ELMODIS

SDMS-MMS Installation manual

Documentation

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1 Safety & personnel qualifications

⚠ Information marked with this sign is important from the point of view of safe operation and reliable operation of the device. Failure to comply with them may result in permanent disability or death.

⚠ This manual contains important information for safe operation. It is essential that you read it before you connect / start up the device.

⚠ Prior to operation, perform an external visual inspection. If any damage is found, the device should be withdrawn from use and have it repaired at the manufacturer's service centre. ELMODIS shall not be liable for any damage resulting from use of a damaged device.

⚠ Any attempts made by the user to repair or tamper with the device will void the warranty. ELMODIS accepts no liability for damage resulting from use of the device altered in this manner. Any repairs should be made at the manufacturer's service centre.

⚠ If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

⚠ **Use only approved accessories!**

The terminals of the device carry a voltage hazardous to health and life. All works related to installation and configuration of the device must be performed with disconnected power supply voltage. Installation can be performed only by persons with appropriate authorization.

	Keep away from heat sources!
	Protect against moisture! Do not immerse in liquids!

1.1 Personnel qualifications

The following table shows the special qualifications that are required for personnel using the module described in this manual.

	Electrician	Network administrator	Trained employee
Installation	✓	✗	✗
Commissioning	✓	✓	✗
Maintenance	✓	✓	✗
Troubleshooting	✓	✓	✓

1.2 Contact

Elmodis Sp. z o.o.

Aleja Pokoju 1

31-548 Kraków, Poland

Email: biuro@elmodis.com

Web: http://www.elmodis.com

2 Introduction & approvals

Electro module is a part of Elmodis system used to monitor electric induction motor-supplied machines. Measurements of physical quantities used by the system (current, voltage, key phasor) are connected to the module. The device is used for collecting and processing measurement data, communicating with other SDMS modules and communicating on-line with Elmodis application located in the Cloud.

2.1 Basic features

- Direct voltage measurements with the use of voltage dividers
- Connection of motor current measurement through Rogowski coils
- Connection of key phasor signal (inductive or photoelectric sensor)
- Key phasor outlets for synchronization of measurements with other devices
- Ethernet interface used for the communication with the Internet and other SDMS modules
- 1 relay output
- Temperature measurement by 1-Wire standard sensors
- 24 VDC supply
- Installation on DIN TS35 rail

2.2 Approvals

Compliance with European Standards:

- 2014/35/UE (LVD)
- 2014/30/UE (EMC)

3 Technical data, connection & labeling

3.1 Technical data

Measurement category	300V CATIII
Nominal measurement voltage	Three-phase four-wire systems (U_{LN}/U_{LL}) : 277/480 V Three-phase three-wire systems unearthed (U_{LL}) : 480 V
Measurement current range	3.5 kA (RMS) for coils with sensitivity 100mV/kA @ 50 Hz 3 kA (RMS) for coils with sensitivity 120mV/kA @ 60 Hz
Accuracy	1.5% per measurement range
Temperature measurement	up to 8 1-WIRE sensors (DS18B20+ standard)
Relay output (SELV)	1 A / 30 VDC (resistive)
Phase marker	NPN/PNP sensors support
Power supply (SELV)	24 VDC
Power consumption	< 6 W
Ethernet	10/100 Mbit
Operating temperature	-20 ÷ 50 [°C]
Storage temperature	-20 ÷ 85 [°C]
Operating humidity range	5% do 90% without condensation
Pollution degree	2
Maximum altitude	2000 m
Mounting method	TH 35 rail (acc. to PN-EN 60715 standard)
Dimensions	37 x 115 x 125 [mm]
Weight	0.3 kg

3.2 LED signalling

Symbol	Status	Description
	BLINKING	Failure-free operation of the system
	STEADY	Service required
	STEADY	Stable communication with the Cloud
	STEADY	No communication with the cloud
	BLINKING	No Internet access
	BLINKING	Collecting electrical measurements
	STEADY	No electrical measurements
	BLINKING	Correct operation of the key phasor
	STEADY	Key phasor high
	BLINKING	Temperature measurement by sensors
	BLINKING	No response from a sensor
	BLINKING	Communication
	BLINKING	No communication
Casing back-light	STEADY	Machine OK
	BLINKING	Module identification
	BLINKING	Machine-related alarm

3.3 Connectors and labeling

The following figures show views of the module containing the connectors with their markings and the nameplate. The first pins of the connectors are marked with a dot.

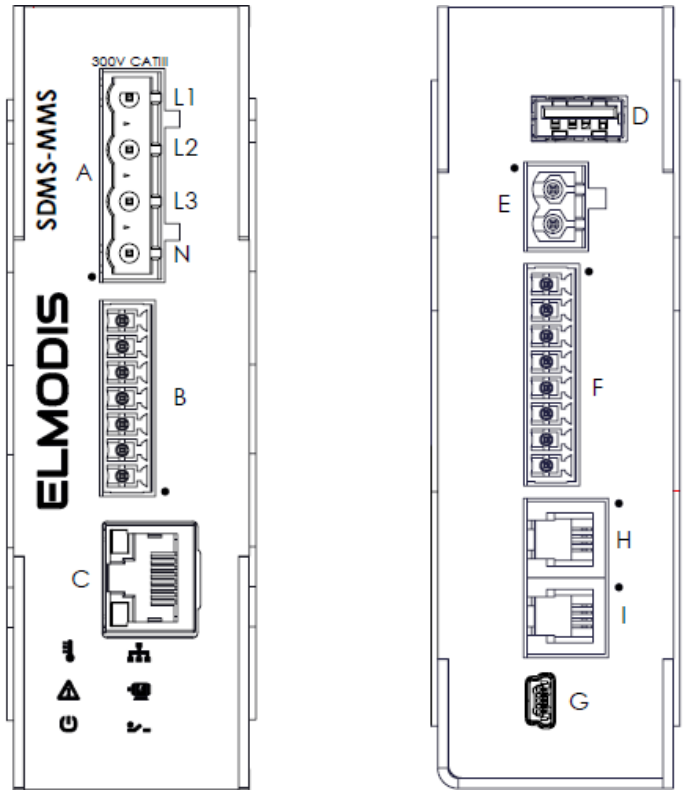

Fig 1. View of the connectors from the front and bottom

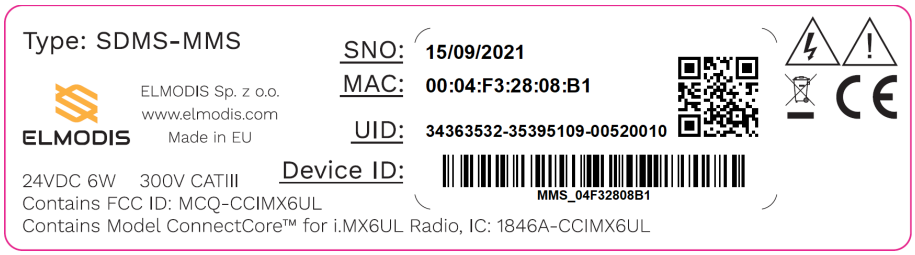

Fig 2. Nameplate

The nameplate contains the information necessary to identify the module and to register it on the ELMODIS portal. An example of the nameplate on the photo above shows the type of module along with the serial number which at the same time informs about the date of production of the device - SNO: 15/09/2021 (15th SDMS-MMS module manufactured in September 2021)

3.4 Wiring diagram

The following figure shows the basic measurement scheme.

