SALTEK®

Overvoltage controlled. ANYWHERE.

ELECTRONIC MONITORING OF VLD

EM-VLD-045
EM-VLD-060
EM-VLD-120

EM-VLD-500-M
EM-VLD-500-M-R

Installation and Use Instructions

These Installation and Usage Instructions contain the information necessary for proper installation, commissioning, operation and maintenance of the product. If further detailed information regarding the usage and servicing of the product is required, contact the manufacturer or its representative.

C17016.02/20250703

Table of Contents

1 General provisions, definitions

1.1 Manufacturer´s declaration

The manufacturer declares that if the product is used in a manner other than that specified in this manual, the product may malfunction or be damaged or destroyed. When installing and using the product, the legal requirements or the provisions of the technical standards for electrical installation must be observed. The manufacturer shall not be liable for any direct or indirect damage caused by using the product in a manner other than that specified in these instructions, or by handling the product in violation of the technical standards specified. Any use or connection of the product contrary to the procedures and connections specified in the instructions is considered incorrect and the manufacturer shall not be held liable for any consequences caused by such actions. Furthermore, the manufacturer shall not be liable for damage or destruction or loss of the product caused by improper placement, improper installation, improper operation, natural disaster, or as a result of tampering with the product such as replacing parts, rewiring the circuit, or modifying the control algorithm. The safety of any system containing this equipment is the responsibility of the person installing the equipment. The manufacturer makes no warranty for loss or corruption of data. The manufacturer assumes no responsibility for damages caused by product failure.

The Declaration of Conformity / Product Safety Assurance can be downloaded from the manufacturer‘s website at www.saltek.eu.

1.2 Acronyms, terms and definitions used

The product has been developed, manufactured and tested in accordance with the requirements of European standards, in particular EN 61010-1. This manual uses especially definitions, abbreviations and technical terms based on these standards.

2 Safety

2.1 Use of the product, expertise of persons

The products of the EM-VLD, in particular, are intended for monitoring the status and functionality of voltage limiters (SALTEK BVL series), especially in railway DC power supply systems up to the rated voltage of 3 kV. Persons authorised to install, commission, operate and maintain the device must have the necessary electrical qualifications and be familiar with the function of the product and its inclusion in the railway power supply and protection system. Unauthorized and improper handling of the product can cause serious damage to property, health and life of persons.

2.2 Symbols and important instructions

2.2.1 Symbols used in the text

Pay close attention to information marked with the following pictograms:

Important information to ensure the correct functioning of the product and the safety of persons, product operators and persons who may come into contact with the equipment under test. If damage to property, railway infrastructure, health and life of persons is to be avoided, it is necessary to comply with all instructions marked as such.

Risk of electric shock. This symbol draws attention to important instructions that must be followed to prevent electric shock during product installation, operation and maintenance.

Important information for product operation.

2.2.2 Symbols used on the device

The device is marked with the following safety and information pictograms:


Read the Installation and use instructions before installing and handling the product.

The product must be disposed of in an environmentally friendly manner within the framework of electronic waste return collection.

The product complies with the relevant EU requirements.

The product complies with the relevant UK requirements.

2.3 Safety precautions

In order to achieve the maximum level of protection, it is essential to:

- use the product only for the purpose for which it is intende
- use the product in accordance with the instructions given in the Installation and Use Instructions, which must be made known to persons who operate, maintain and periodically check the function of the product
- prevent unauthorised persons from handling the product
- periodically check the correct functioning of the product
- in the event of damage to the product (e.g. excessive overloading, etc.), ensure that the damaged parts are immediately replaced professionally, or the product is completely replaced by a faultless one
- observe the principles and standards of safe working on electrical equipment, in particular those stipulated in EN 50110 (or the relevant national versions of the standard)
- before starting work on the product or the technology connected to it, please note the following instructions:
  - disconnect the product from the power source
  - ensure the product cannot be inadvertently connected to the power supply during work
  - ensure that no part of the product is live
  - ground the rail (short or cross-connect the leads to the RAIL and EARTH terminals)
  - secure parts that must remain live so that live parts cannot be touched by workers (or ensure that only a person authorised to work on live equipment really performs tne works)
  - before starting the work, check that there are no parts of the product heated to a high temperature by previous operation - risk of burns
  - when working, follow the principles of working on live equipment

3 Description of the product and its variants

3.1 General description of the product

The EM-VLD series products are used to verify the functionality of a Class 2 Voltage Limiting Device (VLD) (SALTEK BVL series) and to monitor the status of the rail junction where the VLD is installed. The products are supplied in custom IP65-rated enclosures designed for mounting on wall, pole or DIN rail. Connection between the units and to the supervisory system (SCADA) is provided via rugged M12 connectors and shielded S/FTP cable with a length of up to 150 m. Online communication with the SCADA system is running via MODBUS protocol (via TCP/IP). Measured values can be recorded with the use of a built-in SD memory card. In addition to the continuous measurement of voltage and current in the track node equipped with VLD, the software automatically evaluates the correct functioning of the monitored VLD and reports anomalies and malfunctions to the SCADA system.

