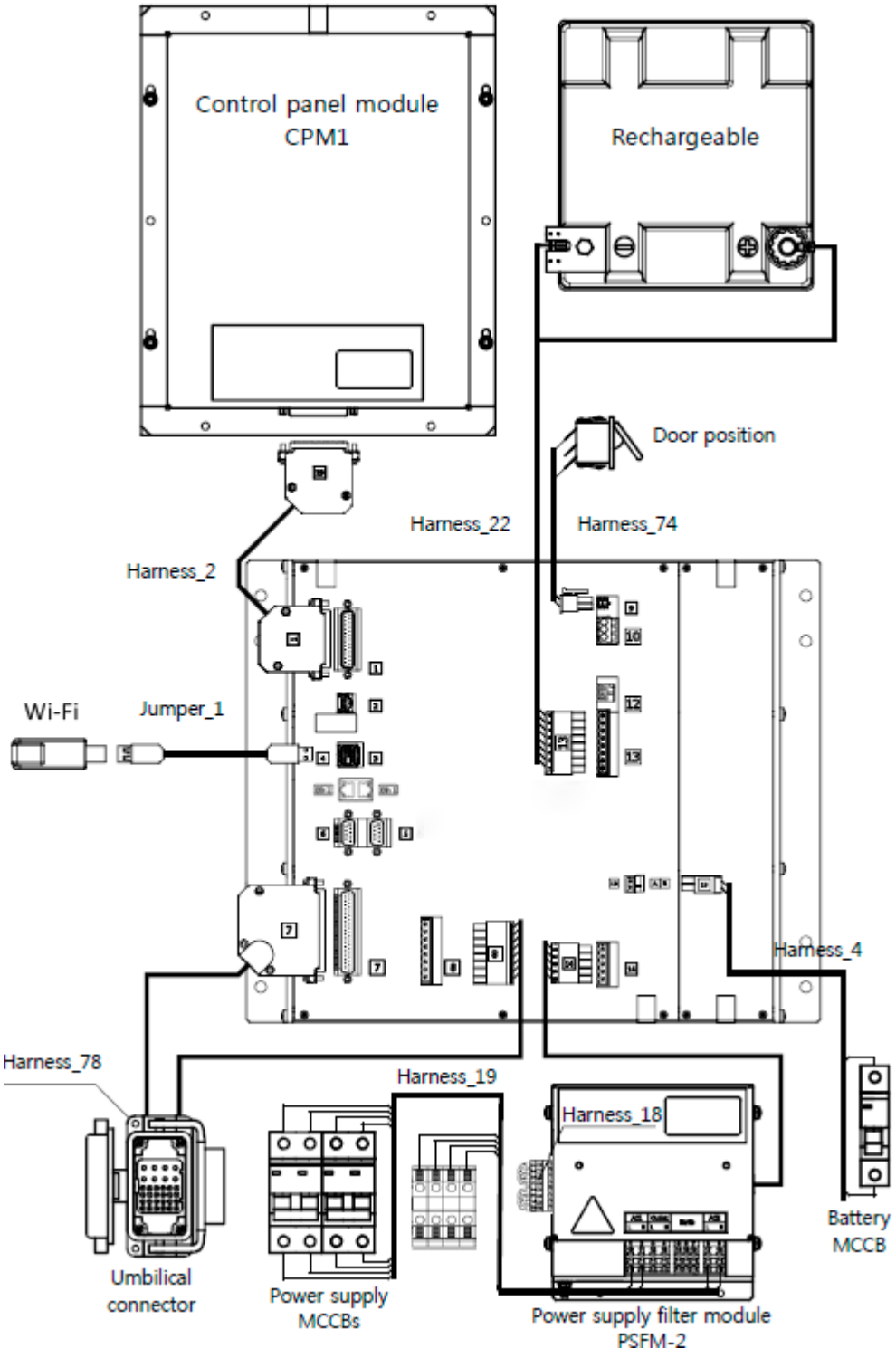


Figure 109

RC5_4 wiring diagram

List of changes

Document version	Change date	Scope of change	Reason of change
8.0	18.04.2025	– Update	Document improvement
8.1	07.11.2025	– Update	Document improvement
8.2	19.12.2025	– Update	Document improvement

MAGVATECH

FAST PRECISE RELIABLE

Latin America

Avenida Paulista, 1337 CJ192,
São Paulo, Brazil
Phone: +55 11 2050 5411
E-Mail: info@magvatech.com.br

Europe

Im Leimen 14, 88069 Tettnang,
Germany
Phone: +49 7542 94 678 51
E-mail: info@magvatech.com

South Africa

Unit 8, N12 Industrial Park,
188 Dr Vosloo Road, Bartlett,
Boksburg, 1460 South Africa
Phone: +27 11 914 2199
E-Mail: support@magvatech.co.za

Turkey

Ege Freezone, Zafer SB. Defne Street.
No:3-1, Gaziemir, 35410, Izmir, Turkey
Phone: +90 232 504 98 91
E-Mail: izmir@magvatech.com

magvatech.com

Document code: MVT_Rec35_Guide_Smart5-5p-TM_EN Version: 8.2 Date: 19.12.2025