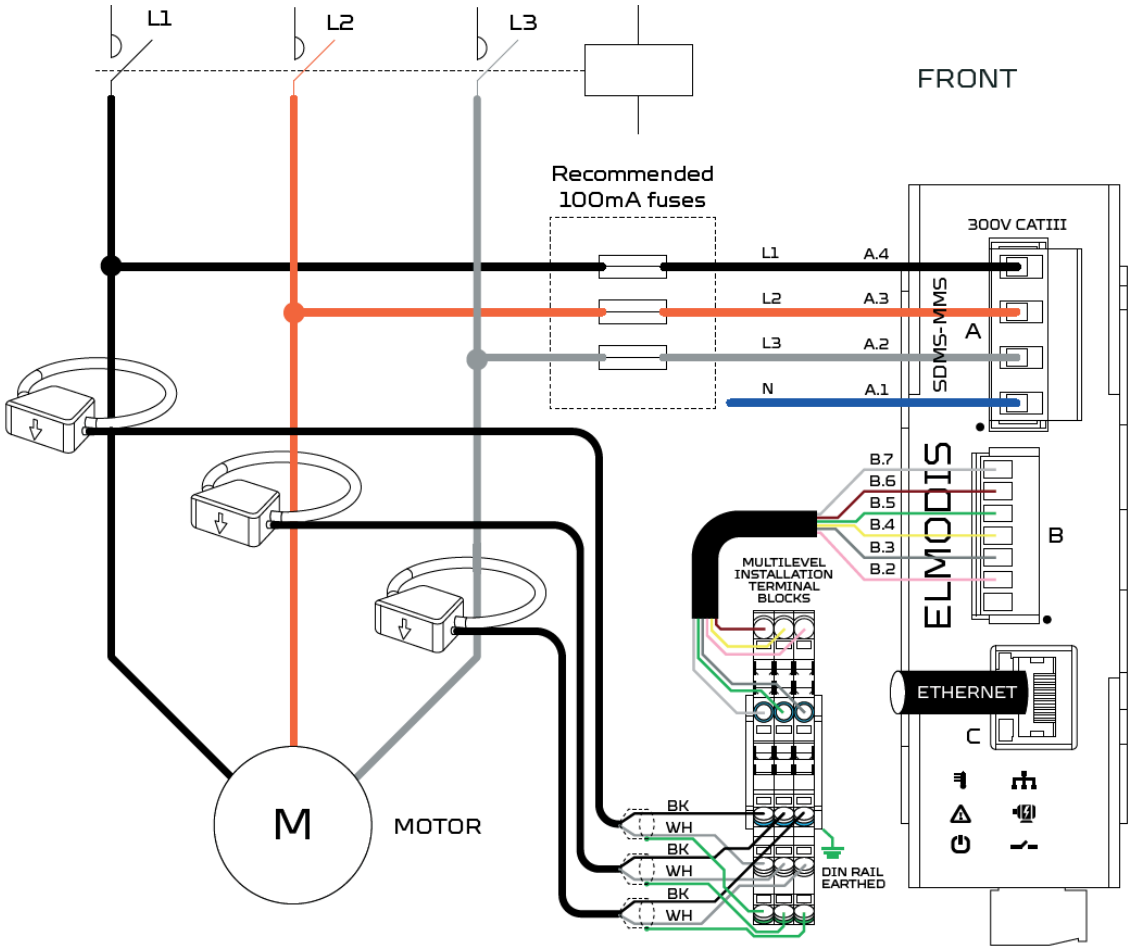

Fig 3. Basic measurement scheme using Rogowski coils

The figure below shows the connection of the power supply and optional sensors and signals such as:

- F.1~3 - phase marker sensor (NPN/PNP)
- F.4~6 - 1-WIRE temperature measurement sensor (DS18B20+)
- F.7~8 - binary output (normally open relay contact - NO)
- H,I - measurement synchronization input / output signal