3.2 Design options

The complete monitoring set consists of a central evaluating unit EM-VLD-XXX and one to four measuring units EM-VLD-500-M(-R) placed at the monitored VLDs.

The evaluating unit is supplied in variants according to the value of the nominal triggering voltage of the VLD being monitored.

The measuring unit can be equipped with specially designed electronics to ensure faster interruption of the current flowing through active VLD, at a moment in which the current interruption can no longer cause the contact voltage to rise up to the permitted limit (typically 50 A). By limiting stray currents, the risk of corrosion of structures along the railway line is significantly reduced.

Only one type of measuring unit can be connected to the evaluating unit, i.e. either only with forced shutdown function or only without forced shutdown function.

Placement	Type designation	Order No.	Intended for VLD with U_{Tn}	Forced shutdown function
evaluating	EM-VLD-045	A07408	45 V	-
	EM-VLD-060	A07409	60 V	
	EM-VLD-120	A07195	120 V	
measuring	EM-VLD-500-M	A07410	-	no
	EM-VLD-500-M-R	A07196		yes

3.3 Dimensions

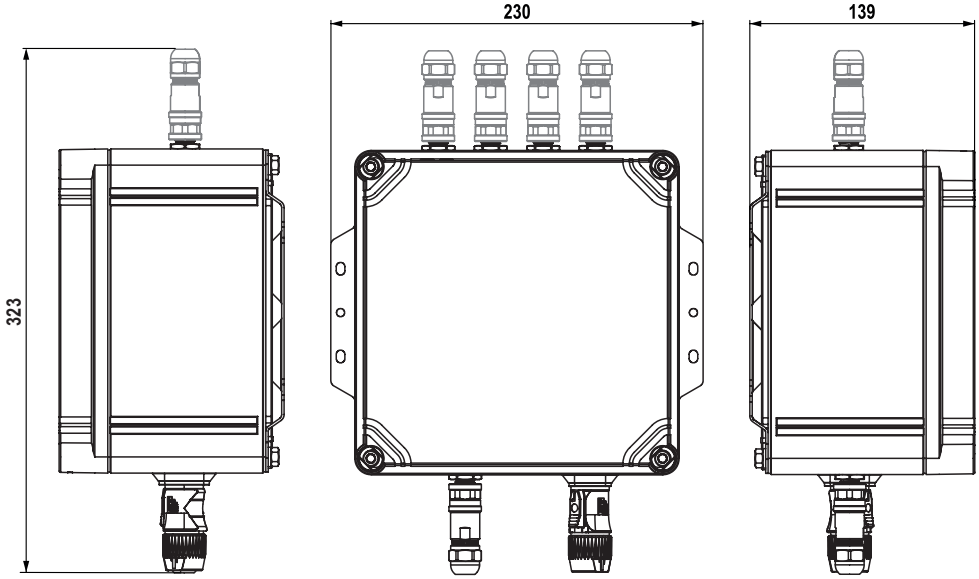


Fig. 1: Dimensions of the evaluating unit

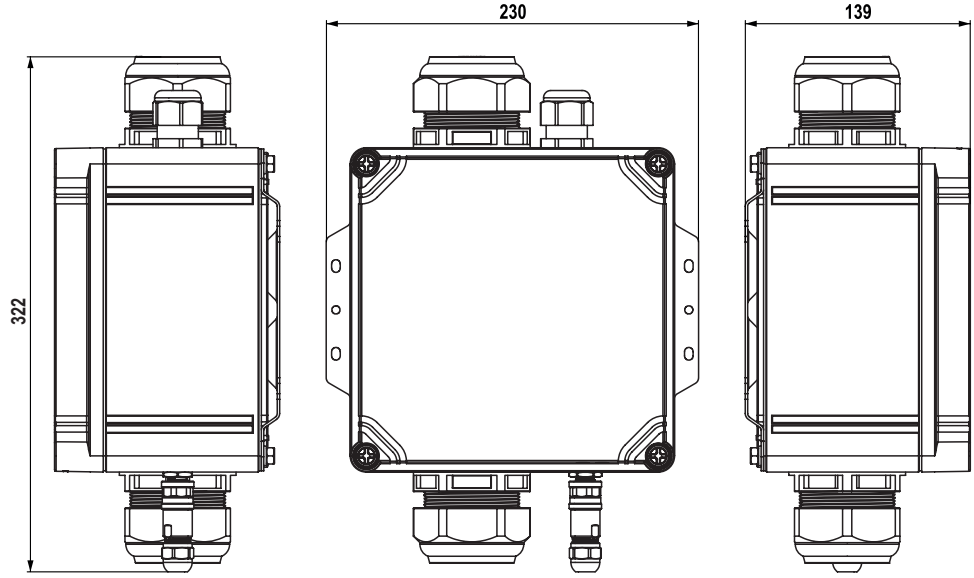


Fig. 2: Dimensions of measuring unit

3.4 Connecting elements

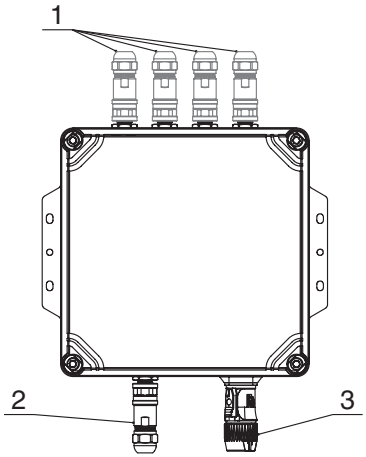


Fig. 3: Connecting elements of the evaluating unit

1	connecting terminals of the EM-VLD-500-M(-R) measuring units - the connector is included in the EM-VLD-XXX package
2	connection to the supervisory system (SCADA)
3	power supply connection terminal

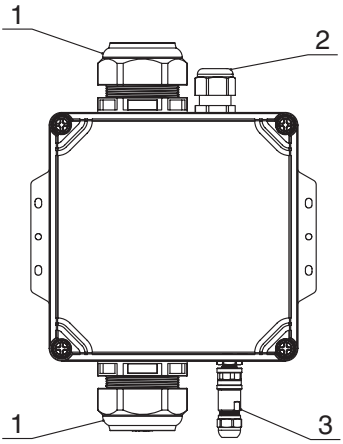


Fig. 4: Connecting elements of the measuring unit

1	grommet for current measurement
2	connection point for voltage measurement
3	connection point to the EM-VLD-XXX evaluating unit

3.5 Basic block diagram of the monitoring system

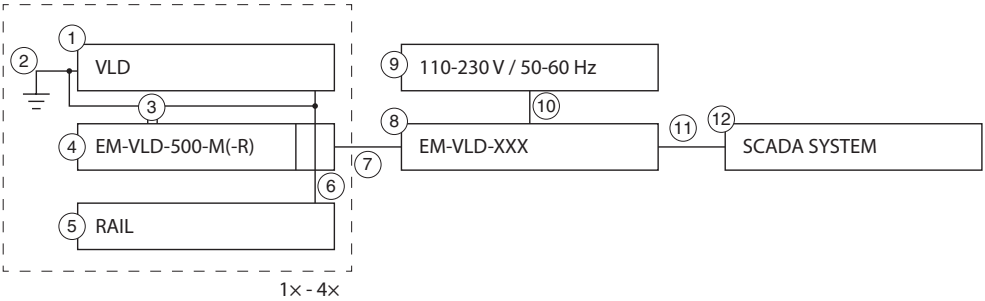


Fig. 5: Basic block diagram of the monitoring system

1	monitored VLD	7	connection link between the measuring and evaluating units
2	VLD earthing	8	EM-VLD-XXX evaluating unit
3	voltage measurement	9	Power source
4	EM-VLD-500-M(-R) measuring unit	10	connection link between the EM-VLD-XXX and the power source
5	RAIL return circuit	11	connection of EM-VLD-XXX to the supervisory system
6	current measurement	12	supervisory system

4 Transport and storage

The product described is a sensitive electrical and electronic device. Do not expose it to shocks and observe the storage temperature and humidity range. The limit values for storage and transport of the product are:

Storage temperature range: –20 to +70 °C

Humidity range: 10 to 95 %, non-condensing

Protect the product from falling or tipping over! On receipt of the product from the carrier, check the packaging for damage and signs of dropping, bumping, etc. If you find any signs of damage, contact the carrier or distributor. In this case, only an authorized employee of the manufacturer or distributor is allowed to assess the possibility of installing and operating the product.

The unpacked product may only be stored in a dry, ventilated and dust-free warehouse. After unpacking the product, allow it to equalize its temperature for at least 2 hours with the surroundings at the place where it will be installed.