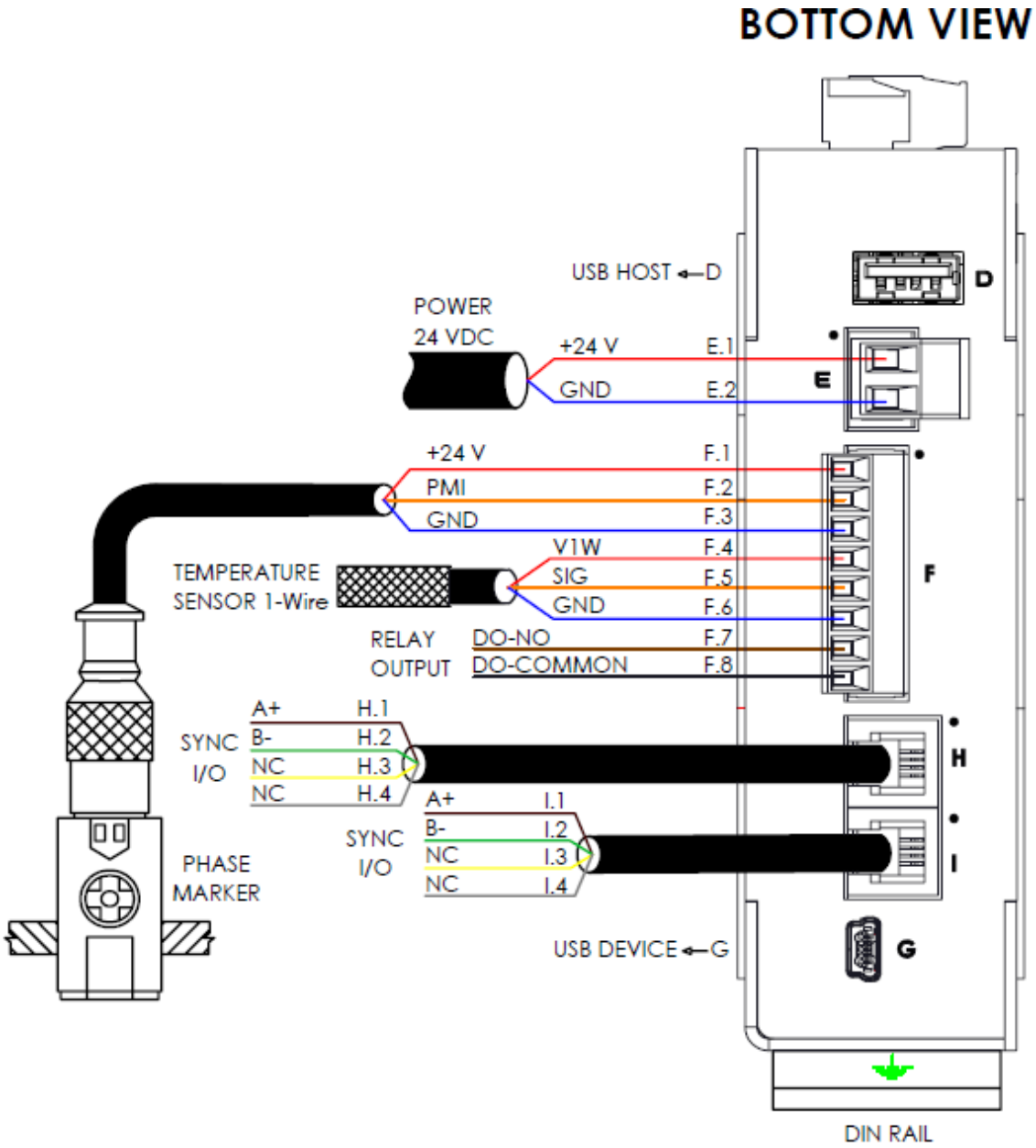

Fig 4. Extended diagram of connections to the module connectors

3.5 Dimensions

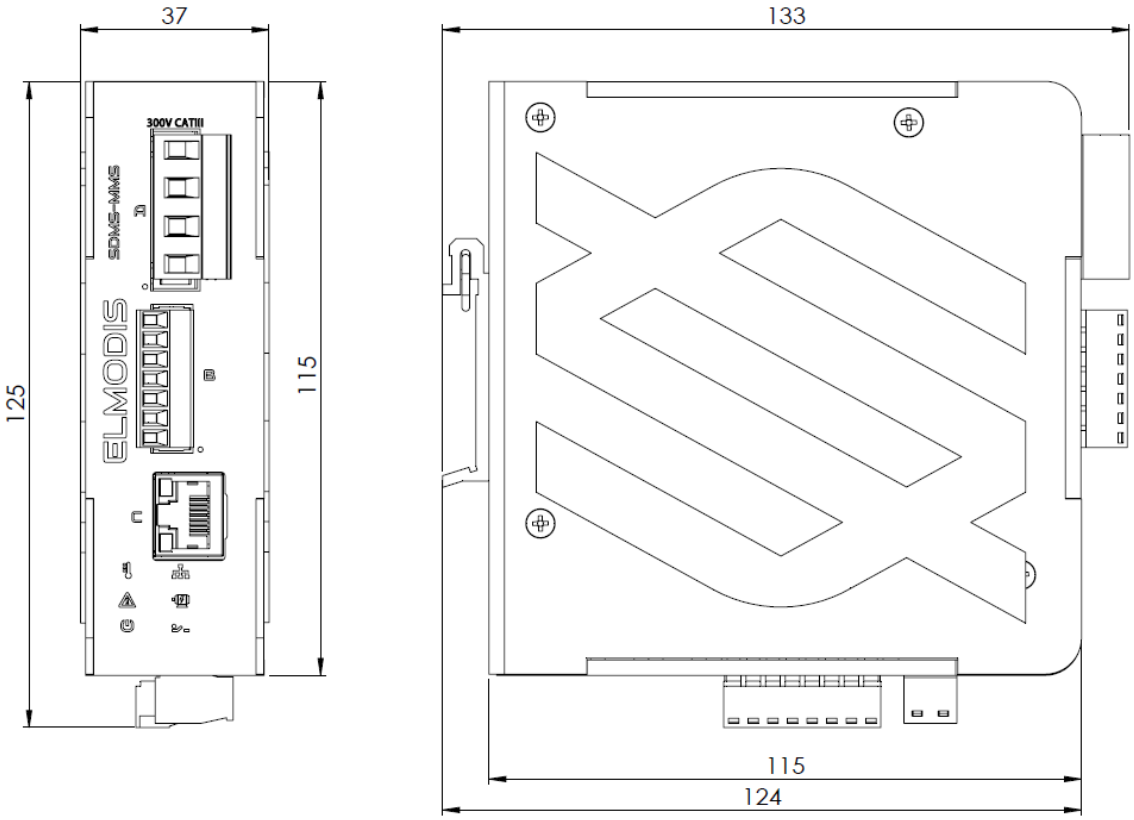

Fig 5. SDMS-MMS module dimensions [mm]

4 Installation guidelines

4.1 Guidelines for installing the module

- The module is intended for indoor use.
- The module is designed to be DIN rail mounted in enclosed cabinets/housing and the like, that afford protection against fire hazards, environmental conditions and mechanical impact. It is recommended that the control cabinet or enclosure in which the module is to be mounted provides IP54 protection.
- The temperature in the control cabinet or enclosure where the module is mounted must not exceed the maximum operating temperature of the device. Therefore it is recommended that cabinets/housings should be properly ventilated/air conditioned.
- The module must be mounted at least 1 cm away from other devices and components, whose temperature exceeds the maximum temperature of operation of the module.
- The module must be mounted at least 25 cm away from inverters.
- The DIN rail on which the module is mounted should be earthed.

4.2 External wiring

- Material of power and measuring cables: copper.
- Minimum working temperature of external wires: 75°C.
- Minimum working voltage of voltage measurement wires connected to the plug A: 500V.
- Minimum working voltage for other wires: 300V.
- Before connecting the wires to the plugs, they should be properly prepared by crimping the sleeve endings on them.
- During installation, follow the instructions regarding cable cross sections and types.
- Cables shall be marked.
- The cable colours, marking shall be included in the documentation.

4.3 Installation requirements

- Voltage measurement lines must be connected in accordance with standards in order to avoid malfunctions in the installation and, above all, to exclude the possibility of danger to life and health of personnel.
- Accident prevention regulations must be observed during installation, startup, maintenance and repair work.
- Emergency stop devices and functions must be effective - see the relevant standards (e.g. DIN EN 418).
- To eliminate potential sources of interference, the installation must be carried out according to EMC guidelines.

- The norms, standards, guidelines and local regulations in force at the time of installation must be observed.
- All attached sensors must provide the required isolation from dangerous voltages.
- At least simple drawing, showing connections on the terminal in the cabinet where the devices are connected, should be prepared.

4.4 Additional safety requirements

- Proper types of fuses for power supply and voltage measurement.
- Mechanical cable clamping.
- Use of mechanical shielding for cables and equipment.
- The wiring, components and devices used should have higher current and voltage ratings than expected for the installation.
- The cabinet shall be securely fastened using appropriate materials and installation techniques.

⚠ PROHIBITED

- Use of yellow-green cables for purposes other than protecting (earthing) equipment and mechanical guards.
- Mechanical bending, pressing of cables.
- Using cables with a lower operating voltage than required.
- Leave the cables unattached.
- Expose cables without additional protection outside the mechanically protected area.
- Use fuses with different values than those required for safety requirements.

4.5 Measurement quality

- Connected cable shield.
- Proper direction of the current coils (direction of the arrow on the coil).
- Well-fixed coils, centered.
- Do not run the coil cables in parallel with the motor voltage/power cables.

5 Power supply and earthing

Use an isolated power supply with the specifications listed below.

5.1 Parameters

Power supply type	SELV
Supply voltage	24V DC ± 5%
Maximum power required	6 W
Recommended power supply	TRACO POWER TPC030-124
Cross section of the connection cables	0.5-2.5 [mm^2] (20-13 AWG)
Tightening torque	0.5 Nm (5.0 Lb-In)

5.2 Connection

The table shows the pin description of the power connector E shown in the following figure.

Pin of E connector	Marking
E.1	+24V
E.2	GND

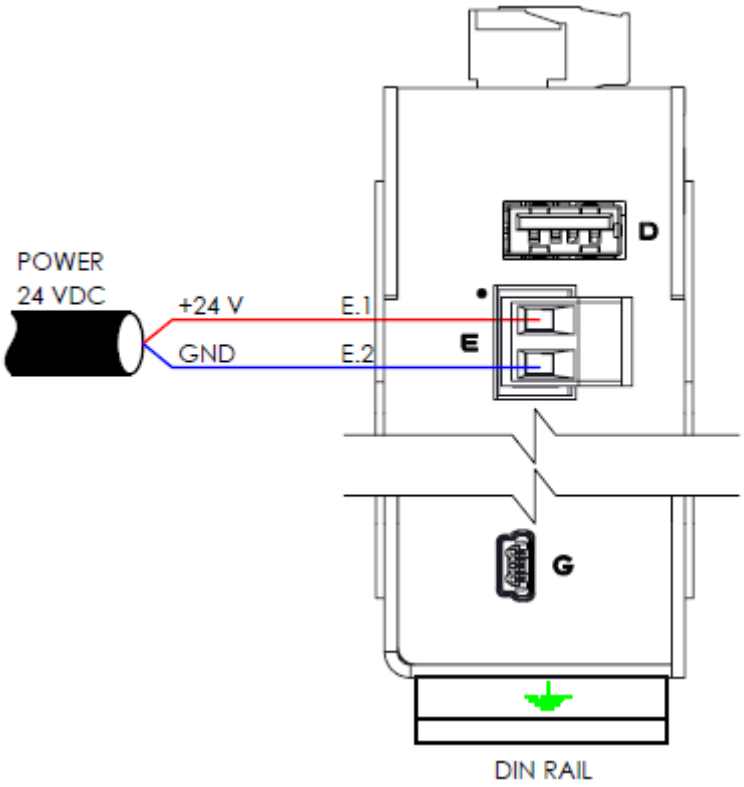

Fig 6. 24 VDC power supply

5.3 Earthing

The device is earted via a DIN rail mounting bracket. Earth resistance of the DIN rail must not be higher than 1 Ω.

6 Communication via Ethernet

The SDMS-MMS module communicates with the cloud and other devices via a 10/100 Mbps Ethernet interface (RJ-45 connector marked with the letter C).

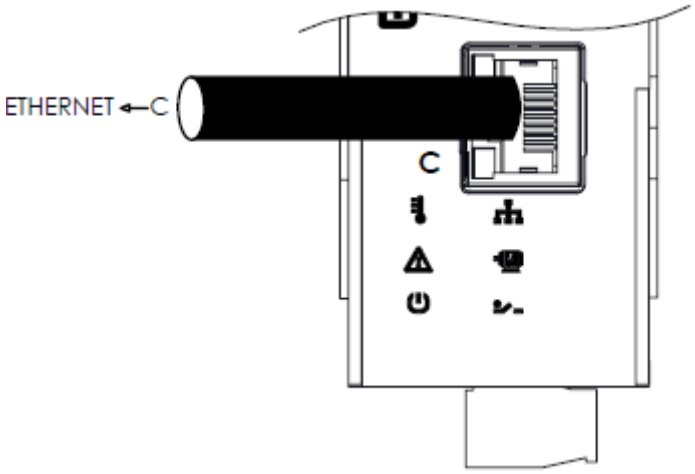

Fig 7. Ethernet connection

7 Input and output signals

7.1 Voltage measurement

7.1.1 Parameters

Measurement category	300V CATIII
Nominal measurement voltage	3-phase 4-wire systems: 277/480 V
	3-phase 3-wire systems unearthed: 480 V
Cross section of the connection cables	0.5-2.5 [mm^2] (20-13 AWG)
Tightening torque	0.5 Nm (5.0 Lb-In)

7.1.2 Connection

⚠ **Before starting work, switch off the power supply to the motor and protect it from being switched on again while work is being carried out, then ensure that there is no voltage at the terminals.**

- It is recommended to use fuse disconnectors (~100mA) or overcurrent circuit breakers to protect the unit. Their use will also allow safe and efficient servicing of the device without switching off the power supply to the monitored machine in case it is necessary to disconnect or replace the device.
- Pay attention to the correct sequence of phase voltages connected to the voltage measurement plug (A).