Unless otherwise agreed in the delivery conditions, the manufacturer will not be liable for damage to the product during transportation.

After unpacking the product, check the completeness of the delivery. The basic delivery includes:

- EM-VLD-XXX / EM-VLD-500(-R)

- assembly material
- installation and use instructions

Do not install a product that has been subjected to dropping or other visible damage, extreme temperatures or other influences that could result in damage to the electrical and electronic parts of the product during transport! There is a risk of injury!

5 Mechanical and electrical assembly, installation check

5.1 Mechanical assembly

Mounting on the wall or DIN rail is carried out using suspension brackets and the supplied installation material. The spacing of mounting holes is shown in Fig. 6 (identical for both measuring and evaluating unit). Mounting on the pole can be done with mounting strips (not included).

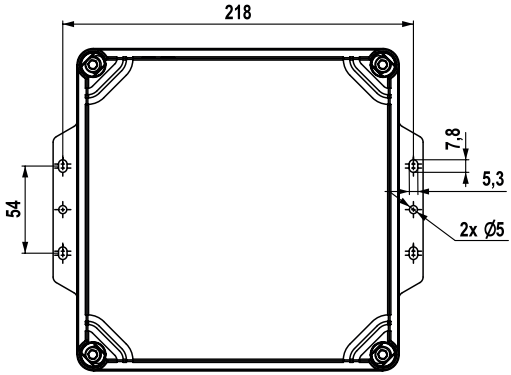


Fig. 6: Mounting holes

5.2 Electrical assembly

ATTENTION! The product is connected to systems where dangerous voltages may be present on the connected parts. There is a risk of electric shock!

The electrical installation of the product and its connection to the system may only be carried out by a person with the necessary electrical qualification, authorised to do so.

Before connecting the product to the protected system, it is especially necessary to:

- disconnect the system to be connected from the power supply
- ensure that no one can arbitrarily connect the system to the power supply without the consent of the persons making the connection
- verify that no electrical charge remains in the system (e.g. with a discharge rod)

Before connecting the product to the power supply, it is especially necessary to:

- verify the necessary parameters of the power supply (voltage, protection, etc.)
- disconnect the connection point from the mains before connecting the product
- check that the connection point is de-energised
- verify/ensure that a back-up power supply (diesel generator, batteries, etc.) is prevented to restore the power supply voltage at the connection point

5.2.1 Connecting the monitored VLD

5.2.1.1 Current measurement

Current passing through the monitored VLD is measured in contactless manner. Pass the wire connecting the return circuit (rail) to the VLD through the grommet marked „CURRENT MEASURING“, see Fig. 7. The maximum wire diameter is 35 mm. It is recommended to select the connecting lug so that it can be threaded through the measuring grommet (i.e. max. lug width 35 mm).

5.2.1.2 Voltage measurement

The voltage at the terminals of the VLD being monitored is measured using a two-core cable terminated with connection lugs and exiting the measuring unit through a grommet marked with „VOLTAGE MEASURING“.

The connection lugs must be connected to the terminals of the VLD to be monitored according to Fig. 7. In the case of a positive rail potential, the measured value will also be positive.

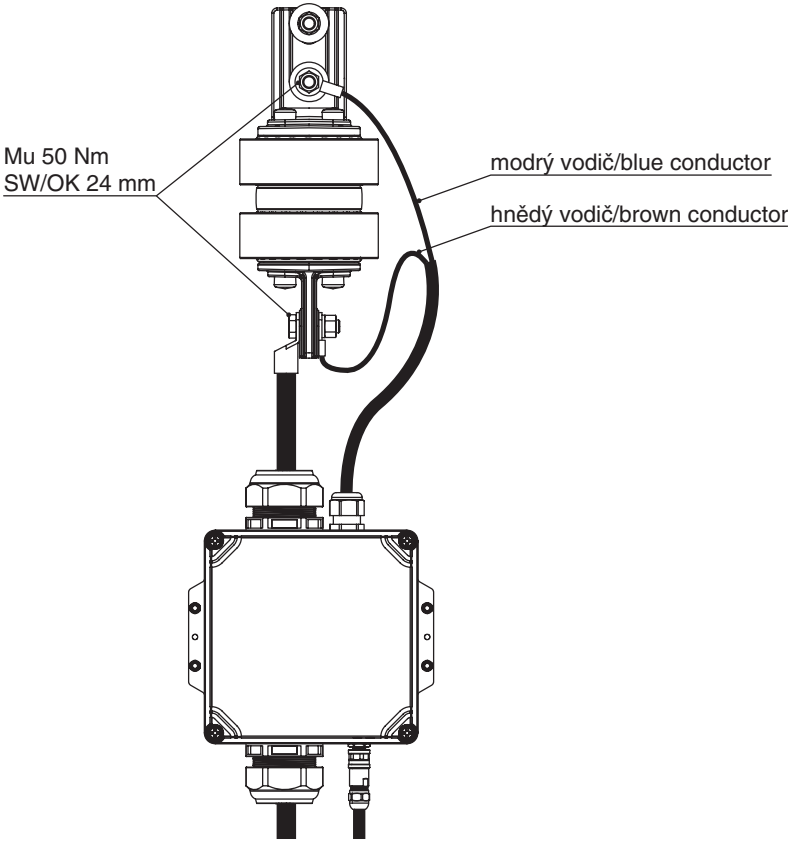


Fig. 7: Connection of voltage and current measurement

The maximum length of the measuring wires is 1 m. This length is already set at the factory - do not extend the wires! It is possible to shorten the wires to a length of 0,5 m.

5.2.2 Connection link between the measuring and evaluating units

Communication between the measuring and evaluating unit takes place via an Ethernet cable terminated with M12A-8pin connectors inserted to the connection points marked „M-DATA“ (measuring unit) and „M1“ to „M4“ (evaluating unit). It is recommended to establish the connection using an S/FTP cable of outdoor version, minimum category Cat. 6, with a maximum operating temperature in excess of 70 °C.

The „M1“ to „M4“ connectors must be placed from the lowest number (i.e. in case of connecting one measuring unit the connector „M1“ will be used, in the case of connecting two measuring units the connectors „M1“ and „M2“ will be used, etc.)! It is recommended to seal the unused connectors with the supplied caps.

Connect the connector to the data cable acc. to Fig. 8 and Fig. 9. The grommet can accommodate a 4 to 6 mm diameter cable. The connector screw terminals of the connector can accomodate conductors of 0,25 – 0,5 mm^2 cross-section (with ferrule) or 0,14 – 0,34 mm^2 (without ferrule).

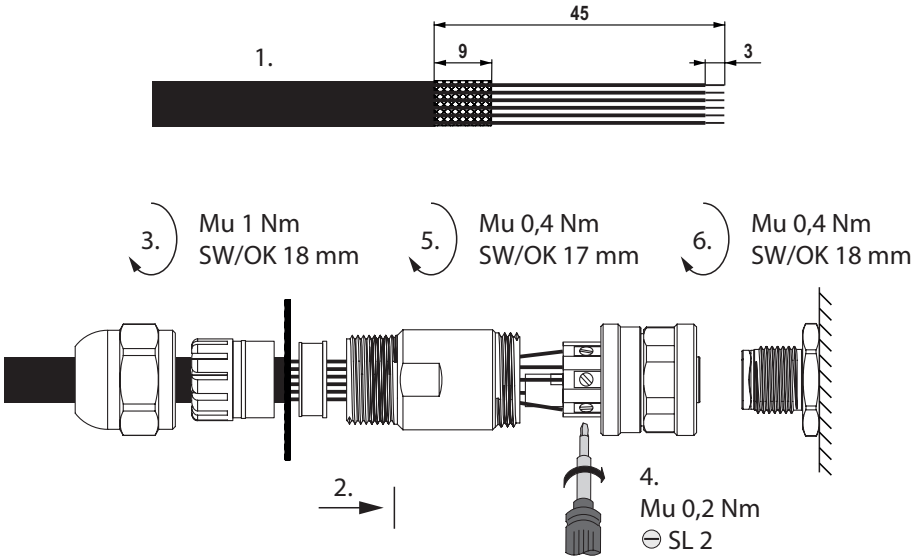
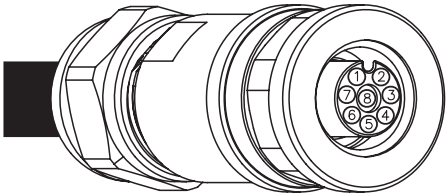


Fig. 8: Data cable connector (Mu = torque, SW/OK = wrench size)



1 - oranžová a bílá/orange and white
2 - oranžová/orange
3 - zelená a bílá/green and white
4 - modrá/blue
5 - modrá a bílá/blue and white
6 - zelená/green
7 - hnědá a bílá/brown and white
8 - hnědá/brown

Fig. 9: Data cable connector – wire colours

After connecting the connector, it is necessary to check the individual pins for a short circuit between them and also for a short circuit between the pins and the connector shield/cover! It is also recommended to check the continuity of the individual pins. If the connector is assembled incorrectly, there is a risk of damaging the device during connection!