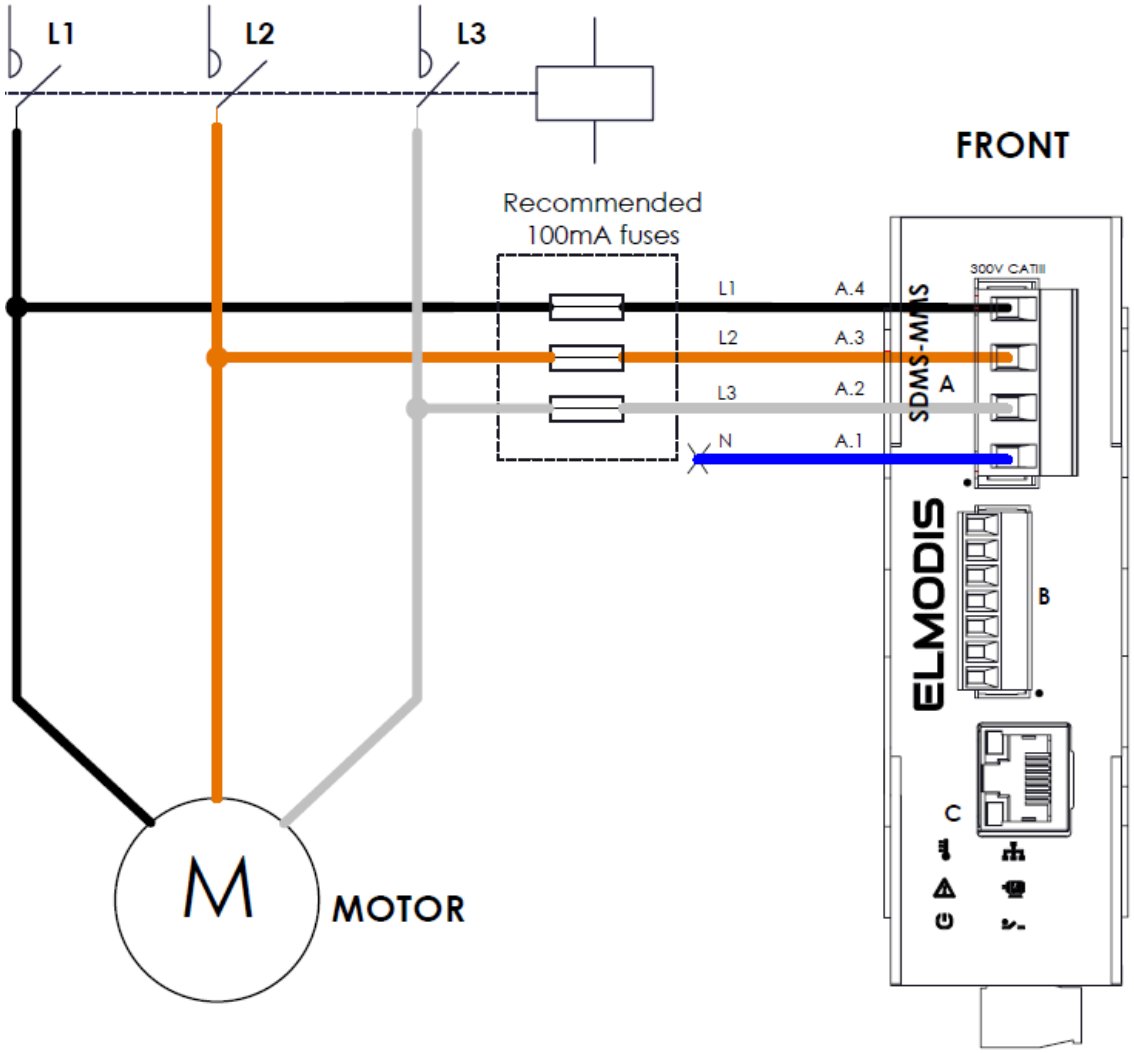

Fig 8. Voltage measurement connection

7.2 Current measurement

7.2.1 Rogowski coils

For current measurement, UL Listed Rogowski coils with ratings suitable for the application should be used. Refer to the table below for recommended Rogowski coils with their parameters:

Manufacturer	ALGODUE ELETTRONICA
Series	MFC150-UI
Type	Splitted, flexible
Coil length	30 cm
Sensor internal diameter	7 cm
Cord diameter	8.3 mm
Nominal output rate	100 mV/kA @ 50 Hz 120 mV/kA @ 60 Hz

7.2.2 Connection and installation of coils

Cross section of the connection cables	0.2-1.3 [mm^2] (24-16 AWG)
Tightening torque	0.34Nm (3.0 Lb-In)

Requirements

- The Rogowski coils may not be installed in equipment where they exceed 75% of the wiring space of any cross-sectional area within the equipment.
- Restrict installation of Rogowski coil in an area where it would block ventilation openings.
- Restrict installation of Rogowski coil in an area of breaker arc venting.
- Not suitable for Class 2 wiring methods. Not intended for connection to Class 2 equipment.
- Secure Rogowski coil and route conductors so that the conductors do not directly contact live terminals or bus.

- WARNING: To reduce the risk of electric shock, always open or disconnect circuit from power-distribution system (or service) or building before installing or servicing Rogowski coils.
- The wires and shields of individual coils should be connected to three multilevel installation terminal blocks (i.e. WAGO 2003-6646) installed on the same earthed DIN rail as the SDMS-MMS module. The terminal blocks should be installed directly next to the module. Coil shields should be connected to the terminal blocks contact which is internally connected to the DIN rail holder of the terminal blocks. The connection between the three multilevel installation terminal blocks and the SDMS-MMS module should be made with one shortest possible and flexible cable with twisted wire pairs (3x2 - one pair for wires of one coil).

Recommendations

- The coils are recommended to be mounted on the last section of the supply cable between the motor and the nearest protection or control device (contactor, circuit breaker, inverter, soft start, etc.).
- If the coil leads are too long they should be shortened.
- The coils should not be mounted near a noise source such as an inverter.
- It is recommended to run the coil wires at least 10 cm away from the phase wires.

Connection table between the coil wires and the SDMS-MMS module:

Phase coil	Coil wire	Pin of plug B
L1	BK	7
	WH	6
L2	BK	5
	WH	4
L3	BK	3
	WH	2

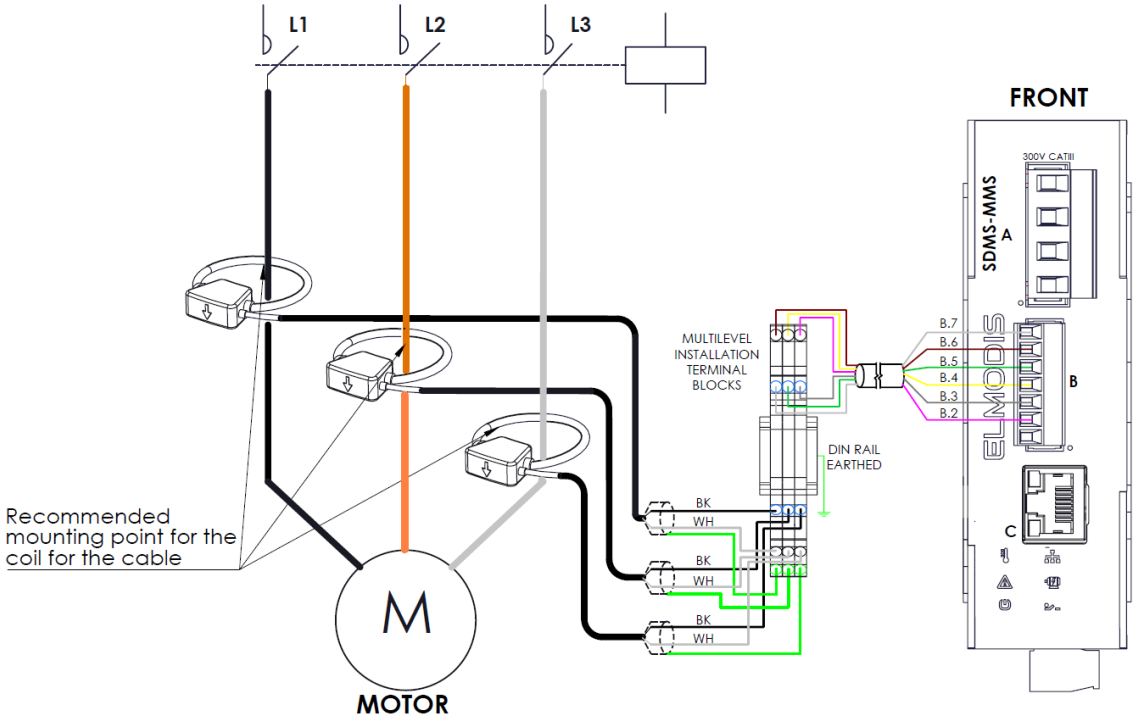

Fig 9. Connection of Rogowski coils

Mounting the coil on the wire

⚠ **Before starting work, make sure that the motor phase wires are not live.**

- Note the arrow on the coil. This determines the direction from the power source to the motor (load).
- The coil should be attached to the wire using two plastic zip ties.
- The wire must be on the opposite side to the coil latch.
- Ensure that the coil latch is correctly clipped and twisted so that there is no air gap.

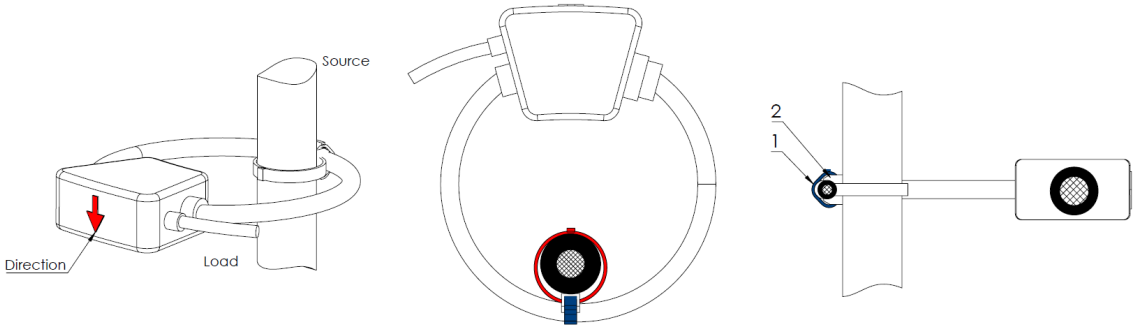

Fig 10. Mounting the Rogowski coil on a wire

7.3 Phase marker

It is possible to connect a speed sensor to the device. Such measurement can be performed in two ways:

- Inductively - Hall sensor, which reacts to the presence of a marker in the form of an element made of magnetic material placed on the shaft or other rotary element of the machine.
- Optically - an optical sensor that responds to the presence of a reflective element placed on the shaft or other rotating element of the machine. The sensor is equipped with a source of such light.

7.3.1 Parameters

Sensor supply voltage	20V DC - 24V DC
Maximum sensor supply current	25mA
Supported sensor configuration	NPN NC / Dark-on
Frequency range	0-25kHz
Recommended inductive sensor model	E2B-M18KN16-WP-C2-2M
Recommended optical sensor model	E3FB-DN22
Cross section of the connection cables	0.2-1.3 [mm^2] (24-16 AWG)
Tightening torque	0.34Nm (3.0 Lb-In)

7.3.2 Connection and installation

Pin of F connector	Marking	Description
F.1	+24V	Sensor power output
F.2	PMI	Phase marker signal input
F.3	GND	Ground

Electrical installation of sensors

Inductive sensor (E2B-M18KN16-WP-C2-2M)

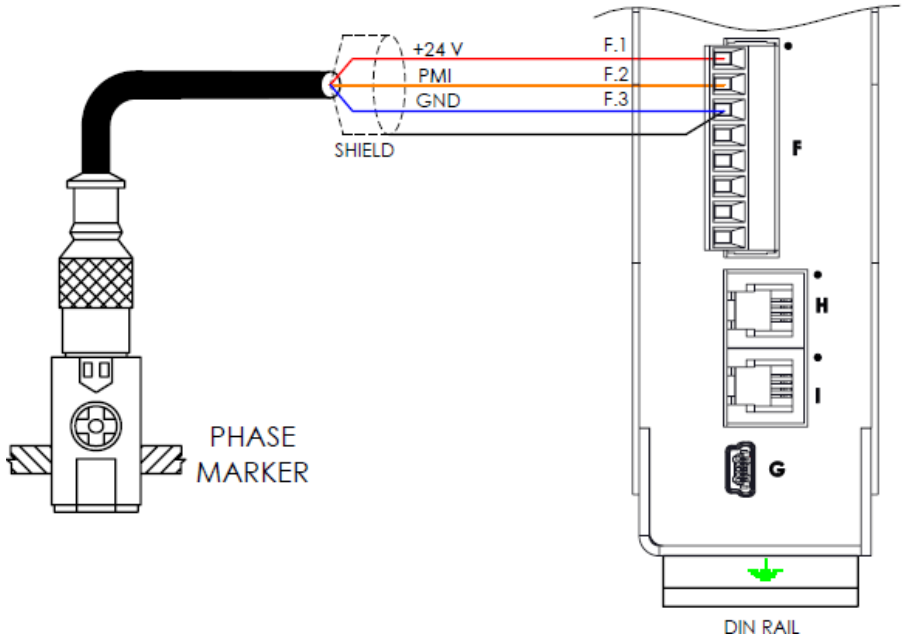

Fig 11. Connection of inductive sensor

- The cable shield, if any, should be connected to GND.
- The cable connecting the sensor with the device should be as short as possible.
- The cable connecting the sensor with the device must be led away from electromagnetic interference and power supply cables (especially if an inverter is used).

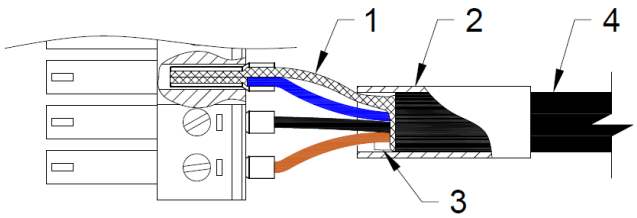

Fig 12. Mating the plug for the inductive sensor

1. Twist the shield tightly and crimp it into the sleeve along with the GND wire.
2. Put heat shrink tubing over the wire.
3. Hide the fourth wire of the inductive sensor (if any) under the heat-shrinkable tube.
4. We recommend the following cable for shrinking: LAPP CABEL: Li2YCY-TP; 2x2x0.34mm^2.

Optical sensor (E3FB-DN22)

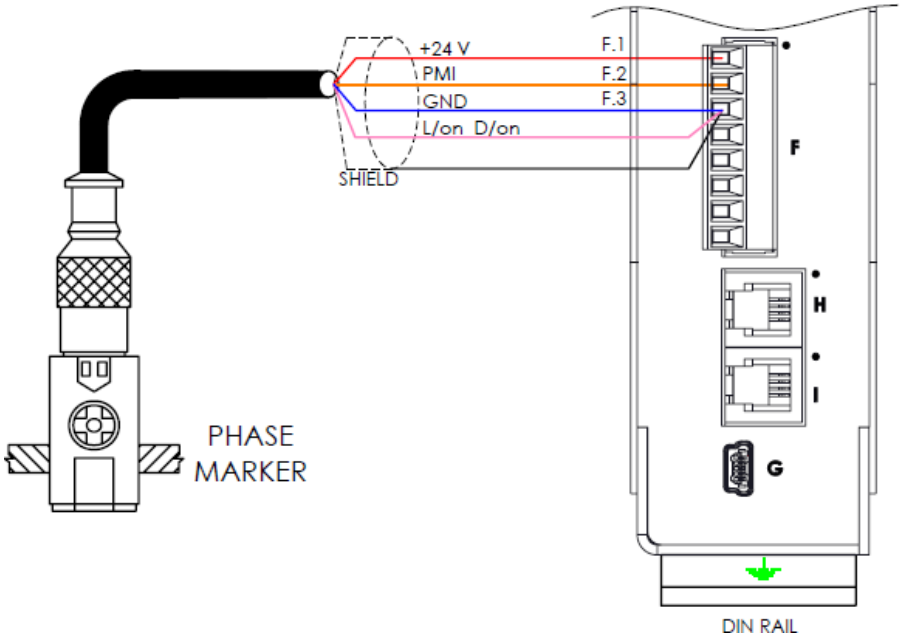

Fig 13. Connection of the optical sensor

- The cable shield, if any, should be connected to GND.
- The cable connecting the sensor with the device should be as short as possible.
- The cable connecting the sensor with the device is to be led away from electromagnetic interference and power supply cables (especially if an inverter is used).
- Adjust the sensitivity of the sensor.