The connectors are fitted with cover caps. If one of the connectors is not used (not connected to the measuring unit), leave the corresponding cover cap on, otherwise the IP 65 degree of protection will not be achieved. Without the cover cap the degree of protection is IP 21, only.

5.2.3 Power supply connection

To function normally, the product needs to be powered from a single-phase AC mains supply with a rated voltage within the range of 110 - 230 V ± 10% and a rated frequency of 50 Hz. The product must protected with an upstream circuit breaker (meeting the requirements of IEC/EN 60947-2), with the B load characteristic and rated current of 6 A, which also serves as the main switch. The circuit breaker needs to be suitably located close to the equipment, be easily accessible and marked as a “disconnecting element for EM-VLD-XXX”.

Power is supplied via the power connector located at the bottom of the evaluating unit. The connector must be connected according to Fig. 10 and Fig. 11.

For the power connection it is recommended to use a 3 × 1,5 mm^2 cable (L+N+PE). The terminals for the individual wires are tightened with a screwdriver PZ1 with a tightening torque of 0,7 Nm. The grommet can accommodate a connecting cable with a diameter of 6 to 10 mm. The tightening of the union nut takes place using a 21 mm wrench and a torque of 2 Nm.

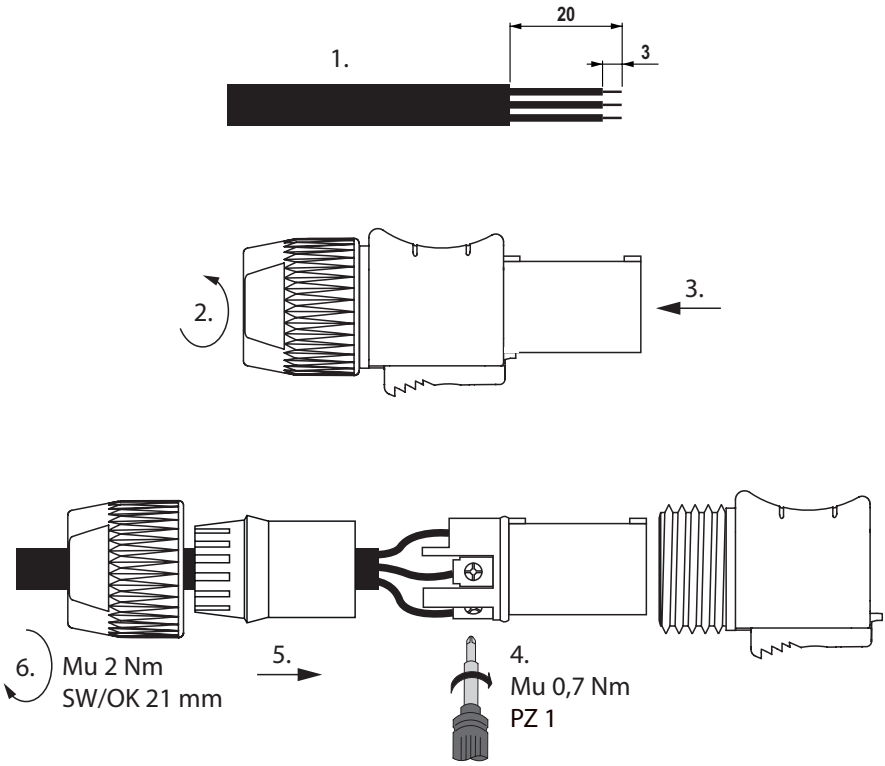


Fig. 10: Power supply connector (Mu = torque, SW/OK = wrench size)

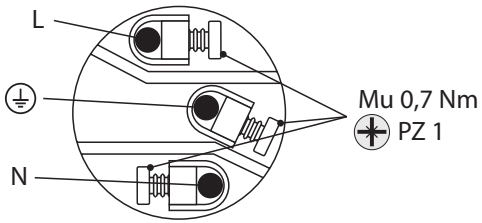


Fig. 11: Power supply connector (Mu = torque)

Do not connect or disconnect the connector if it is under load or live.

To ensure fault-free operation of the equipment, it is recommended that a complete surge protector be installed upstream.

5.2.4 Connection to the supervisory system

The communication between the evaluating unit and the supervisory (SCADA) system is carried out via an Ethernet cable, which is connected on the evaluating unit side with an

M12A-8pin connector inserted to the connection point marked „DATA“. For the connection, it is recommended to use an outdoor S/FTP cable, of minimum category Cat. 6, with a maximum operating temperature in excess of 70 °C.

Connect the connector to the data cable acc. to Fig. 8 and Fig. 9. The grommet can accommodate a 4 to 6 mm diameter cable. The connector screw terminals of the connector can accomodate conductors of 0,25 – 0,5 mm^2 cross-section (with ferrule) or 0,14 – 0,34 mm^2 (without ferrule).

The shield of the communication cable must be connected only on the M12 side of the connector.

5.3 Installation check

After completing the installation work, make sure that:

- the product enclosure is firmly mounted to the wall, frame or base so that it does not come loose and fall down
- all electrical wiring connections are properly connected, tightened and do not put mechanical stress on the product enclosure or its components

6 Commissioning

Risk of electric shock from touching dangerous live parts when the cover is removed!

To access the PLC it is necessary to remove the cover of the evaluating unit. The screwdriver size necessary is PH 3. When returning the cover, the fixing screws need to be tightened with a torque of 2 Nm.

When commissioning the product proceed in accordance with the steps hereunder:

1. Install the product in accordance with steps outlined in chapter 5 of this manual.
2. Connect the power by switching the main switch (circuit breaker) ON.
3. Check that the evaluating unit receives data from the connected measuring units – the display of the PLC evaluating unit shows the measured values.
4. Set the mode according to the type of measuring unit - the white backlight of the display indicates the setting mode for measuring units with forced shutdown function (EM-VLD-500-M-R), in case of using measuring units without forced shutdown function (EM-VLD-500-M), press the ESC+up arrow keys (the display backlight goes out). ESC+down arrow returns the mode to the original setting.
5. Set the IP address of the supervisory system on the PLC by pushing first the down key twice and then the ESC key. The display shows the main MENU. Before changing the IP address, you must stop the program with STOP and confirm. To change the IP address, see Network/IP Address.
6. Verify that the evaluating unit is communicating with the connected supervisory system.

7 Information about the status of the VLD and the node

The monitoring system (EM-VLD-XXX + EM-VLD-500-M(-R)) enables continuous collection of information about the VLD status and measured variables (instantaneous voltage

and current flowing through the RAIL terminal, the VLD activity and status, VLD fault conditions, etc.). The data is sent via the Ethernet 100BASE-T interface using the MODBUS communication protocol (via TCP/IP) and simultaneously stored on the SD memory card being a part of the product delivery and inserted into the PLC slot of the evaluating unit.

Risk of electric shock from touching dangerous live parts when the cover is removed.

To access the PLC, it is necessary to remove the cover of the evaluating unit using a screwdriver size PH 3. When returning the cover, it is necessary to tighten the fixing screws with a torque of 2 Nm.

On the PLC display, you can use the up and down arrows to switch between the screen showing the voltage and current status and the screen with the number of activations of individual VLDs.

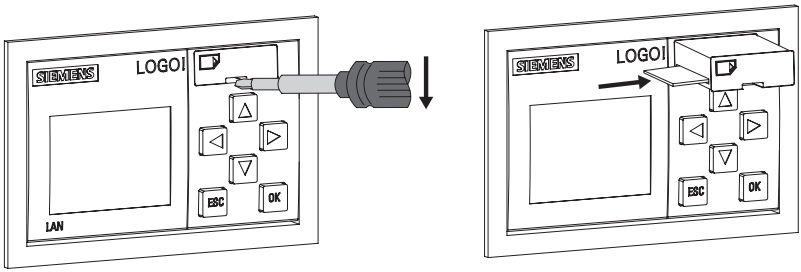


Fig. 12: Memory card location

The VLD status is recorded every 3 seconds. If current is flowing through the VLD, a recording is made once every 1 second.

The following table shows the default state of the logs being stored:

Event	MODBUS id
Voltage on VLD1	Holding register 513
Current on VLD1	Holding register 514
Voltage on VLD2	Holding register 515
Current on VLD2	Holding register 516
Voltage on VLD3	Holding register 517
Current on VLD3	Holding register 518
Voltage on VLD4	Holding register 519
Current on VLD4	Holding register 520
700 A on VLD1 exceeded	Coil 8258
700 A on VLD2 exceeded	Coil 8259
700 A on VLD3 exceeded	Coil 8260
700 A on VLD4 exceeded	Coil 8261