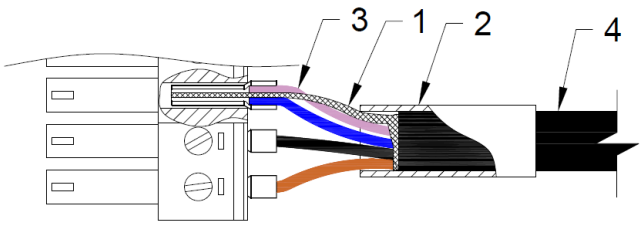

Fig 14. Mating the plug for the optical sensor

1. Twist the shield tightly and crimp it into the sleeve along with the GND wire.
2. Place a heat shrink tube over the wire.
3. The fourth wire of the sensor should be connected to GND in order to obtain "Dark ON" configuration.
4. We recommend the following cable for shrinking: LAPP CABEL: Li2YCY-TP; 2x2x0.34mm^2.

Mechanical installation of sensors

Installation example for inductive sensor

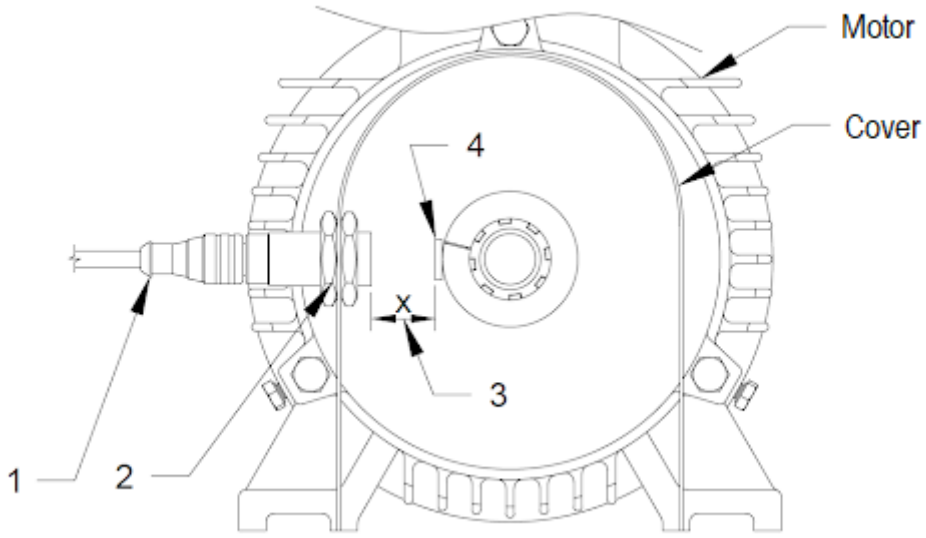

Fig 15. Mounting the inductive sensor

1. Use the recommended sensor or a sensor that meets the given parameters.
2. The sensor is to be mounted on a structure, on a firmly fixed element. Mounting must be resistant to vibrations and nuts must be secured against spontaneous unscrewing (e.g. by using serrated washers or anaerobic glue).
3. If the sensor does not have a potentiometer for sensitivity adjustment, adjust its range of operation by setting the distance X, i.e. the tripping distance of the sensor.
4. The sensor activator must be a metal element. Its width should be from 5 to 20% of the circumference of the element on which the speed is measured. It is recommended to fix the activator mechanically, however, due to the difficulty of making it, it is permissible to fix it chemically. For small drives where the mass of the actuator is significant and may cause unbalance it is recommended to use an optical sensor.

Example of optical sensor mounting

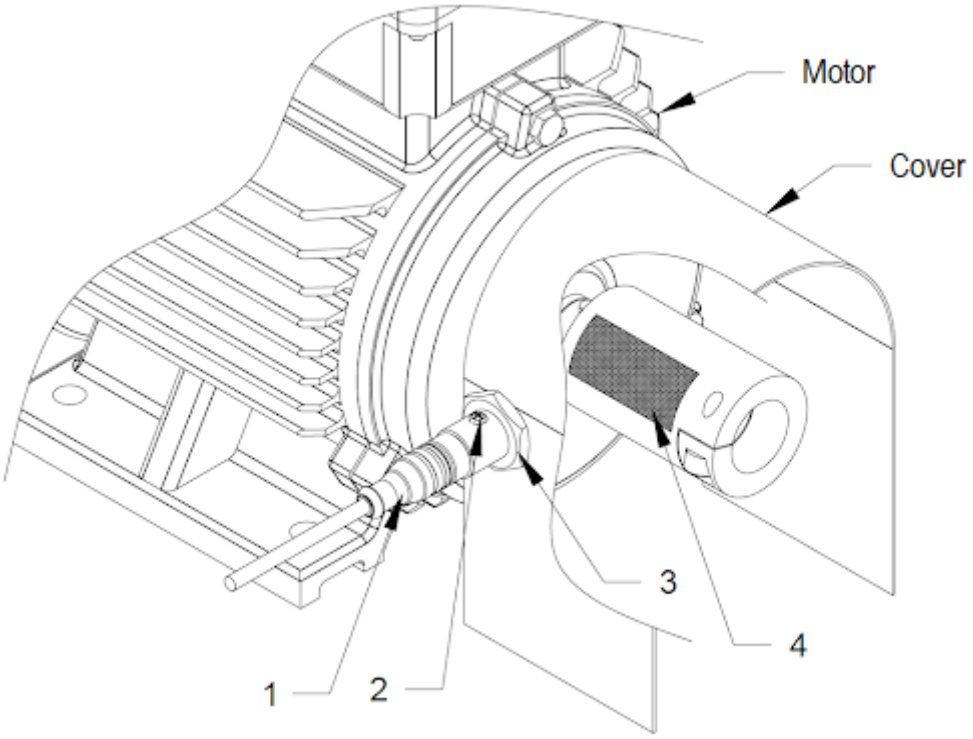

Fig 16. Mounting the optical sensor

1. Use the recommended sensor or a sensor that meets the specified parameters.
2. Adjustment knob for sensor sensitivity. Adjust the sensor according to the sensitivity adjustment procedure described below.
3. Mount the sensor to a structure, firmly attached. The mounting must be resistant to vibrations and the nuts must be secured against spontaneous unscrewing (e.g. by using serrated washers or anaerobic glue). It is recommended that the cover should also act as a barrier to light, particularly from discharge lamps, to avoid interference.
4. The reflector should be glued to a clean surface and its width should be from 5 to 20% of the circumference of the element on which the speed is measured. It is recommended to use a special self-adhesive reflective tape for optical sensors.

Procedure for adjusting sensor sensitivity

- Mount the sensor in the target position.
- Set the sensitivity to the lowest.
    - In the case of the E3FB-DN22 sensor, this is the extreme left position of the potentiometer. Both LEDs (orange and green) should be lit.
- Position the shaft (or other rotating element on which a marker is placed) so that the marker is within the range of the sensor.
- Gradually increase the sensitivity until the sensor output changes.
    - For the E3FB-DN22 this is indicated by the green LED only.
- Experimentally verify the change of state with simultaneous rotation of the shaft (or other element on which the marker is placed). The state should be:
    - high, when the marker is within the range of the sensor
    - low, when the marker is outside the range of the sensor

Changes in the sensor's output signal should be visible **only** when the shaft rotates and when a marker "appears" in the sensor's range or "disappears" from it. So there should be exactly two changes per revolution.

For the E3FB-DN22, watch the LEDs while turning the shaft very slowly. When the marker is in range only the green LED should be lit. On the contrary, both should be lit. In the transient state, the diodes may go out for a while.

7.4 1-WIRE temperature sensor interface

The module has the ability to measure temperature via sensors in the 1-WIRE communication standard. Depending on the sensor housing, it is possible to measure the ambient temperature, surface temperature or the medium flowing in the pipelines.

7.4.1 Parameters

Number of supported sensors	8
Supported sensor type	DS18B20
Sensor operating voltage	5V DC
Cross section of the connection cables	0.2-1.3 [mm^2] (24-16 AWG)
Tightening torque	0.34Nm (3.0 Lb-In)

7.4.2 Connection

The table shows the description of the pins on the F connector intended to support 1-WIRE sensors.

Pin of F connector	**Designation**	**Description**
F.4	V1W	Sensor supply voltage 5V DC
F.5	SIG	1-WIRE signal
F.6	GND	Ground

The figure below shows the wiring diagram of the 1-WIRE sensor to the module.

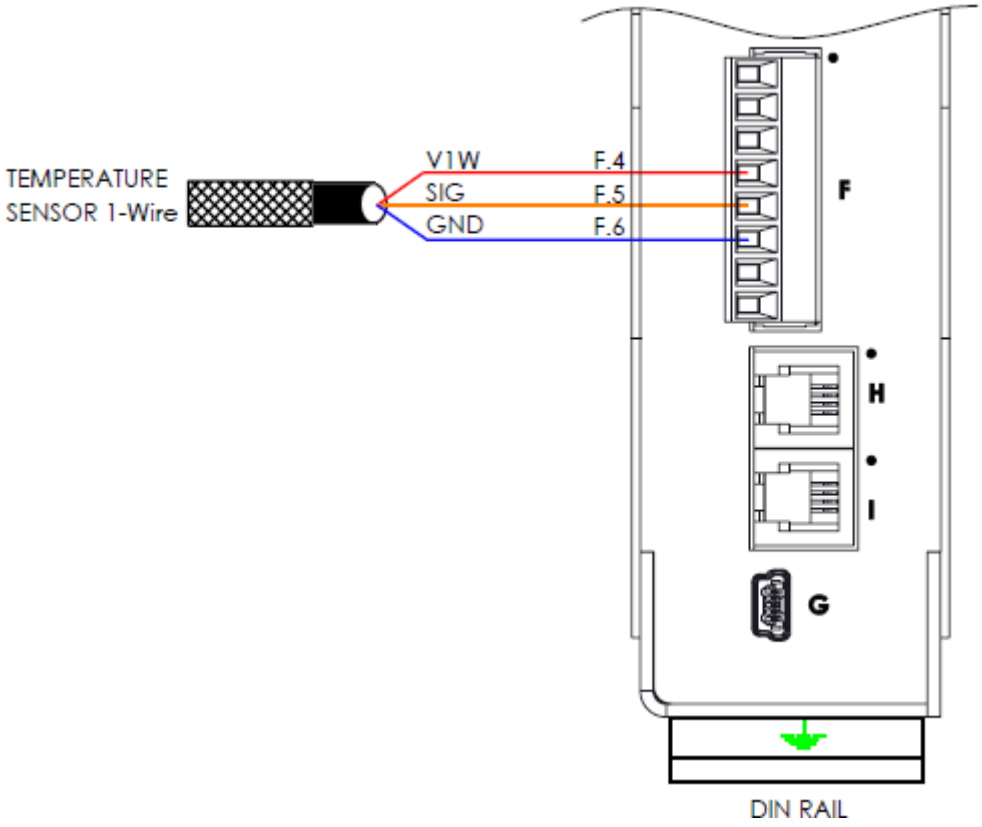

Fig 17. 1-WIRE sensor connection

Notes:

- Avoid laying cables and sensors close to power cables.
- It is recommended that sensor cables are laid in comb trays or other cable sheaths.
- The sensors and wires should be mounted in such a way that they cannot be pulled out or damaged mechanically.

7.5 Two-state output (relay)

The device is equipped with a two-state output in the form of relay contacts. The main purpose of this functionality is to signal the ‘warning’/'alarm' status. The relay has contacts brought out to the connector:

- NO - normally open contact
- COMMON - common contact

7.5.1 Parameters

Maximum contact voltage	30V DC
Maximum load	1A / 30V DC (resistive)
Cross section of the connection cables	0.2-1.3 [mm^2] (24-16 AWG)
Tightening torque	0.34Nm (3.0 Lb-In)

7.5.2 Connection

The table shows the description of the pins on connector F to which the relay contacts are connected.

Pin of F connector	Designation	Description
F.7	DO-NO	'Normally Open' relay contact
F.8	DO-COMMON	'Common' contact of the relay

The figure below shows the internal structure of the relay contacts (together with pin markings of the F connector to which they are connected) in a situation when the relay coil is not driven (e.g. when the module is not powered).

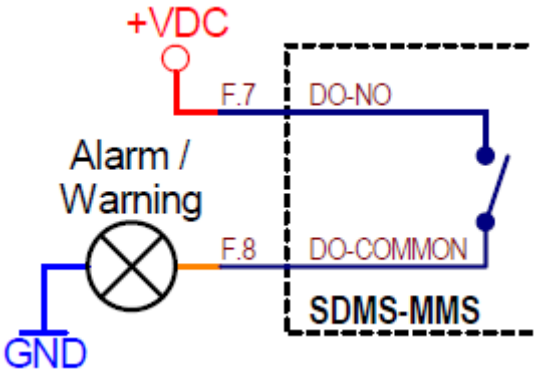

Fig 18. Internal construction of the relay contacts with pin markings on the F connector

The figure below shows an example application using a two-state output.

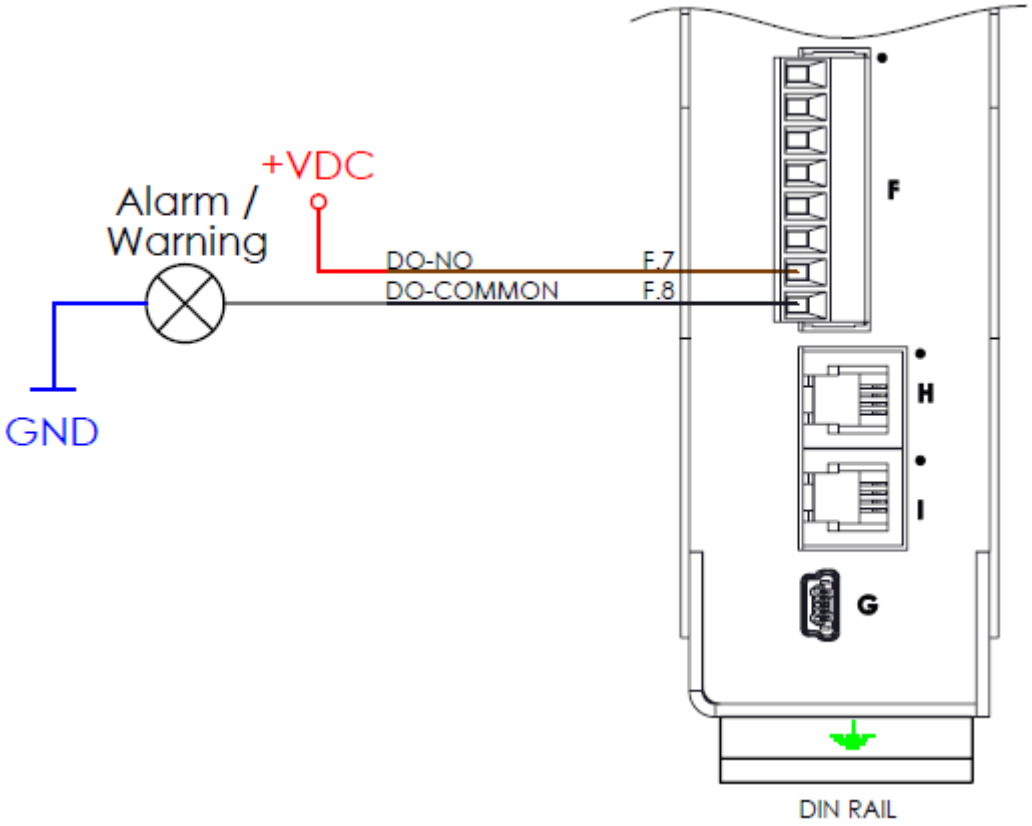

Fig 19. Example application using relay output

7.6 Synchronisation signal input/output interface

The device is equipped with an interface enabling synchronisation of measurements (time waveforms) in multiple devices. The synchronisation signal is a low voltage differential signal. On two identical RJ-9 (4P4C) connectors the same synchronisation bus is brought out, which allows for a convenient connection of subsequent devices. The source of the synchronisation signal may be one of the devices or a phase marker connected to one of the devices.