Event	MODBUS id
Sensors connection error	Coil 8262
Reset of relay 1–4 trip counter	Coil 8263
Reporting global reset	Coil 8264
Reset of VLD1 trip counter	Coil 8265
Reset of VLD2 trip counter	Coil 8266
Reset of VLD3 trip counter	Coil 8267
Reset of VLD4 trip counter	Coil 8268
VLD1 voltage exceeded	Coil 8269
VLD2 voltage exceeded	Coil 8270
VLD3 voltage exceeded	Coil 8271
VLD4 voltage exceeded	Coil 8272
VLD1 error detection	Coil 8273
VLD2 error detection	Coil 8274
VLD3 error detection	Coil 8275
VLD4 error detection	Coil 8276
Relay 1 worn out	Coil 8277
Relay 2 worn out	Coil 8278
Relay 3 worn out	Coil 8279
Relay 4 worn out	Coil 8280
Error of bypass 1 detected	Coil 8289
Error of bypass 2 detected	Coil 8290
Error of bypass 3 detected	Coil 8291
Error of bypass 4 detected	Coil 8292
Short-circuit on VLD1 detected	Coil 8293
Short-circuit on VLD2 detected	Coil 8294
Short-circuit on VLD3 detected	Coil 8295
Short-circuit on VLD4 detected	Coil 8296

8 Fault conditions

During operation, the following fault conditions can occur, displayed on the PLC display or communicated via the supervisor system:

- „SENSOR CONNECTION FAILURE“ – defective connection link between the measuring and evaluating unit. Check the connection acc. to chapter 5.2.2.
- „OVERVOLTAGE“ – voltage on the monitored VLD has been exceeded
- „SHORT CIRCUIT VLD1–4“ – current is flowing through the corresponding VLD for a period longer than 20 minutes
- VLD voltage exceeded – voltage level on VLD (45/60/120 V -> 55/70/130 V) has been exceeded
- VLD error detection – defective functioning of the VLD; current measured without detecting the voltage
- Worn out relay – the short-circuiting relay has been activated by more than 70 000 times. Contact the service
- Error of bypass detected – the VLD is all the time active (with current flowing through it), even after the bypass sequence

These fault conditions have their own address in MODBUS communication assigned and as soon as they finish it is necessary to either restart the device or activate the Global Reset message. To reset the relay trip counter, it is necessary to activate the relay 1-4 trip counter reset 1-4.

9 Maintenance

The equipment does not require any special maintenance. Unauthorised persons are not allowed to disassemble the product.

9.1 Cleaning

Use a soft cloth dampened with water to clean the surface of the equipment or accessories. Allow to dry the equipment completely before further use.

10 Technical data

10.1 Evaluating unit

Parameter name / Product type	EM-VLD-045	EM-VLD-060	EM-VLD-120
Nominal triggering voltage of VLD	45 V DC	60 V DC	120 V DC
Number of connectable measuring units	1 – 4		
Rated power supply voltage AC 50 Hz	110 – 230 V ± 10 %		
Maximum rated power (in the case of connecting 4 measuring units)	80 VA		
Communication with the SCADA system	MODBUS using TCP/IP		
Connection of measuring units	M12, 8-pin, a-code (S/FTP min. Cat. 6, < 150 m)		
Connection to the SCADA system	M12, 8-pin, a-code (S/FTP min. Cat. 6)		
Weight	2,3 kg		
Placement, installation location	indoors and outdoors		
Mounting	wall / column / DIN rail 35 mm		
Range of operating temperatures (min/max)	–20 °C / 50 °C		
Altitude	up to 4000 m above sea level		
Humidity (min/max)	20 % / 95 %		
Pollution degree (IEC 60664-1)	2		
Degree of protection	IP 65		
Overvoltage category for power circuit	CAT II do 300 V		
Degree of mechanical resistance	IK 08 (5 J)		
Meets the requirements of standards (as amended)	EN 61010-1, IEC 61010-1, EN IEC 61326-1, IEC 61326-1		
Ordering number	A07408	A07409	A07195

10.2 Measuring unit

Parameter name / Product type	EM-VLD-500-M	EM-VLD-500-M-R
Measured voltage range	± 500 V DC	
Measured current range (linear/saturation)	± 500 A / ± 1250 A DC	
VLD forced shutdown function	no	yes
Power supply	from the evaluating unit	
Connection to the evaluating unit	M12, 8-pin, a-code (S/FTP min. Cat. 6, < 150 m)	
Weight	3 kg	
Placement, installation location	indoor and outdoor	
Mounting	wall / column / DIN rail 35 mm	
Range of operating temperatures (min/max)	–25 °C / 70 °C	
Altitude	up to 4000 m above sea level	
Humidity (min/max)	20 % / 95 %	
Pollution degree (IEC 60664-1)	2	
Degree of protection	IP 65	
Overvoltage category for VLD circuit	CAT II up to 150 V	
Electrical strength, measuring circuit - rail circuit	2,2 kV AC / 3,1 kV DC	
Degree of mechanical resistance	IK 08 (5 J)	
Meets the requirements of standards (as amended)	EN 61010-1, IEC 61010-1, EN IEC 61326-1, IEC 61326-1	
Ordering number	A07410	A07196

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