7.6.1 Parameters

Signal standard	LVDS
Maximum signal voltage difference	3.3V ± 10%

7.6.2 Connection

The table shows the description of the pins on the H and I connectors to which the synchronisation signal bus is brought out.

Pin connector H and I	Designation	Description
H.1 & I.1	A+	Non-inverting input/output
H.2 & I.2	B-	Inverting input/output

Notes:

For longer connections between devices it is recommended to use a cable with a twisted pair.

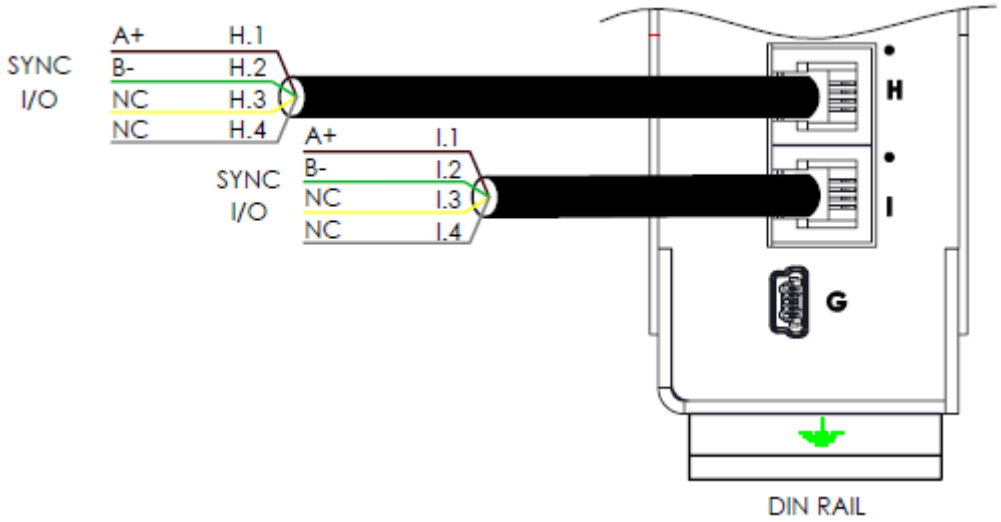

Fig 20. Marking of the synchronisation bus pins on RJ-9 sockets

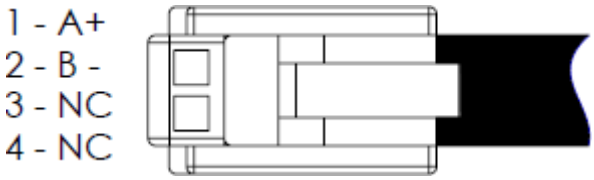

Fig 21. Synchronization bus pinout on RJ-9 plug

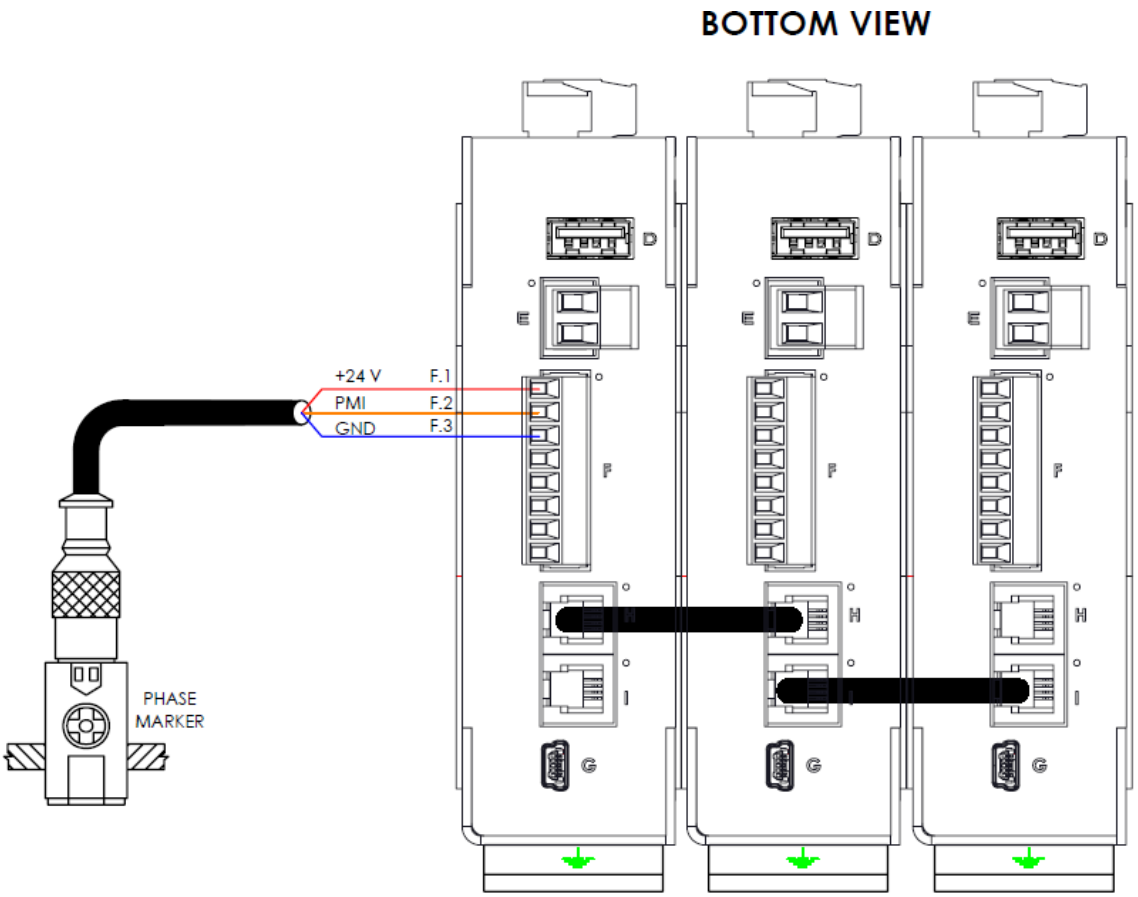

Fig 22. Circuit diagram when the synchronisation source is a phase marker sensor

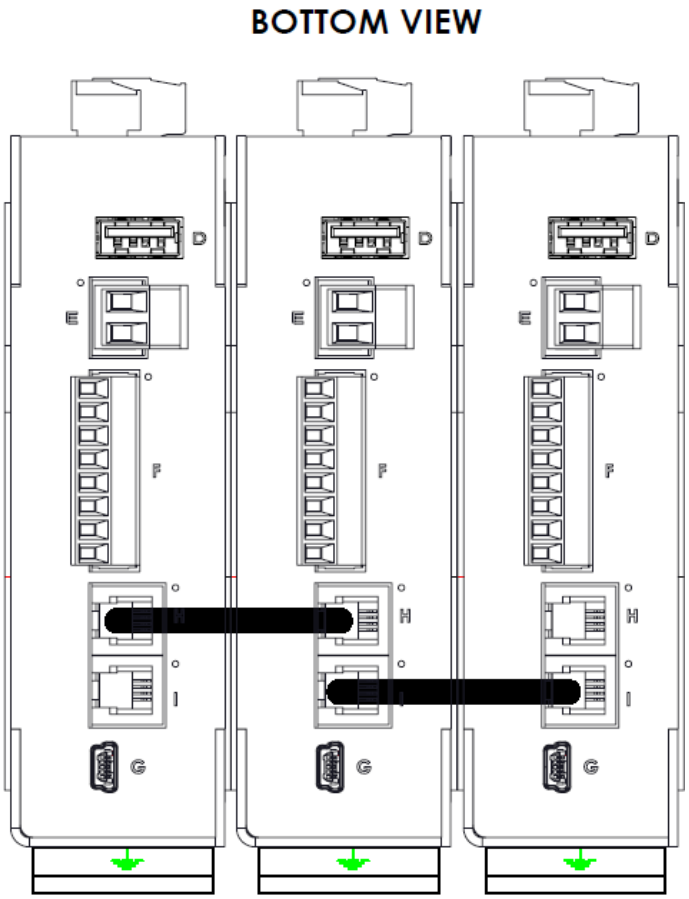

Fig 23. Connection diagram when the synchronisation source is one of the SDMS-MMS devices